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CONTROLLED MISSILES

A. VERTICAL BOMBS

PART I AZON

PART II RAZON

PART III FELIX

PART IV ROC

B. AIRCRAFT

PART I GMA-1

PART II CASTOR

C. GLIDE BOMBS

PART I GB-1

PART II HYDROBOMB

PART III 36-42-51

[redacted]

X-745-3
Part I

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Auth: DIR. ATSC
Initials: C.M.T
Date: 24 FEB. 1945

CASE HISTORY

of

CONTROLLED MISSILES - VERTICAL BOMBS
PART I - AZON

Part I of the Controlled Missiles, Vertical Bombs Project is a study of the VB-1, or Azon, which was the principal development under army project, with NDRC, No. AC-36. The Azon, a high angle bomb controlled in azimuth only, was the first controlled missile produced on a large scale for combat use.

Documents in this case history were obtained from the files of Air Materiel Command, Wright Field, and Headquarters, Army Air Forces, Washington, D.C.

Classified documents are included herein, and therefore, compliance with pertinent sections of AR 380-5 is necessary.

Compiled by
Historical Division
Intelligence, T-2
Air Materiel Command
Wright Field

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Auth: DIR. ATSC.
Initials: CMT.
Date: 24 FEB 1945

CASE HISTORY

of

CONTROLLED MISSILES PROJECTS
PART I - AZON

Part I of the Controlled Missiles Project is a study of the VB-1, or Azon, which was the principal development under army project, with NDRC, No. AC-36. The Azon, a high angle bomb controlled in azimuth only, was the first controlled missile produced on a large scale for combat use.

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Compiled by
Historical Office
Air Technical Service Command
Wright Field
~~August 10th~~
May 1945

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SUMMARY

[redacted]

Dir A.I.S.C.
C.M.T.
24 Feb 1945

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CONTROLLED MISSILES PROJECTS
PART I
AZON

Azon missiles (AZ-1), later designated VB-1 (vertical bomb), differed from glide bombs (GB) in that they had no wing attachments to reduce the high angle of descent. They were equipped, however, to be directed within narrow variations in azimuth by remote radio control during their descent. In the present case history, these missiles are referred to as Azon, a name derived from azimuth only. They were developed by scientists directed by Mr. L.O. Grondahl under the sponsorship of the National Defense Research Committee, Washington, D.C.

The original Army Project, number AC-1, under which the National Defense Research Committee work was being done, had been set up for another purpose, namely, the determination of means and methods of precision bombing while flying above or in an overcast. On 14 November 1941, the National
*(1) Defense Research Committee requested that this situation be corrected. As a result, on 30 December 1941, Lieutenant Colonel B.W. Chidlaw, Air Corps Representative with the National Defense Research Committee, requested that the following project be submitted for consideration to that Committee: "AC-36 Controlled Trajectory Bombs. Development of devices which will enable the bombardier to control the direction of fall of a bomb during
(2) its flight,...."

Flight tests of the National Defense Research Committee's controllable bomb were held at Eglin Field, Florida, 19 to 23 April 1942. Experimental Engineering Section, Wright Field, reported 2 May that these tests proved
(3) that it was possible to control the trajectory of a bomb, and further experimentation was recommended. Dr. Vannevar Bush, Chairman, National Defense Research Committee, reported 12 May on progress in the general field
(4) of controlled missiles. He did not comment specifically on Azon bombs, but of the high angle designs which included television he said that development was capable of being accelerated; as to the high angle designs to be used in conjunction with instruments showing the relative position of target and bomb, he said that development did not seem to be actively pur-
(6) sued. Experimental Engineering Section commented on Dr. Bush's report 19 May; Colonel F.O. Carroll, Chief, stated that the high angle work was being carried on by the National Defense Research Committee with the cooperation of the Special Weapons Unit, Equipment Laboratory, Wright Field, and that information as to the work should be obtained directly from the National Defense Research Committee Section.

The Materiel Command, Washington, assisted the National Defense Research Committee Section during the summer of 1942; two instances were the
(7) allocation to the Section of television equipment, and the approval of the
(8) priority application for critical materials. On 8 July tests were started

*The numbers placed in parentheses in the margin refer to the documents found in the Document File attached.

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at the Aberdeen Proving Ground, Aberdeen, Maryland, attended by representatives of the Materiel Center. These tests were outlined in a report by Captain J.M. Pomykata, Wright Field, 31 July; the results were not described, however, and the recommendation was made that no Materiel Center personnel be sent to observe controllable high angle bomb tests until development had reached the point where its effectiveness could be demonstrated. He indicated the willingness of the Materiel Center to cooperate in the development of the project, but he believed that results could best be shown by the moving
(9) pictures taken by the camera in the nose of the bomb. On 14 and 15 July further tests were conducted at Eglin Field, at which Lieutenant N.H. Zimmerman represented the Materiel Center. In his report, Lieutenant Zimmerman concluded that the television equipment tested was unsatisfactory, and he
(10) recommended that the direct sight method of control be used in its place. Four months later, Brigadier General F.O. Carroll advised Washington that "all effort should be made to develop the high angle bomb even to the extent
(11) of dropping the glide bomb development."

The National Defense Research Committee Section scientists worked on design development at Massachusetts Institute of Technology, Cambridge,
(12,13,21) Massachusetts, and tests were conducted at Eglin Field. On 21 May 1943 Mr. H.B. Richmond, Chief, Division 5 of the National Defense Research Committee, wrote Lieutenant Colonel W.G. Brown, Army Air Forces, Washington, stating that development had been carried to the point where a person should be designated, either a colonel or, preferably, a brigadier general, whose sole job would be to get the equipment designed, procured, and used in the right place. Mr. Richmond recognized that the Army Air Forces had various sections whose functions were to handle design, procurement, operations, etc., but he implied that the guided missile program would be handled more
(14) effectively if a single person were to coordinate its many phases. This letter was referred to Colonel W.H. Joiner, Chief, Armament Section, Washington, who said that he thought that the appointment of an officer of the rank recommended went further than the Materiel Command had gone previously, but that he favored the appointment of a project officer, and he cited the precedent of Major H.L. Denicht for rocket propulsion. He expressed doubt as to the value of the work being done by National Defense Research Committee Division 5, and said that he doubted whether anyone would notice the
(15) difference as far as the outcome of the war was concerned if its work were wiped out.

Brigadier General B.W. Chidlaw, Chief, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution, wrote Wright Field, 1 June 1943, stating that the Assistant Chief of Air Staff, Operations, Commitments and Requirements, after having seen motion pictures of recent National Defense Research Committee tests of the high angle controllable bomb (in azimuth) direct sighted, had issued a directive to the effect that this project be expedited, and expressed an immediate requirement for this equipment. In view of this requirement, General Chidlaw directed the Materiel Command to initiate and expedite a program immediately to prepare

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a quantity of these bombs for test purposes; he directed further that steps be taken to develop a device to aid the bombardier in visually controlling the flight of the bomb, but that the development of this device should not detract from the work of the National Defense Research Committee on radar or television controlled missiles. He directed that the Materiel Command prepare for the procurement of production quantities, and he advised the National Defense Research Committee of the action and
(16) plan contemplated. The Materiel Command issued CTI-1350 to Engineering
(17) Division, 5 June, covering General Chidlaw's directive.

Engineering Division held a conference at Wright Field, 6 August 1943, with representatives of the National Defense Research Committee contractors for production of prototype Azon bombs; the National Defense Research Committee was not represented. The conference related to the fuzing of the bomb and the arming of the flare. The report of this conference was sent forward 24 August; it was agreed that tail fuses be
(18, 19) omitted in the units under consideration, in order to speed up the project. This decision was reviewed by higher authority and approved 8 September by Colonel R.C. Wilson, Chief, Development Engineering Branch of Materiel
(20) Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance and
(21) Distribution. Sufficient progress had been made with tests and with the procurement of the pre-production lot of 200 bombs, to warrant General Carroll stating, 13 October, that his office could release the Azon bomb for final ballistic and evaluation tests, and for possible training purposes to a tactical group. Work continued, however, on various other
(23) aspects of the project. Engineering Division decided that one of the
(22) National Defense Research Committee Division 5 radio control systems had the best possibilities so far as early availability was concerned.

On 23 October 1943 Colonel Wilson directed the Materiel Command to procure 10,600 Azon control and flare assemblies to be used with ordinary
(24, 25) 1,000 pound bombs; a CTI to this effect was issued 25 October. Of this total, 600 were for the Navy; deliveries of the radio receivers were to
(25) start the middle of January 1944, at the rate of 50 sets a day. On 10 November 1943 General H.H. Arnold, Commanding General, Army Air Forces, directed the Air Communications Officer to assume complete responsibility
(26) for monitoring all guided missiles projects. Colonel S.P. Wright was designated in this capacity. On 25 November Production Engineering Section reported that an order had been placed for 10,600 Azon tail structures, AZ-1, with the Union Switch & Signal Company, Swissvale, Pennsylvania (AC-1706), deliveries to be 600 in January, 1,200 in February, 1,800 in
(29) March, 2,200 in April, 2,400 in May, and 2,400 in June 1944. The clearance of radio receiving sets from Dayton Signal Corps Procurement District to
(30) Union Switch & Signal Company for this contract was directed 25 November. General Carroll requested, 14 December, that the flare requirements of the
(31) Azon bomb be cleared with Ordnance Department. The letter contract to the Union Switch & Signal Company was placed 24 November, and accepted 1 December

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(32) for 10,600 tail structures, in the amount of $10,600,000 or $1,000 each.
(33) Colonel Wright reported, 20 December, on the general status of the program; he stated that it was then estimated that first deliveries might be made about 1 February 1944 and that the Azon might be ready for introduction to
(33) the theaters about 1 March.

Brigadier General H.M. McClelland, Air Communications Officer, recommended, 4 February 1944, that a program be set up to use at least 100 Azon bombs against special targets in the European Theater of Operations. He recommended immediate action as to various matters which would allow the
(39) B-17 crews involved to leave the United States not later than 1 March 1944.
(42) On 12 February he reported that Azon had finally completed successful tests.

Tests at Eglin Field, although satisfactory, indicated that Azon was better suited to strip target bombing than to pin-point target bombing. The control of the bomb during descent as to azimuth direction, affected the range of the bomb. This fact was reported by Lieutenant Gordon C.
(40) Bigelow, Eglin Field, 7 February, who commented in detail as to the most favorable circumstances under which Azon should be used. These ideas were put forward as a basis for training and further experimentation in the
(41) tactical use of Azon. In the light of Lieutenant Bigelow's comments, General McClelland recommended that the original orders be amended so that destination would be Fifteenth Air Force, Mediterranean Theater of Opera-
(43) tions, instead of the Eighth. The special equipment needed in connection with the use of Azon was cleared in correspondence between Colonel Wilson's office, Washington, and General Carroll's office, Wright Field, 1 February
(37,44) and 21 February 1944.

Colonel Wilson suggested, 26 February, that it might be possible to fasten two 1,000 pound Azon bombs together and adjust the controls so that
(45) the combination bomb would be controllable in range as well as in azimuth.
(52) Wright Field studied this proposal but recommended that the idea be dropped.
(55) Materiel Division agreed to this disposition 1 April.

On 29 February Lieutenant Colonel Paul Hanick, Azon Project Officer, 301st Bombardment Group, advised the Materiel Command that Azon was not yet practicable for Air Corps use; it was recommended that the production schedule be revised to allow incorporation of all suggested improvements already in the hands of the Aircraft Radio Laboratory and the National De-
(47) fense Research Committee. Brigadier General H.A. Craig, Assistant Chief of Air Staff, Operations, Commitment, and Requirements, submitted a memorandum to General Arnold the next day, however, stating that this report
(48) was premature.

The procurement of the production Azon tail structures from Union Switch & Signal Company encountered difficulty; first deliveries were de-
(46) layed a month and the rate of build up of schedule was slower than expected. Lieutenant Colonel K.P. Royce, Resources Control Section, Wright Field, wrote the contractor, 8 March, urging the improvement of this schedule,

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(49) and advising that emergency assistance would be given to expedite any materials or components shortages. On 29 March, however, enough success had been attained to permit Colonel Wright to advise the Bureau of Aeronautics, Navy Department, Washington, that six B-17 airplanes were ready to depart at once for the Mediterranean Area, and that, an additional squadron of ten B-24 airplanes was being set up for departure to the China-Burma-India Theater 1 May. Navy personnel were invited to witness drops
(54) of Azon.

Interest in Azon continued at a high level. Colonel B.S. Kelsey, Washington, suggested 17 March to Lieutenant General Carl Spaatz, Commanding General, United States Strategic Air Forces, London, England, that Azon be considered for diversion to the European Theater of Operations; he referred to it as having good possibilities on long targets where evasive
(50,67) action was not needed. On 6 April Colonel R.A. Legg, Acting Chief, Development Engineering Branch, Materiel Division, directed the Materiel Command to accomplish the prompt procurement of an additional 10,000 Azon tail structures. The existing order with Union Switch & Signal Company would
(56) run out in August 1944 and a continuing production rate of 3,000 units per month was desired. Two days later this order was followed up with a request to determine the total production capacity of the Union Switch &
(57) Signal Company and to determine several other potential manufacturers. On 11 April the Materiel Command issued an amendment to CTI-1350 covering this
(58) additional procurement. A report of special tests being made with B-24
(66) airplanes dropping Azon bombs was submitted 27 April, including score sheets. Scoring on the whole was reasonably accurate.

Reports from the operating groups in the various theaters of operation began to come in. On 30 April Colonel Helmick reported from Italy that Azon bombing had been tried and that while quite a few difficulties had been encountered, the value of Azon on certain targets had been demon-
(69) strated successfully. Another report from Italy, 15 May, described a
(74) successful mission using Azon bombs. On 2 June Colonel Helmick reported again from Italy, described a mission in which an effort was made to control Azon bombs dropped by several airplanes from one control airplane; the bombs responded satisfactorily, but the results were not considered
(80) representative. By 13 July five operations had been completed in Europe with Azon bombs. It appeared from this experience that Azon was function-
(87) ally reliable. Flare failures and fuze difficulties still presented problems. On 8 August the results of the first mission of a B-26 Azon squadron
(89) of the 9th Bomber Command were reported.

(57) Pursuant to the request of Colonel Phillips, 8 April, Wright Field reviewed other possible sources for the Azon tail structures to supplement the capacity of Union Switch & Signal Company. On 29 April the Materiel
(68,76) Command recommended five companies as possible additional sources. On 17 April the Materiel Command had reported that the maximum capacity of Union
(62) Switch & Signal Company would be about 150 units a day. On 15 June the

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Chief, Materiel Division, directed the procurement of an additional
(83) 30,000 Azon tails for 1944 delivery. The Materiel Command presented a
schedule, 23 June, providing for the establishment of a second source
(85) which would build up to the same volume as Union Switch & Signal Company,
5,000 units a month, and whose output taken with the capacity output of
the existing source, would provide the additional 30,000 units required.
Point was made of the fact, however, that radio receivers must be increased
to permit the increased production. Azon requirements for 1945 tentatively
(88) were set at 100,000 units. On 14 August the Materiel Command initiated the
(90) procurement of 60,000 tail units for 1945 requirements.

It was apparent from the tests at Eglin Field and at Orlando, and from reports of operating groups attached to the several bombardment squadrons, that further design development was necessary in order to make Azon bombing more effective. Engineering Division recognized the situation although the project was then on a production basis, on 1 May General Carroll requested that seventy-five Azon units be allocated to Wright Field for further study; he suggested that the National Defense Research Committee participate in
(71) the work on the same basis as in the past. He requested Ordnance Department to initiate a project for the development of a tail fuze for the Azon bomb. On 12 May he announced that the designation VB (vertical bomb) had
(73) been adopted, and that Azon had been designated VB-1. Engineering Division
(81) reported progress as to the correction of certain defects 5 June. Particu-
(82) lar attention was directed to anti-dispersion development work, and a directive establishing the priority of such an improvement was requested;
(86) Colonel Wilson issued such a directive 28 June.

By August 1944 progress on the VB-1 (Azon) could be summarized as follows: (a) the Army Air Forces Board, 8 May, had reported favorably
(72) on the Azon bomb and had recommended its adoption as standard equipment. The unit cost of Azon bombs was approximately four times that of ordinary bombs, but the prospect of much greater accuracy presented the possibility
(72) of offsetting this higher cost; (b) bombardment groups had been set up with the Eighth, Ninth, Tenth and Fifteenth Air Forces, and a substantial number of missions had been flown giving encouraging results; (c) design and development work was being carried on by Wright Field and the National Defense Research Committee to correct performance shortcomings; (d) Union Switch & Signal Company was in substantial volume production on the tail structures, and a second source was being set up; (e) Major General R.W. Harper, Assistant Chief of Air Staff, Training, had directed the First Air
(61) Force to establish a training program for guided missile teams; and (f) 4,512 units had been released to the various theaters as of 1 June 1944, with an additional 1,000 units a month scheduled to the Fifteenth Air Force and
(84) 2,000 units a month to the Eighth Air Force.

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Enthusiasm with regard to the performance of Azon was reported among overseas units in spite of difficulties encountered
(98) by inexperienced personnel, but failures of flares, radios, and anti-dispersion methods indicated that Azon was still short of
(102, 103, 95, 106) being a perfect weapon. Furthermore, control of the air and
(112) plentiful supplies in the European Theater encouraged "high tonnage" bombing procedure. On 21 September 1944, at the request of the Air Communications Officer, Col. T. A. Sims, Chief of Adm., ATSC, WF, directed the Procurement Division to cancel all future VB-1 tail assemblies, with the exception of the radio
(102, 105, 112) equipment. This involved 36,300 units on Union Switch and
(105) Signal Company and G. & A. Aircraft Company contracts. However, instructions were issued by Dr. N. L. Bowles, Special Consultant to CG/AAF, that the AAF should not permit facilities for producing servo motors and Schwein gyros to be dissipated, since development of new missiles using Azon equipment was pro-
(110) gressing. The Materiel Division, Wash., was requested by the Air Communications Officer to continue deliveries of 2000 motors
(111) and gyros a month for a six months period. Cancellation was effected with delivery of 14,071 Azontails, but large quantities of gyros, servos, and batteries were stored for use with fut-
(115, 123, 130) ure projects. In January 1945, CTI-1350 was closed out.

Experimentation with VB-1 continued, however, with mixed
(122, 126, 127) results. Target-seeking and light-sensitive devices were studied
(124, 125) as anti-dispersion measures. The India-Burma Theater requested
(136) 50 aircraft installations for the operation of VB-1 and reported
(141, 151) considerable success in using it against bridges. The 7th Bomb Group reported that Azon was ten times as effective against
(144) bridges as standard bombing, and General Chennault, CG 14th AF, urgently requested shipment of Azon equipment and an opportunity to send men on temporary duty to the India-Burma Theater to
(148) learn techniques. VB-1 was entered into Standard Classification by ATSC on 21 April 1945 and was rated as satisfactory for
(156) combat use.

VB-2, introduced for tests and development in the latter part of 1944, was an adaptation of VB-1 for use with 2000-pound bombs. When contracts for VB-1 were canceled, it was hoped that certain parts of VB-1 equipment could be transferred
(113) to the VB-2 program. VB-2 was proved to be satisfactory aero-
(116) dynamically in tests conducted in August and September. Expenditure Order 673-52 was issued 31 October, stating that development of VB-2 was to be financed, for the most part, by the National Defense Research Committee, with advisory assistance and testing
(119) to be borne by ATSC. After undergoing modifications in size to
(139, 154) permit their being carried internally by B-17's and B-24's, bombs
(150) of the new type were tested with favorable results in March 1945.

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PHOTOGRAPHS

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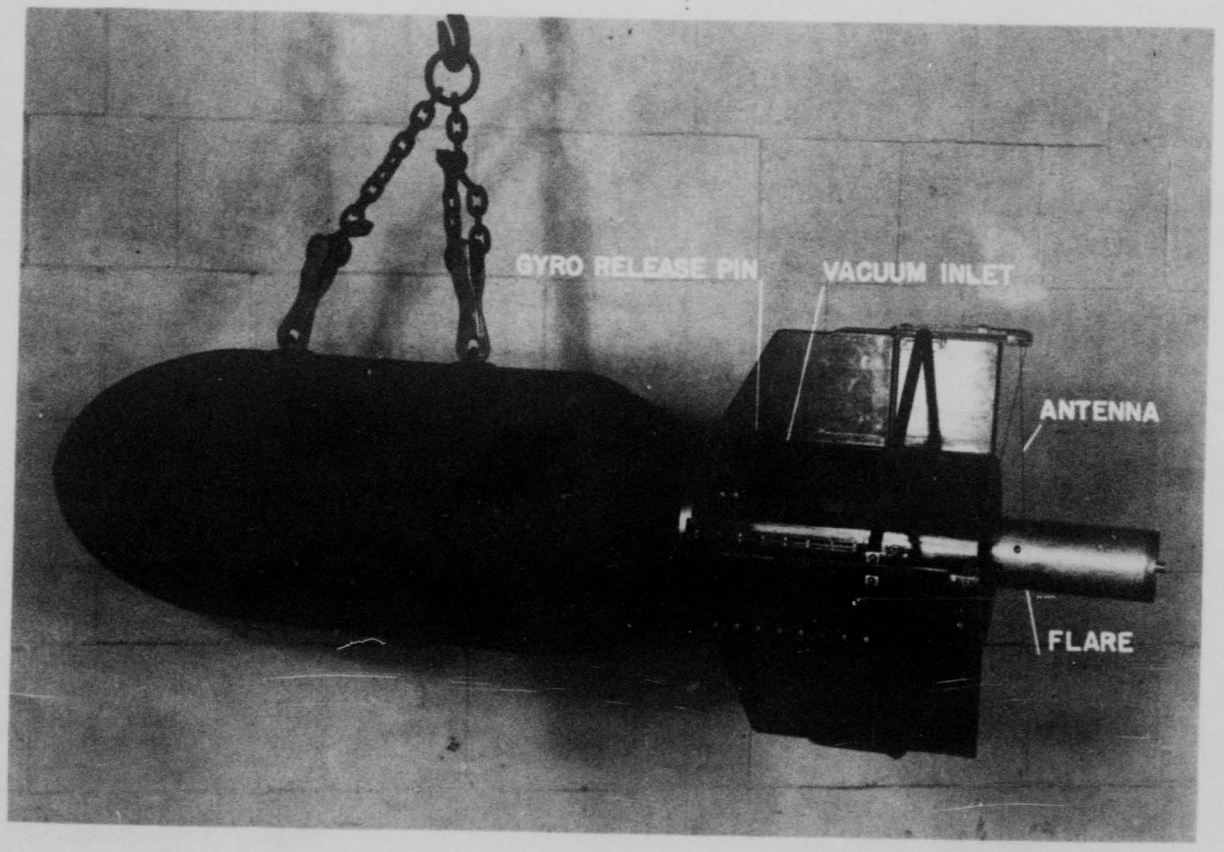

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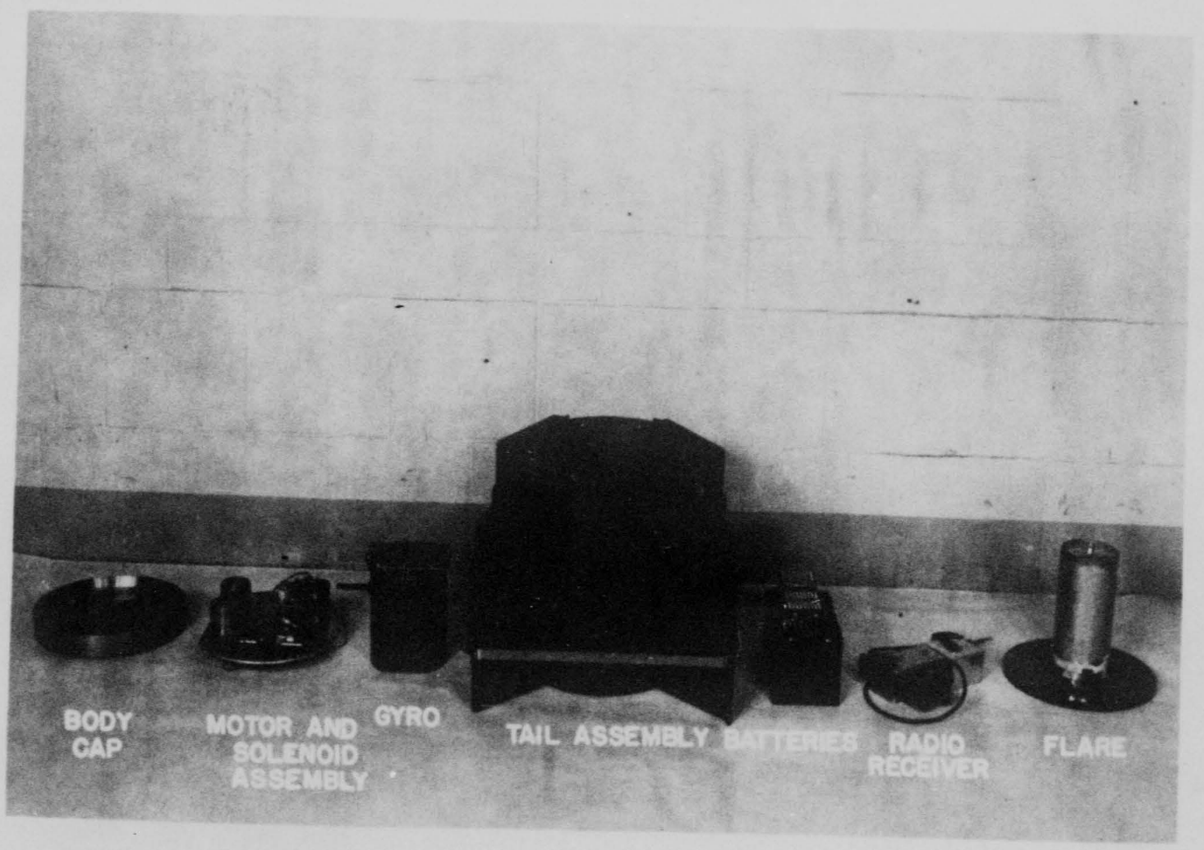

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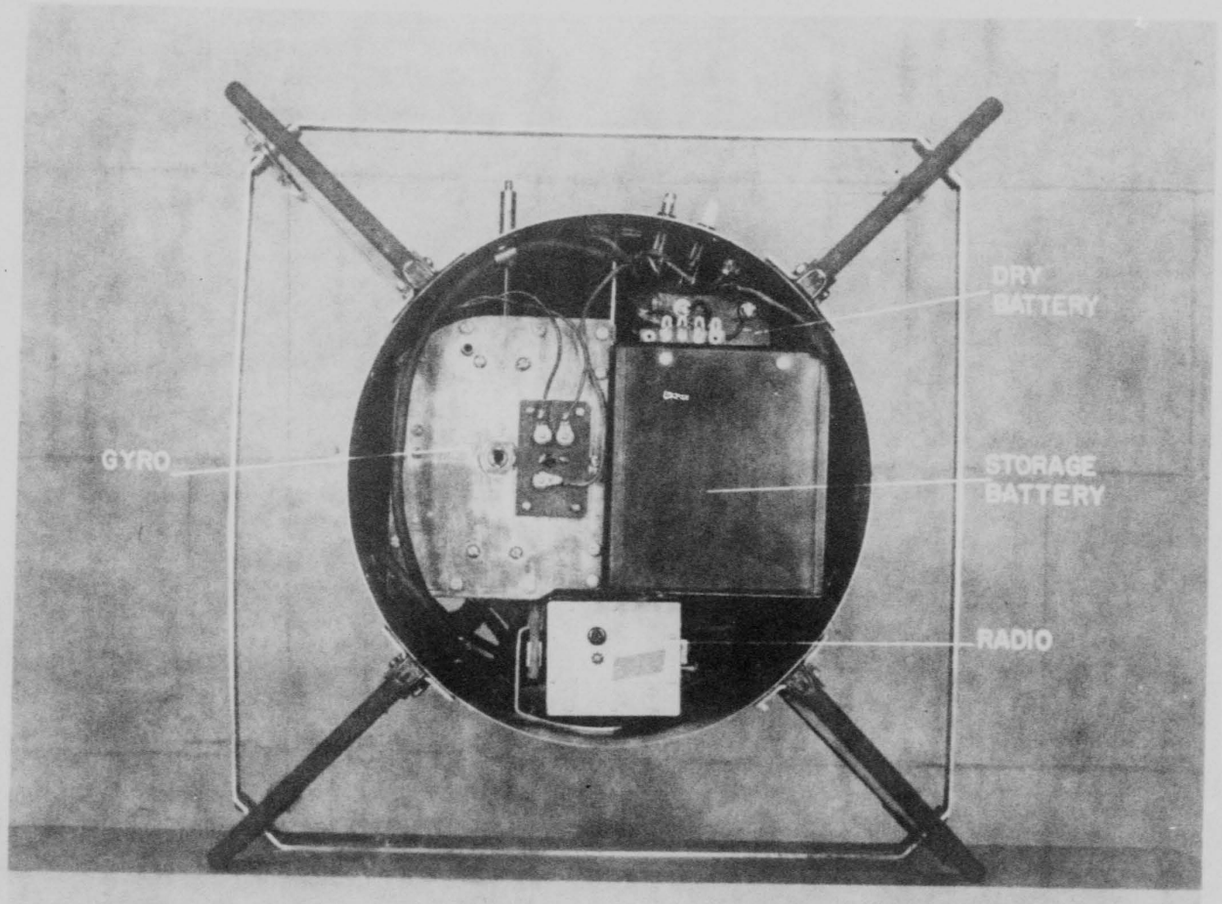

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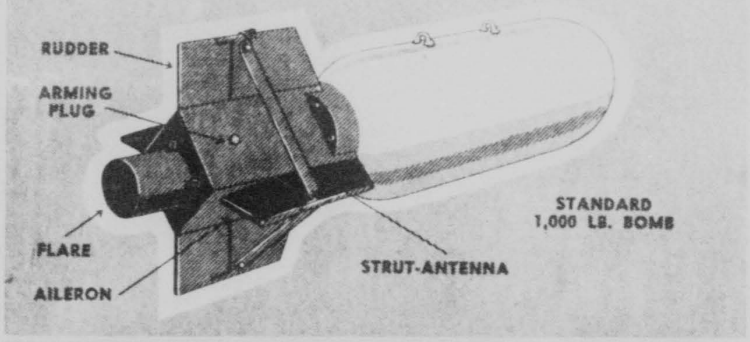
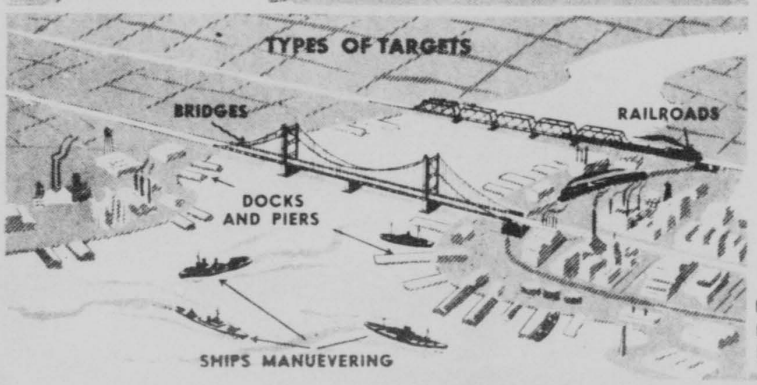
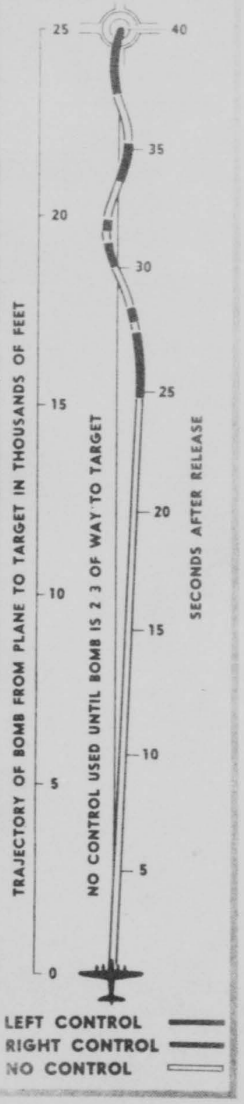
THE VB-1 (AZON) 1,000 LB.
RADIO CONTROLLED (IN AZIMUTH ONLY)





PROJECTED PATH OF AZON BOMB FROM 20,000 FEET ALTITUDE SHOWING AMOUNT OF CONTROL USED. (BASED ON OPERATIONAL REPORTS)



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Auth: DIR. A.T.S.C.
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Date 24 FEB. 1945

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Author: DIR. A.T.S.C.
Interpreter: C.M.T.
24 FEB 1945

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Part I

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1. (S) Ltr. 14 Nov. 1941
Fr: E.B.Bradford,Tech.Aide
Div.A,NDRC
To: Dr.J.G.Trump,Tech.Aide
Div.D.,NDRC
(File: M&S)

It appeared that a certain amount of confusion existed concerning work in progress on dirigible bombs. The research on these controllable bombs was being carried on under Army Project No. AC-1, an undesirable situation because of the following reasons: (1) no work was being done on the project as it was described; (2) records of work being done were therefore incorrect; (3) research which was being done was not properly covered by an Army Project. A new description was suggested to cover the work being done on controllable bombs, and a new project number was to be assigned.

2. (S) Ltr. 30 Dec. 1941
Fr: Lt.Col.B.W.Chidlaw,
AC Representative
NDRC
To: Brig.Gen.G.M.Barnes,
War Dept.Liaison Officer
NDRC
(File: M&S)

Col. Chidlaw suggested that research on controllable bombs should now be carried on under the following project:
<u>AC-36 Controlled Trajectory Bombs</u>
Development of devices which will enable the bombardier to control the direction of fall of a bomb during its flight, and of devices to indicate to him the need for and effect of such control.

3. (C) Memo Rpt. 2 May 1942
EXP-M-54-673-16
(File: Central Files)

Four experimental units of the NDRC type high angle controllable bomb (Azon, AZ-1) were flight tested at Eglin Field. Although final conclusions were dependent on development and study of film in cameras which had been located in the bombs, the report stated that it was possible to control the trajectory of the bomb and that further tests with radio and television equipment should be made "in order to establish the tactical value of this weapon."

4. (S) Memo 13 May 1942
Fr: H.L.Clark,Secy.Comm.
Joint Chiefs of Staff
To: Brig.Gen.R.G.Moses
(File: M&S)

A summary of controlled missiles projects under NDRC, prepared by Dr. Bush, was forwarded for information. In return it was requested that detailed information be compiled with regard to army projects in progress. Mat. Com., was directed to supply the information desired.

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5.	(S) Memo 21 May 1942 Fr: Maj.Gen.O.P.Echols CG,Mat.Com.,Wash. To: Col.Earl S. Hoag G-4 Sect.,General Staff (File: M&S)	Gen. Echols forwarded Mat. Center report on AF Special Weapons program which had been requested by Joint Chiefs of Staff. He called attention to the fact that AAF views were not "in exact agreement with those brought out in [Dr.] Bush's report."
6.	(S) 1st Ind. 19 May 1942 Fr: Col.F.O.Carroll,Chief Exp.Eng.Sect.,WF To: CG,Mat.Com.,Wash. (File: M&S)	In response to the request expressed in the directive from Joint Chiefs of Staff, Special Weapons projects under development by AAF were discussed in some detail. Progress of the Army program was summarized under the following headings: (1) Targets (Robot Planes with Motors); (2) Controllable Bombs (High Angle); (3) Controllable Bombs, Glide, Preset Data; (4) Controllable Bombs, Glide, Radio Controlled (Remote Control); (5) Controllable Bombs, Glide, Target Seeking (Automatic Homing); (6) Controllable Glider Bombs; (7) Controllable Bomb, Power Driven, Ground Launched; (8) Controllable Bombs, Power Driven, Air Launched; (9) Radio Control Equipment; (10) Television Equipment; (11) Target Seeking Devices. Exhibit "A" to the report showed the Mat. Center projects in chart form with a brief description and the project number of each development indicated.
7.	(C) IOM 26 May 1942 Fr: Col.F.O.Carroll,Chief Exp.Eng.Sect.,WF To: Dir.,Airc.Radio Lab. WF (File: Central Files)	Exp. Eng. Sect. stated that NDRC had been working for approximately a year on the high angle controllable bomb, and that development of the project had reached the stage in which radio and television equipment would be used for testing. Allocation of an RCA television set to NDRC for this purpose was therefore requested, with the understanding that funds were to be furnished by Section D-3 of NDRC.
8.	(U) Ltr. 18 June 1942 Fr: Capt.W.F.Browne Asst.Exec.,Mat.Com.,Wash. To: NDRC,Sect.D-3 (File: M&S)	Capt. Browne stated that Project AC-36 was to be expanded and accelerated. Gulf Research and Development Laboratory, which had done a great deal of the testing and fabrication on the project, had decided to construct two buildings at their own expense for use on this work. Aid was to be given to the company in the matter of priorities for critical building materials.

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9.	(C) Memo Rpt. 31 July 1942 EXP-M-54-673-16A (File: Central Files)	Further tests on controllable high angle bombs were carried on by NDRC at Aberdeen Proving Grounds. It was suggested that since information concerning results of the tests could best be obtained from photographic records it would not be necessary for Mat. Center personnel to attend the tests at this stage of development of the project.
10.	(C) Memo Rpt. 29 Aug. 1942 EXP-M-54-673-16B (File: Central Files)	In a continuation of NDRC tests two bombs were dropped, using television transmitter and radio receiver. Data obtained was not satisfactory, however, especially with relation to the television pictures, and it was recommended that further tests of controllable high angle bombs be conducted "using the direct sight method of control rather than television sight."
11.	(C) IOM 26 Nov. 1942 Fr: Brig.Gen.F.O.Carroll Chief,Exp.Eng.Sect.,WF To: CG,Mat.Com.,Wash. Attn: AC/S(E) (File: NACA,Navy,NDRC Liaison Br.,Eng.Div.)	It was suggested by WF that "all effort should be made to develop the high angle bomb even to the extent of dropping the glide bomb development. It is also believed that it should be made clear that the Army Air Forces is not interested in the glide bomb."
12.	(S) 1st. Ind. 13 Jan. 1943 Fr: Brig.Gen.Grandison Gardner CG,AAF,Prov.Ground Com. To: Hq.,AAF,Wash. Attn: Dir.,War Org. & Movement (File: MWS)	In response to inquiries from Wash., Gen. Gardner stated that tests of the high angle bomb had been completed and Dr. Grondahl and his assistants had left the Proving Ground on 12 Jan. The tests were considered satisfactory and further testing was to be carried on in the near future. The Proving Ground had offered all assistance necessary to facilitate the work and "would continue to assist with the future tests."
13.	(C) Memo Rpt. 11 March 1943 ENG-M-54-673-16K (File: Central Files)	Tests were made at Eglin Field on ten radio controlled high angle bombs and on two special bombs having cylindrical control surfaces. The tests of the first group indicated that gyro stabilization of the bombs was insufficient and that pivot point on rudders was located too far from leading edge. Excellent control was obtained in one flight and a fair degree of control in two other flights. Tests of the two special bombs indicated that the type was very stable in the axis of spin but efforts at applying control were unsuccessful.

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14.	(S) Ltr. 21 May 1943 Fr: H.B.Richmond,Chief Div.5,NDRC To: Lt.Col.W.G.Brown Wash. (File: M&S)	Mr. Richmond forwarded to Col. Brown a brief statement of the status of the guided missiles program. The principal concerns of Mr. Richmond were: (1) the matter of procurement of pilot models, and; (2) the establishment of a unit with a project officer of sufficient rank, ability and interest to carry on a vigorous program of research and development. He emphasized the fact that cooperation of AAF with NDRC in the past had been most satisfactory, but he felt that the guided missiles program had reached the stage where the interests of the services would be better served by a comprehensive program headed by one man.
15.	(S) IDM 24 May 1943 Fr: Col.W.H.Joiner,Chief Armament Sect.,Wash. To: Lt.Col.W.G.Brown, Wash. (File: M&S)	Col. Joiner stated that appointment of a Brigadier General as project officer on guided missiles would be"farther than the Mat. Com. has gone to date in sponsoring and promoting experimental work relating to armament." However, since large sums of money would probably be expended on the program it appeared that it would be wise for the AAF to "have someone to evaluate and recommend" concerning the work.
16.	(S) Ltr. 1 June 1943 Fr: Brig.Gen.B.W.Chidlaw Chief,Mat.Div., Ofc. AC/AS,M&D,Wash. To: CG,Mat.Com.,WF Attn: Tech.Exec. (File: Central Files)	As a result of a showing of motion pictures of tests on the high angle bomb direct sighted and controllable in azimuth an immediate requirement for this equipment was expressed by AC/AS, OC&R. Consequently WF was directed to coordinate with NDRC on a project to test these bombs. It was directed that standard cases and fuses be used if at all possible and that the bombs include the following characteristics: (1) control in azimuth only for the present; (2) good ballistic characteristics; (3) suitable radio control apparatus; (4) means for visually following the bomb in flight to be included; (5) effort to be made to procure simplest and most durable components possible. Gen. Chidlaw emphasized that work on this phase of AC-36 should be conducted in such a manner that development of radar or television controlled versions with two axis control would not be interfered with in any way.

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17.	(S) CTI-1350, 5 June 1943 Fr: Col.C.K.Moore, Asst.Tech.Exec.,WF To: Eng.Div.,WF (File: NACA,Navy,NDRC Liaison Br.,Eng.Div.)	CTI-1350 initiated action requested by letter dated 1 June 1943, from Brig. Gen. B. W. Chidlaw, Chief, Mat. Div., AC/AS, MM&D.
18.	(C) Ltr. 24 Aug. 1943 Fr: Col.H.Z.Bogert, Actg.Chief,Eng.Div.,WF To: CG,AAF,Wash. Attn: AC/AS,MM&D (File: M&S)	A conference was held at Wright Field relative to fusing of bomb and arming of flare on the high angle controllable bomb project. It was pointed out that engineering changes in design were the responsibility of NDRC. Because of complications which would arise and because of the urgency of completing engineering and experimental tests on the weapon it was decided that no provision for tail fuses should be made. It was also agreed that flare should be designed to provide for delayed action of igniter cord. Approval of the above decisions, which had been made by representatives of Eng. Div., Ordnance Aircraft Service, and NDRC, was requested.
19.	(C) Ltr. 3 Sept. 1943 Fr: L.O.Grondahl,Dir. of Research & Eng., NDRC Section To: CG,Mat.Com.,WF Attn: Capt. J. H. Evans (File: Central Files)	NDRC representative at Union Switch and Signal Co. stated that it would simplify high angle controllable bomb program if tail fuses were omitted. Permission to proceed along these lines was requested.
20.	(C) Ltr. 8 Sept. 1943 Fr: Col.R.C.Wilson Chief,Dev.Eng.Br., Mat.Div.,Ofc. AC/AS, MM&D To: CG,Mat.Com.,WF Attn: Special Weapons Unit (File: Central Files)	Authority to delete the tail fuse in high angle bomb controllable in azimuth was granted with reluctance and only in order to expedite completion of the project "to a workable stage at earliest possible date."
21.	(C) Memo Rpt. 23 Sept. 1943 ENG-54-673-16M (File: M&S)	Further tests were made at Eglin Field for the purpose of testing roll stabilization when the bombs were launched at 45 degrees, and to check the performance of the apparatus. Six Azon bombs were dropped and

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		six units having control in both range and azimuth. Because of malfunctioning of radio apparatus and flare failure tests of both types were considered unsatisfactory.
22.	(S) Memo Rpt. 5 Oct. 1943 ENG-54-673-4-I-1 (File: NACA,Navy,NDRC Liaison Br.,Eng.Div.)	Conferences were held concerning the development of radio controls for use on controllable glide and high angle bombs. It was concluded that one of the control systems under development by NDRC, Div. 5, had the best possibilities as far as early availability was concerned. It was recommended that several alternative systems be developed as soon as possible.
23.	(C) Ltr. 13 Oct. 1943 Fr: Brig.Gen.F.O.Carroll Chief,Eng.Div.,WF To: CG,AAF Attn: Dev.Eng.Br.,Mat.Div. AC/AS,M&D (File: Central Files)	Eng. Div., WF, stated that "pre-production" group of 200 high angle bombs controllable in azimuth would probably be released by the manufacturer between 1 November 1943 and 1 January 1944. It was also felt that the Azon bomb could be released for final ballistic and evaluation tests and possible training purposes in November or December 1943. AAFSAT was suggested as agency to handle final tests.
24.	(S) Ltr. 23 Oct. 1943 Fr: Col.H.C.Wilson,Chief Dev.Eng.Br.,Mat.Div., AC/AS,M&D To: CG,Mat.Com.,WF Attn: Tech.Exec. (File: Central Files)	Col. Wilson stated that Air Communications Officer had directed that 10,600 control and flare assemblies suitable for use with standard 1,000 pound bomb be procured for the high angle controllable bomb project. 10,000 of these assemblies were destined for Army use, 600 for Navy. Development of necessary radio equipment was to be handled through the Signal Corps.
25.	(S) CTI-1350, Add. 1 28 Oct. 1943 Fr: Col.T.A.Sims,Dep. Chief of Staff,WF To: Prod.Div.,WF (File: Central Files)	This addendum to CTI-1350 initiated action requested by Chief, Dev. Eng. Br., AC/AS, M&D by letter of 23 Oct.
26.	(S) Memo 10 Nov. 1943 Fr: Brig.Gen.H.M.McClelland Air Communications Officer (File: M&S)	A Special Projects Section was set up in the Air Communications Office to assume complete responsibility for all work in connection with the guided missiles program.

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27. (C) Ltr. 10 Nov. 1943
Fr: W.H.Cadwallader, Vice Pres. & Gen.Mgr. Union Switch & Signal Co.
To: Col.S.R.Stewart, Special Weapons Br., WF
(File: Central Files)

Mr. Cadwallader forwarded to WF a set of general specifications for the Azon tail structure for a 1000 pound bomb. The structure consisted of the following component parts: (1) a box containing apparatus attached to fins and control surfaces; (2) a gyro assembly to keep bomb from rotating about its own axis; (3) two channel radio receiver; (4) a servo motor energized by storage battery; (5) two double acting solenoids which control the ailerons; (6) a 24 volt battery which powers the unit; (7) an electrically ignited flare attached to tail of the bomb.

28. (C) Memo Rpt. 22 Nov. 1943
ENG-54-673-16N
(File: M&S)

A total of 24 Azon bombs were dropped in a series of tests carried out at the Nat. Com. Flight Test Base, Muroc, Calif. Twelve of the bombs were controlled throughout flight, the rest experiencing either flare failure or radio failure. On the basis of the tests the following conclusions were reached: (1) electrically driven gyro was superior to those which were air driven; (2) flares were still unsatisfactory; (3) radio functioned satisfactorily under ideal conditions.

29. (C) Ltr. 25 Nov. 1943
Fr: Col.W.M.Morgan, Chief Prod.Eng.Sect., WF
To: Dayton Signal Corps Procurement Dist.
(File: Central Files)

Signal Corps was informed that an order had been placed with Union Switch and Signal Co. for 10,600 Azon tail structures. It was requested that an equal number of AN/CRW-2 radio receivers be procured by Dayton Signal Corps Procurement District with shipping schedule for these items to correspond to schedule proposed by Union Switch and Signal Co.

30. (C) 1st. Ind. 25 Nov. 1943
Fr: Maj.C.P.Patterson Tech.Exec., Dayton Signal Corps Procurement Dist.
To: Prod.Eng.Sect., WF
(File: M&S)

The Signal Corps stated that 10,600 radio receivers had been contracted for with Emerson Radio and Phonograph Corp. However, production would not begin on the order until a definite decision was made on what design receiver was to be used. Emerson could meet the schedule suggested in basic communication if the design remained unchanged.

31. (C) Ltr. 14 Dec. 1943
Fr: Brig.Gen.F.O.Carroll Chief, Eng.Div., WF.
To: CG, AAF, Wash.
Attn: Air Ordnance Officer AC/AS, MMRD
(File: Central Files)

WF requested that Chief of Ordnance be asked to design a new flare for the Azon type AZ-1 bomb. It was stated that the flare in use was unsuitable for tactical use, and a list of desirable characteristics for a new flare was submitted.

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32.	(C) Ltr. Contract, 20 Dec. 1943 W 33-038 ac-1706 (File: Contract Files)	Letter contract was issued to Union Switch and Signal Co. for 10,600 Azon tail structures at a total estimated price of $10,600,000. Fixed Price Contract was to be placed by 1 Feb. 1944 and total expenditure authorized under letter contract was $5,300,000.
33.	(S) Rpt. 20 Dec. 1943 By: Col.S.P.Wright [Special Projects Sect., Air Communications Office, Wash.] (File: M&S)	Col. Wright summarized the developments on the guided missiles program since his previous report of 1 Dec. The Azon bomb was discussed under four headings: (1) Development - pre-production models were well under way, radio receiving units were to be completed 24 December 1943 and 1 January 1944, and work was progressing on flares with three contrasting colors. (2) Tests - latest tests at Eglin Field, using the General Instrument Co. super-regenerative receiver, had not been especially successful. Failure was not due to the radio, however, but to mechanical and other difficulties. Further tests were to be made on revised versions. (3) Training- some enlisted personnel had been trained for work on the Azons and a more elaborate training program was to be carried on. (4) Procurement - 10,600 units were on order. Extra radio receivers had been ordered from several sources. In general it appeared that the Azon project was proceeding satisfactorily and it was hoped that the bombs would be ready for introduction into the theatres about March 1944.
34.	(C) Ltr. 11 Jan. 1944 Fr: Brig.Gen.F.O.Carroll Chief, Eng.Div., WF To: NDRC, Div.5-5 (File: NACA, Navy, NDRC Liaison Br., Eng.Div.)	Eng. Div., WF, suggested that pulse type radio control transmitter developed by Hammond Research Corp. might prove suitable for use with the Azon bomb and eventually the Razon and the glide bomb. It was suggested that Div. 5-5 make some study of this development "with a view of eventually sponsoring it...for use in the Materiel Command controllable missile program."
35.	(C) Ltr. 13 Jan. 1944 Fr: Dr.L.O.Grondahl Chief, Sect.52, NDRC To: Col.R.C.Wilson, Chief Dev.Eng.Br., Mat.Div. Ofc.AC/AS, M&D (File: M&S)	Dr. Grondahl stated that he was very pleased with the fact that opportunity had been afforded NDRC to test an AN-M-65 bomb in the Langley Field wind tunnel for the purpose of obtaining aerodynamic data. Data for high speeds had been lacking in the past, and it was hoped that a complete set could be obtained which would prove useful in future experiments.

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36.	(C) Amendment No. 1 to Letter Contract W 33-038 ac-1706 25 Jan. 1944 (File: Contract Files)	Date for placing a formal contract was extended from 1 Feb. 1944 to 1 April.
37.	(C) Ltr. 2 Feb. 1944 Fr: Col.R.C.Wilson,Chief Dev.Eng.Br.,Mat.Div. AC/AS,MMZD To: CG,Mat.Com.,WF (File: M&S)	Col. Wilson called attention to the statement in a letter of 1 Feb. to the effect that the production order of 10,600 Azons was to follow Mat. Com. production procedure. He suggested that his office should be informed of any difficulties encountered in the changeover from NDRC experimental procedure.
38.	(C) IGM 3 Feb. 1944 Fr: Col.W.M.Morgan,Chief Prod.Eng.Sect.,WF To: Inspection Sect.,WF (File: Contract Files)	Prod. Eng. Sect. requested that an AAF inspector be assigned to Union Switch and Signal Co. for the Azon program. Status of the program and projected schedule for the Air Corps contract were explained and it was stated that every effort was being exerted to meet deadlines on the "paper work" involved although information had at all times been inadequate.
39.	(S) R&R-1, 4 Feb. 1944 Fr: Brig.Gen.H.M.McClelland Air Communications Officer To: AC/AS,OC&R (File: M&S)	A project was set up under the Eighth Air Force for the purpose of employing Azon bombs against suitable targets in the European Theater of Operations. Crews technicians, airplanes, and necessary equipment were to be ready for departure from continental United States not later than 1 March 1944.
40.	(S) Rpt. 7 Feb. 1944 Fr: Lt.G.E.Bigelow Hq,AAF To: Air Communication Officer Special Projects Sect., Wash. (File: M&S)	In his report concerning the tactical use of Azon Lt. Bigelow emphasized the fact that inherent range error was an important factor to take into consideration. This error is compensated for in conventional bombing by the use of string or train drops, but such compensation is not possible with Azons. For this reason he felt that Azon bombs would be most useful if employed against longitudinal or strip targets rather than pin point targets. Selection of the proper bombing altitude would also help make Azons more effective. Lt. Bigelow suggested that a program be set up to determine by actual experiment the tactics best suited for use of

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Azon units. Some of the problems which could probably be solved this way would include: (1) how many aircraft could drop Azons simultaneously on the same bomb run and still maintain control of all bombs; (2) evasive action, the amount necessary and the amount possible while still maintaining control of the Azons; (3) maximum and minimum altitudes at which control could still be maintained; (4) night bombing possibilities; (5) the types of aircraft which could best use the Azon units.

41. (S) Rpt. 11 Feb. 1944
Fr: Lt.Gordon E. Bigelow
HQ,AAF,Wash.
To: Air Communications Officer
Special Projects Sect.,
Wash.
(File: M&S)

Lt. Bigelow stated the reasons why he considered Azon more suited to medium bombardment aircraft. They were: (1) range error can be reduced to a minimum by dropping Azons from lowest safe altitude; (2) this is the range of medium bombers, and their bomb-carrying capacity, speed, and accustomed targets are all suitable for Azon; (3) advantages of heavy bombers would be wasted on Azon operations. Lt. Bigelow proceeded on this basis to set up, in considerable detail, a minimum training program for Azon crews combining experimentation and training into a single program.

42. (S) R&R-1, 12 Feb. 1944
Fr: Brig.Gen.H.M.McClelland
Air Communications Officer
To: AC/AS,M&D,Research
Liaison Sect.
(File: NACA,Navy,NDRC Liaison
Br.,Eng.Div.)

Gen. McClelland stated that the Azon bomb had completed successful tests and that early introduction into a combat theater was contemplated. He requested assignment of an NDRC engineer to the particular detachment taking the Azon into combat.

43. (S) R&R-1, 17 Feb. 1944
Fr: Brig.Gen.H.M.McClelland
Air Communications Officer
To: AC/AS, OC&R
Attn: Brig.Gen.H.A.Craig
(File: M&S)

On the basis of observations and discussions concerning tactical use of Azon it was decided that this weapon would probably be more useful against targets in Northern Italy, and the project was therefore transferred to the cognizance of the Fifteenth Air Force. The training phase of the project was extended to 15 March in order that more information might be accumulated concerning the relationship between range and the amount of control applied to the Azons.

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44. (S) 1st. Ind. 21 Feb. 1944
Fr: Brig.Gen.F.O.Carroll, Chief,Eng.Div.,WF
To: CG,AAF,Wash.
Attn: Dev.Eng.Br.,Mat.Div. AC/AS,MM&D
(File: Central Files)

In response to inquiries made by Col. Wilson, WF listed requested items of information concerning the guided missiles program. Concerning the Azon bomb particularly, it was stated that no procurement of kits for modifying airplanes for carrying the AZ-1 had been initiated but that no difficulties in procurement of necessary items were anticipated. It was also stated that no difficulties were anticipated in the procurement of radio sets, bomb fin sleeves, flares, fuses, and the bomb itself. Specifications for the Azon flare were listed. With regard to the question of inspection WF stated that the degree of inspection required for the production contract of the Azon bomb had not as yet been determined.

45. (S) Ltr. 26 Feb. 1944
Fr: Col.R.C.Wilson,Chief Dev.Eng.Br.,Mat.Div. AC/AS,MM&D
To: CG,Mat.Com.,WF
(File: Central Files)

Dev. Eng. Br., MM&D, suggested that it might be possible to fasten two 1000 pound Azon bombs together and adjust gyros and controls so that the combination bomb would be controllable both in azimuth and range. Control was to be achieved by coordinating the efforts of crews in two separate airplanes due to the unavailability of a suitable range sighting device for guided missiles. It was stated that such an arrangement could be made into a usable tactical weapon, if successful, far before the Razon bombs, which were being developed, would be available. WF was therefore directed to study the proposed adaptation and to report on its feasibility.

46. (C) IOM 26 Feb. 1944
Fr: Col.W.M.Morgan,Chief Prod.Eng.Sect.,WF
To: Chief,Res.Control Sect. WF
Attn: Lt.Col.K.F.Royce
(File: Contract Files)

Latest delivery schedule of Azons was set at 20 per day 15-29 Feb., 30 per day 1-15 March, 50 per day 15-30 March, 100 or more per day after 1 April. It was believed that schedule could be met provided sufficient materials were available. MM&D had requested that Azon AZ-2 (2000 pound version) be provided either currently or after AZ-1 order, and probable delivery schedules on an order of 5,300 units were given. It was stated that material problems were increasing on subject contract and it was requested that special attention be given to these problems by Res. Control Sect.

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47.	(U) Cable 29 Feb. 1944 Fr: AAF Board,Orlando,Fla. [Col. Helmick] To: CG,Mat.Com.,WF (File: M&S)	Col. Helmick stated that work at Orlando with Azon indicated 30 percent failure or higher, and he suggested that the large number of improvements needed be incorporated into a revised production schedule. In Col. Helmick's opinion "present equipment" was "definitely unsatisfactory under service conditions."
48.	(S) Memo 1 March 1944 Fr: Brig.Gen.H.A.Craig AC/AS,OC&R To: Gen. Arnold (File: M&S)	Gen. Arnold was informed that action had been taken on the basis of Col. Helmick's cable, to send qualified experts to Orlando to investigate the numerous difficulties which he had reported. Contact with AAF Board appeared to indicate: (1) that insufficient data had been obtained on the Azon to support any conclusions such as those set forth in Col. Helmick's cable; (2) that the cable indicated only the personal opinion of Col. Helmick; and (3) the communication might be characterized as "slightly premature." Until more complete and accurate data was available close control over the project with the Fifteenth Air Force was to be maintained.
49.	(C) Ltr. 8 March 1944 Fr: Col.W.H.Herod,Actg.Chief Res.Control Sect.,WF To: Union Switch & Signal Co. (File: Contract Files)	WF suggested that if at all possible a higher schedule should be worked out for delivery of Azon AZ-1 units since the project had been given extremely high priority. Difficulties with shortages were to be cleared through Washington, if necessary, to expedite the program.
50.	(S) Cable 17 March 1944 Fr: Col.B.S.Kelsey [Wash] To: Gen.Spaatz,CG,U.S. Strategic Air Force, London (File: M&S)	Col. Kelsey suggested that a project for the Italian theater and China involving use of the high angle bomb controllable in azimuth be considered. The project was on a test basis but appeared to have good possibilities on long targets involving little evasive action.
51.	(S) TG 24 March 1944 Fr: Gen.McClelland,Wash. To: CG,Mat.Com.,WF (File: Central Files)	WF was directed to send four hundred additional Azons packed for water shipment in lot of one hundred or more to Karachi, India. One hundred Azons packed for air shipment were to be sent to Orlando, Florida.

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52.	(S) Ltr. 27 March 1944 Fr: Brig.Gen.F.O.Carroll Chief,Eng.Div.,WF To: CG,AAF,Wash Attn: Dev.Eng.Br.,Mat.Div. AC/AS,M&D (File: Central Files)	WF had studied the problem of combining two 1000 pound Azons in order to achieve control in both azimuth and range, and the following objections were presented: (1) separate radio frequencies would be required; (2) alteration of control surfaces on second bomb would be necessary; (3) center of gravity in the combination would be such that tendency to roll would be difficult to overcome; (4) effectiveness of control surfaces was questionable; (5) extensive tests would be necessary to obtain good ballistics data; (6) suggested technique of control by two airplanes has been found to be unsatisfactory; (7) modification of tail assemblies would be required. In view of problems involved WF recommended that further consideration of above arrangement be dropped and effort be concentrated on development of the 2000 pound Razon bomb.
53.	(C) Amendment No. 2 to Letter Contract W 33-038 ac-1706 28 March 1944 (File: Contract Files)	Date for placing a formal contract was extended from 1 April 1944 to 1 June 1944.
54.	(S) Ltr. 29 March 1944 Fr: Col.S.F.Wright,Chief Special Projects Sect. Office of Air Communications Officer,Wash To: BuAer,Navy Dept.,Wash. Attn: Capt. Temple (File: M&S)	Col. Wright informed BuAer that six B-17 airplanes equipped to drop Azons were about to depart for the Mediterranean area where Azon was to be tried in combat. A squadron of 10 B-24's was to depart for the China-Burma-India theater around 1 May for the same purpose. The latter unit was to undergo operational training at Orlando 8-25 April. Navy representatives would be able to observe Azon drops during this period.
55.	(S) Ltr. 1 April 1944 Fr: Col.R.A.Legg,Actg.Chief Dev.Eng.Br.,Mat.Div., AC/AS,M&D To: CG,Mat.Com.,WF Attn: Eng.Div. (File: Central Files)	Mat. Div. informed WF that no further action need be taken on project concerned with possible adaptation of 1000 pound Azon bomb which had been requested by letter 26 Feb. 1944 from Dev. Eng. Br.

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56.	(C) Ltr. 6 April 1944 Fr: Col.R.F.Legg,Actg.Chief Dev.Eng.Br., AC/AS,MM&D To: CG,Mat.Com.,WF Attn: Tech.Exec. (File: Central Files)	Procurement of 10,000 additional Azon tail units was directed with production to continue at a rate of 3,000 per month, if possible, and spares percentages to remain the same.
57.	(S) Ltr. 8 April 1944 Fr: Col.R.C.Wilson Chief,Dev.Eng.Br., Mat.Div.,AC/AS,MM&D To: CG,Mat.Com.,WF Attn: Tech.Exec. (File: Central Files)	Dev. Eng. Br. requested information on the following: (1) Total production on Azons which could be secured from Union Switch and Signal Co. facilities: and (2) several other potential manufacturers who would require a minimum increase in facilities and minimum time to start production.
58.	(C) CTI-1350, Add. 4 11 April 1944 Fr: Col.T.A.Sims, Dep.Chief of Staff,WF To: Prod.Div.,WF (File: Central Files)	This addendum to CTI-1350 initiated action requested in letter 6 April 1944 from Chief, Dev. Eng. Br., Mat. Div., AC/AS, MM&D.
59.	(S) Ltr. 11 April 1944 Fr: Brig.Gen.B.W.Chidlaw AAF Liaison Officer NDRC To: War Dept. Liaison Officer,NDRC (File: M&S)	A second project for Azon was being set up with the Tenth Air Force. In view of the premitive conditions in this theater it was requested that an NDRC technician be assigned to the detachment taking the Azon into combat in this area.
60.	(S) TT 11 April 1944 Fr: Gen.Arnold,Wash. To: CG,Mat.Com.,WF (File: Central Files)	Sixth release of Azon bombs (one hundred plus spares) was to be shipped to Fifteenth Air Force. Request for release originated from Caserta, Italy, Gen. Baker. Number seven release of four hundred articles was to go to the same group.
61.	(S) Ltr. 12 April 1944 Fr: Maj.Gen.R.W.Harper AC/AS,Training To: CG,First Air Force, Mitchel Field (File: M&S)	The First Air Force was directed to set up a program for training guided missiles teams and for transition training of heavy bombardment squadrons for combat use of Azon. Enclosures to the directive gave detailed information under the following headings: (1) Manning Table; (2) Schedule of Units to be trained; (3) Summary of Action Taken; (4) Guided Missiles Trainers.

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62. (S) Ltr. 17 April 1944
Fr: Capt.E.H.Wynn
Asst.Tech.Exec.,WF
To: CG,AAF,Wash.
Attn: Dev.Eng.Br.,
Mat.Div.,AC/AS,M&D
(File: Central Files)

In response to inquiries from M&D, WF stated that a production maximum of 150 units daily would be possible at Union Switch and Signal Co. on receipt of a number of important items of equipment.

63. (S) Rpt. 15 April 1944
(File: M&S)

A detailed analysis of the AAF Guided Missiles Program included the following summary of the Azon project:
(1) Description - Azon can be carried in the bomb bay on standard 1000 pound bomb shackles. It is gyro stabilized against rotation and controlled in azimuth by the bombardier. Threecolor flares permit observation and radio frequencies are such that six simultaneous drops can be made.
(2) Characteristics - Azon can be controlled for 2000 to 3000 ft. when dropped from 15,000 ft. Great accuracy in azimuth is possible, expecially in the improved versions.
(3) Availability - Orders have been made for 20,600 tails. Tail production could be accelerated to 3,000 a month. Radio production would need to be increased.
(4) Training - Six B-17 crews had been trained and were now in the Italian theater. Ten B-24's were in the process of being trained. Further heavy bombardment squadrons were to be trained for Azon as well as guided missiles teams for maintenance of Azon equipment.
(5) Comments - The Azon is suitable for long, narrow targets primarily. The equipment of airplanes and training of bombardiers are comparatively simple. Large disperaion when dropped in train constituted one unsolved problem.

64. (S) Memo 25 April 1944
Fr: Maj.H.J.Rand
(AFACO/M-3)
To: Maj.W.L.Nowell
(File: M&S)

Maj. Rand gave a detailed report of the training of ten B-24 crews for Azon operations. Out of the first 40 Azons dropped by this group there were 19 failures attributable to various mechanical difficulties. A total of 41 of the last 60 Azons dropped hit the mark with zero azimuth error and 16 of these had zero rangeth error as well. Radio equipment was for the

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most part satisfactory, but some difficulties continued to be encountered with respect to flares. Lack of visibility from the bombardiers' compartment was solved by cutting an additional window in the flooring. T/O and T/E for an Azon squadron were suggested.

65. (S) R&R-1, 26 April 1944
Fr: Col.R.C.Wilson,Chief Dev.Eng.Br.,Mat.Div. AC/AS,MM&D
To: Air Ordnance Officer AC/AS,MM&D
(File: Central Files)

Considerable difficulty had been experienced with failure of flares tested on Azon bombs at Orlando. Flare difficulties were attributed to effects of moisture and orders were issued to pack all future flares in moisture proof containers. Other possible causes of flare failure were to be investigated and correction of the difficulties expedited.

66. (C) Ltr. 27 April 1944
Fr: Col.H.G.Montgomery Chief,Tactics Div.
To: CG,AAF,Wash. AC/AS,OC&R,Bomb.Br.
Attn: Maj.V.A.Stace
(File: M&S)

Bombing records of B-24's operating on training phase 2 of AAF Board Project (T-1) 13 were forwarded as a preliminary report. Scoring on the whole was reasonably accurate. Final report on the project was to be made available at a later date.

67. (U) IDM 28 April 1944
Fr: Lt.Col.W.G.Brown,Office AC/AS,MM&D
To: Lt.Col.F.H.Richardson Office,AC/AS,MM&D
(File: M&S)

Col. Brown stated that the question of using Azon in the European theater of operations had been discussed and that such a project was viewed in a favorable light by Gen. McClelland. Two squadrons in training were being sent to the Tenth Air Force in the China Burma Theater. It was suggested that training facilities for squadrons in the European theater of operations might be set up in the British Isles, and that informal reports might be forwarded to Gen. Doolittle from time to time on the results of the latest tests at Orlando.

68. (C) Ltr. 29 April 1944
Fr: Capt.E.H.Wynn Asst.Tech.Exec.,WF
To: CG,AAF,Wash.
Attn: Col.R.C.Wilson Dev.Eng.Br.,AC/AS,MM&D
(File: Central Files)

Further study had been made concerning increased production of the Azon unit, and WF now recommended five companies as possible additional sources of manufacture of the Azon bomb. They were: (1) Aeronca Aircraft Company, Middletown, Ohio; (2) Garden City Plating Co., Chicago, Illinois; (3) Ridgefield Mfg. Co., Ridgefield, New Jersey; (4) Crocker-Wheeler

Electrical Mfg. Co., Ampere, New Jersey; (5) National Electric Mfg. Co., Berrien Springs, Michigan. Exhibit "A" to the letter listed principal sub-contracted items and sources of these articles.

69. (C) Rpt. 30 April 1944
Fr: Lt.Col.P.F.Helmick
Project Officer,Azon,
301st Bomb.Group (H)AAF
To: Ofc.Chief of Air
Communications
War Dept.,Wash.
(File: Non-Powered Weapons
Unit,Special Weapons Br.
Equipment Lab.)

Col. Helmick stated that operations with Azons in the Italian theater had been greatly hampered by bad weather, with only four missions having been attempted. These missions indicated a great decrease in accuracy and it was suggested that an additional bombardier trained on the Azon might be necessary. Functional failures had also been encountered considerably more often than they had occurred in Florida during testing activities. They included difficulties with batteries, faulty uncaging mechanisms on the gyros, a tendency of the radio frequency to drift, and some difficulty with fuses. Despite all of the above mentioned failures, however, it was the opinion of the project officer that the value of the Azon on certain targets had been demonstrated successfully, and that their value on point targets would be proved as more experience and more information were obtained.

70. (C) Ltr. 1 May 1944
Fr: Brig.Gen.F.O.Carroll
Chief,Eng.Div.,WF
To: CG,AAF,Wash.
Attn: Air Ordnance Officer
AC/AS,MMRD
(File: Central Files)

Ordnance Department was requested to initiate a project for the development of a tail fuse for the Azon bomb, type AZ-1 and AZ-2. Requirements for the fuse were listed and it was suggested that twenty-five articles be produced at earliest possible date. Requirement for the tail fuse had been waived at earliest stages of the development of this article but early incorporation of the item was now considered necessary.

71. (C) Ltr. 1 May 1944
Fr: Brig.Gen.F.O.Carroll
Chief,Eng.Div.,WF
To: CG,AAF,Wash.
Attn: Radio & Radar Sect.
Dev.Eng.Br.,Mat.Div.
AC/AS,MMRD
(File: Central Files)

Eng. Div., WF, stated that although Azon (AZ-1) bomb was now on a production basis further improvements on the production article could and should be made. It was requested that 75 Azons be allocated to WF for further study and it was suggested that NDRC participation in the work be continued on same basis as in the past.

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72. (S) Preliminary Rpt. 8 May 1944
AAF Board Project (T-1) 13
(File: Non-Powered Weapons Unit, Special Weapons Br. Equipment Lab.)

On the basis of extensive tests on the Azon AZ-1 bomb it was recommended that this type bomb be adopted as standard equipment with present production facilities being maintained at full capacity. It was stated that cost of the article was approximately four times greater than standard bomb but that increased accuracy warranted additional expenditure. Tests had proved that satisfactory control was possible and that continued efforts toward improvement would result in a most satisfactory article.

73. (S) Ltr. 12 May 1944
Fr: Brig.Gen.F.O.Carroll
Chief, Eng.Div., WF
To: CG, AAF, Wash.
Attn: Dev.Eng.Br., Mat.Div.
AC/AS, MM&D
(File: Central Files)

In an effort to obtain consistency of nomenclature in the guided missile program the designation VB (for vertical bomb as distinguished from glide bomb) had been adopted. It was further stated that with the exception of VB-1, participation of WF Eng. Div. in the development of controlled missiles had been entirely on an unofficial basis and "without an explicit directive as to how far it should go in this matter." It was requested, therefore, that specific authority be granted to WF to collaborate with NDRC on the guided missiles program.

74. (S) Radiogram 15 May 1944
Fr: CG, Fifteenth Air Force, Bari, Italy
To: CG, Strategic Air Forces in Europe, London, England
CG, Mediterranean Allied Air Forces, Caserta, Italy
(File: MES)

The 301st Heavy Bomb Group, Fifteenth Air Force, reported a successful Azon mission 13 May against Avisio viaduct on Brenner Pass Railroad. Preliminary examination indicated that the pass had been effectively blocked to all rail traffic. The Azon equipped aircraft led the group and scored 4 direct hits, with good ability to control noted. It was believed that excellent results could be obtained with all aircraft in the group loaded with Azon and with control exercised on one frequency by one aircraft.

75. (C) R&R-1, 17 May 1944
Fr: Col.R.C.Wilson, Chief
Dev.Eng.Br., Mat.Div.
AC/AS, MM&D
To: AC/AS, MM&D, Air Ordnance Officer
(File: Non-Powered Weapons Unit, Special Weapons Br., Equipment Lab.)

Col. Wilson stated that the report of Col. Helmick, dated 30 April, on Azon operations in the Italian theater indicated the necessity of developing a satisfactory tail fuse for the 1000 pound Azon (VB-1) bomb. It was requested that the Air Ordnance Officer initiate development of this equipment and that Dev. Eng. Br. be notified as soon as it was completed in order that prompt procurement could be made for all future Azon production.

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76. (C) Ltr. 20 May 1944
Fr: Capt.E.H.Wynn
Asst.Tech.Exec.,WF
To: CG,AAF,Wash.
Attn: AC/AS,MM&D,
Mat.Div.,Dev.Eng.Br.
Col.R.C.Wilson
(File: M&S)

Additional sources for manufacture of Azon tails were listed. They included the following:

Source of Production	Estimated Peak Production
Crocker-Wheeler Mfg.Co. Ampere, N. J.	2,500-2,000 articles per month
National Electric Mfg.Co. Berrien Springs, Mich.	2,500 articles per month
Grant Aircraft Corp. New York, N. Y.	10,400 articles per month
Laister Kauffman Aircraft Corp., St. Louis, Mo.	7,500 articles per month
Vendo Company Kansas City, Mo.	100 articles per day
G and A Aircraft Willow Grove, Pa.	100 articles per day

77. (S) Ltr. 22 May 1944
Fr: Col.R.C.Wilson
Chief,Dev.Eng.Br.
Mat.Div.,AC/AS,MM&D
To: CG,Mat.Com.,WF
(File: Non-Powered Weapons Unit,Special Weapons Br.,Equipment Lab.)

Dev. Eng. Br. stated that 550 Azon airplane modification kits on order were to be divided as follows: (1) 100 suitable for field or modification center installation; (2) 450 suitable for modifications center installation only. Some delay had occurred in the past due to the fact that a requirement had been expressed for a single kit suitable for modifying B-17, B-24, B-25, and B-26 airplanes. It was directed that procurement be expedited and any delay or difficulty reported promptly to Col. Wilson's office.

78. (S) Radiogram 29 May 1944
Fr: CG,Strategic Air Forces in Europe,London,England
To: War Department
(File: M&S)

Gen. Spaatz requested 150 Azon tail units "urgently required for operations" by Azon equipped B-24's of the Eighth Air Force. He requested that the shipment be expedited. Information was requested concerning a previous order for 250 units.

79. (C) Ltr. 1 June 1944
Fr: Col.R.C.Wilson,Chief
Dev.Eng.Br.,Mat.Div.,
AC/AS,MM&D
To: CG,Mat.Com.,WF
(File: M&S)

Seventy-five flares for Azon were released to Mat. Com. in accordance with the request of 1 May. NDRC had indicated its willingness to cooperate with Eng. Div. in further improvement of the Azon, with details to be worked out at a later date.

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80. (C) Ltr. 2 June 1944
Fr: Lt.Col.Paul F. Helmick
Project Officer,Azon
301st Bomb.Group (H)AAF
To: Air Communications Officer
Hdq., AAF
Attn: Col.S.R.Wright
(File: Non-Powered Weapons
Unit,Special Weapons Br.,
Equipment Lat.)

Col. Helmick reported that six ships carrying two Azon (VB-1) bombs each led the 301st group on a mission over Oradea, Rumania, the object of which was to disrupt traffic through the yards and to detroy rolling stock and supplies going to the Russian front. It had been planned in an effort to determine whether bombardier of one ship could control the bombs, thus permitting use of a group of Azon airplanes with the limited number of control frequencies available. Although a few hits were made and all Azon bombs "were reported to have responded properly," the test was not considered representative and another trial of similar nature was planned for the future.

81. (C) Ltr. 5 June 1944
Fr: Col.H.Z.Bogert
Actg.Chief,Eng.Div.,WF
To: CG,AAF
Attn: Dev.Eng.Br.,Mat.Div.
AC/AS,MM&D
(File: Non-Powered Weapons
Unit,Special Weapons
Br.,Equipment Lab.)

WF listed and explained in detail the efforts which had been made to correct the defects in the Azons (VB-1) which had been reported by Col. Helmick. These corrective measures included: (1) insulation of battery cells from battery case; (2) strict enforcement of test requirements for gyro; (3) efforts to increase sensitivity of radio and to decrease the tendency of the frequency to drift; (4) continuation of efforts to develop a suitable tail fuse; (5) considerable work toward improving the flare. Attention was called to the fact that report from Italian theater covered first 130 production units and that later articles had several improvements incorporated. It was requested that a copy of Col. Bogert's letter be forwarded to Col. Helmick.

82. (C) Ltr. 14 June 1944
Fr: Col.H.Z.Bogert
Actg.Chief,Eng.Div.,WF
To: CG,AAF,Wash.
Attn: Dev.Eng.Br.,
AC/AS,MM&D
(File: Non-Powered Weapons
Unit,Special Weapons
Br.,Equipment Lab.)

WF Eng. Div. expressed concern over undue dispersion of VB-1 vertical controllable bomb (Azon) when the bombs were dropped in train. Minor modification to permit controlled spinning of bomb during first half of its flight was suggested as a possible method of decreasing dispersion. It was requested that a directive be issued in order that the relative importance of the anti-dispersion development be specified and procurement be initiated for the additional equipment.

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83.	(S) CTI-1350, Add 5 17 June 1944 Fr: Col. T.A. Sims, Dep. C/S, WF To: Prod. Div., WF (File: Central Files)	CTI-1350, Add. 5, initiated action for additional procurement of Azon tails to a total of 30,000 plus spares. Effort was to be made to increase rate of production in order that this total could be completed in 1944.
84.	(C) Ltr. 20 June 1944 Fr: Col. G.C. Bale, Comm. Equip., AC/AS, MM&D, Wash. To: CG, ASC, Patterson Field, Ohio (File: M&S)	A tabulation was made of all releases of Azon units to Eighth, Ninth and Fifteenth Air Forces. A total of 4512 units had been released as of 1 June, and future shipping schedule was set at 1000 units per month to the Fifteenth Air Force and 2000 units per month to the Eighth Air Force.
85.	(S) R&R-1, 23 June 1944 Fr: Col. R.C. Wilson, Chief, Devel. Eng. Br., Mat. Div., AC/AS, MM&D, Wash. To: Air Comm. Officer, Special Proj. Sec., Wash. (File: M&S)	Col. Wilson stated that the increase of 1944 Azon production to 50,600 units could be met by the addition of a new source of production. The proposed schedule of production for both sources was submitted. It was requested that the rate of delivery on radio receivers be adjusted so that radios were delivered about one month before the completed Azon tails.
86.	(C) Ltr. 28 June 1944 Fr: Col. R.C. Wilson, Chief, Devel. Eng. Br., Mat. Div., AC/AS, MM&D, Wash. To: CG, Mat. Com., WF Attn: Tech. Exec. (File: M&S)	Air Comm. Officer, Proj. Officer for Guided Missiles, stated that anti-dispersion devices were of extreme importance and that the project should be expedited. Col. Wilson's office was of the opinion, therefore, that funds for the purchase of time switches and gyro modification items should be authorized immediately.
87.	(S) Ltr. 11 July 1944 Fr: Col. R.C. Wilson, Chief, Devel. Eng. Br., Mat. Div., AC/AS, MM&D, Wash. To: CG, Mat. Com., WF Attn: Special Weapons Br., Eng. Div. (File: Central Files)	Radio & Radar Sec., Devel. Eng. Br., had previously suggested and discussed with Eng. Div. the practicability of development of light-seeker for the Azon bomb. The idea was to drop an Azon or some flare equipped bomb, on which the remaining Azons (in bomb bay of plane), equipped with light-seeker instead of radio, would home in azimuth. Devel. Eng. Br. explained that "The purpose of such a procedure would be to establish a linear pattern of bombs, controlled in azimuth by the leading bomb and direction of flight, and controlled in range by the

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time intervals of dropping and by the space intervals between the dropping airplanes." Eng. Div. conclusions on feasibility of such a development and the time necessary to get it into production were requested. By 1st Ind. dated 22 July 1944, Eng. Div. replied that an FCIC device, already developed, could be utilized for above purpose at night and production could begin in three months; however, in daytime, range of response for the available device was limited due to illumination other than the flare; provided bombs were separated by 1000 feet or less, those same available devices as used in night operation would be satisfactory for day operation; the Azon nose would have to be lengthened by twelve inches to accommodate the device.

88. (S) Rpt. 13 July 1944
Fr: Maj. J.C.E. Williams, Hq., AAC, U.S. Strategic Air Forces in Europe
To: CG, AAF, Wash.
Attn: Lt. Col. Richardson, Mat. Div., AC/AS, MM&D
(File: M&S)

Five operations had been completed with Azon at the date of writing. This was not enough evidence on which to base an evaluation of the equipment, but it appeared that Azon was functionally reliable. Emphasis was laid, however, on the fact that flare failures continued to occur on 15% of the units. The suggestion was made that flares should be armored against flak. Fusing presented a further difficulty, and development of a tail fuse was suggested. The Ninth Air Force was in the process of building an Azon squadron with B-26 aircraft. It was stated that information concerning experiences of the Fifteenth Air Force and a good training film on the Azon would be of great assistance in this work. Enclosures to the report included the following: (1) Suggested Standard Squadron Maintenance Kit, (2) List of Comments on Azon Received from Mr. T.J. O'Donnell (Gulf Research & Devel. Corp.), and (3) Bombardier's Check List.

89. (C) Memo Rpt. 20 July 1944, ENG-54-673-16-W
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Eng. Div. stated that most VB-1 drops had been made with single bombs prior to its use in combat; in the Italian Theater it was necessary to drop all the load at one time because the targets were well protected and it was not advisable to make more than one run-in. Wide dispersion of the bombs became objectionable at altitudes over 15,000 feet so the bombs were tied together and dropped in close train or salvoed; the bombs were still controllable and compact pattern resulted from the above method. It was then recommended that Equip. Lab. continue development of the VB-1 in an attempt to reduce the dispersion.

90. (C) Ltr. 25 July 1944
Fr: Lt. D.M. Baltimore, Hq., 753rd Bomb Sqd. (H), 458th Bomb Group (H), APO #558
To: CG, ASC, Fairfield, O.
Attn: Col. F.E. Shanahan, Chief, Comm. Main. Sec.
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Lt. Baltimore (Special Weapons Br., Equip. Lab., WF), then in England, sent a lengthy report of installation and maintenance problems which faced the Azon Mission there. Lack of adequate tools caused some delay in the project; very few equipment failures occurred because the Azons had been well built and carefully packaged when shipped overseas; flares were the only cause of the few mechanical failures. The enlisted personnel were praised highly for their work on the project. The Ninth Air Force was also hampered in Azon operations due to insufficient quantity of tools, test equipment and trained technicians.

91. (C) IOM 25 July 1944
Fr: Col. S.R. Stewart, Chief, Special Weapons Br., Equip. Lab.
To: Chief, Equip. Lab., WF
(File: M&S)

In the daily report of the Special Weapons Br., it was stated that 1945 requirements for Azon would be [redacted]. Investigation of the Azon had revealed the fact that it could be lengthened to provide for a tail fuse and still fit in the B-17, B-25, B-26 and in some positions on the B-24.

92. (C) 1st Ind. 27 July 1944
Fr: Brig. Gen. F.O. Carroll, Chief, Eng. Div., WF
To: CG, AAF, Wash.
Attn: Devel. Eng. Br., Mat. Div., M&D
(File: Central Files)

Eng. Div. advised Devel. Eng. Br. that 25 of the 75 VB-1 units at Tonopah would be tested, beginning 5 Aug., to determine inherent dispersion of production models; the remaining units equipped with modified gyros would be dropped later.

93. (C) Rpt. 28 July 1944
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

WF personnel visited Union Switch & Signal Co. plant from 12 through 14 July regarding Azon production. It was stated that there were already 20,000 Azons on order and procurement of 90,000 more was to be made; therefore, it was necessary to continue a high rate of production and develop new sources for the equipment. After inspection of the assembly line and examination of the components, it was concluded that adequate testing facilities would be available soon, a new production source would be started as soon as sufficient batteries and gyros were available, and production of correctly engineered equipment required close liaison with the Signal Corps. No recommendations were offered at that time.

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94. (U) R&R-1, 1 Aug. 1944
Fr: Col. G.V. Holloman, Chief, Equip. Lab., Eng. Div., WF
To: Chief, Ord. Sec., WF
Attn: Maj. J.E. Hatcher
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Equip. Lab. requested that 25 T-59 tail fuses and 100 T-6 flares, furnished as expendable items, be allocated and shipped to Special Weapons Test Unit at Tonopah for use on VB-2 drop tests.

95. (C) Ltr. 2 Aug. 1944
Fr: Maj. H.B. Sproat, Dir. for Operations & Training, Fort Dix, N.J.
To: CG, First Air Force, Mitchel Field, N.Y.
Attn: Ord. Officer
Thru: 1st Bomber Command
(File: Central Files)

Dir. for Operations & Training at Fort Dix notified 1st Bomber Command that 12 of the 124 guide flares dropped in practice bombing there had failed. Probable reasons for the malfunctions were failure of flare to ignite and unsuitable flare mixtures. It was believed that a more thorough check of flare circuit and use of two flare mixtures instead of one would greatly reduce the failures.

96. (S) Rpt. 8 Aug. 1944
Fr: Maj. J.C.E. Williams, Air Tech. Sec., Hq. ETO
(File: M&S)

The B-26 Azon squadron of the 9th Bomber Command carried out its first mission against highway and railroad targets at Epernon, France. The bombing altitude was 11,500 feet and a total of 5 Azon and 2 regular bombs were dropped on the targets. The lead aircraft did the sighting and the 5 remaining aircraft dropped on the leader. Considerable flak was encountered in that vicinity, and the operational altitude of medium bombardment aircraft plus the necessity of longer bombing run makes Azon bombing particularly hazardous. A method of bombing in which a heavily armored controlling aircraft carrying no bombs would be used was suggested. A further problem, namely the difficulty of distinguishing between bombs, would be involved, but the method would have to be tried out before any definite statements could be made.

97. (S) CTI-1350, Add. 7, 14 Aug. 1944
Fr: Col. T.A. Sims, Dep. C/S, Mat. Com., WF
To: Prod. Div. [WF]
(File: M&S)

CTI-1350, Add. 7, initiated action for the procurement of 60,000 Azon tail units during 1945. These units were to be produced at the rate of 10,000 a month for the first 6 months. Authority for procurement was found in teletype WAR 68049 dated 10 July 1944 from Chief, Prod. Br., Office, AC/AS, M&S.

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98. (S) Ltr. 16 Aug. 1944
Fr: Dr. L.O. Grondahl, Chief, Sec. 5.2, NDRC, Union Switch & Signal Co., Pittsburgh, Pa.
To: Dr. Vannevar Bush, Dir., OSRD, Wash.
(File: M&S)

Chief, Sec. 5.2 of NDRC, sent Dir. of OSRD a copy of diary written when he was in England. While there he discussed Azon with interested British and Air Force officials, and studied application of VB-1. It was found that operational groups and those having contact with Azons were all quite enthusiastic about the apparatus' performance, but some difficulties had been encountered due to inexperienced personnel; they stated they could depend "on the apparatus to be reliable and on the controllability to be adequate for all except the most extraordinary conditions." Both the Eighth and Ninth Air Forces showed much interest in best tactics to be employed in Azon missions, and a statistical study of bombing results was being made by group of mathematicians. The Ministry of Aircraft Production (MAP) and Anti-aircraft Gunnery Establishment (AGE) were both interested in the Azon. A requirement of 10,000 units a month was expected to be established. Other uses of Azon equipment were: (1) to equip P-38's with 1000 pound Azons for bombing; (2) install Azon apparatus in bombers for simultaneous release of bombs in formation by lead ship's bombardier; (3) equip war-weary planes with Azon receivers and servo-motors, in place of other apparatus, load them with explosives and use as controllable bombs; and (4) attach Azon tail behind rocket to high explosive armor-piercing bomb and attempt to direct the bomb straight for target by time the rocket took hold. Suggestions for OSRD liaison and for military personnel were also contained herein.

99. (C) TT 25 Aug. 1944
Fr: Col. G.H. Moriarty, Res. Control Sec., WF
To: AC/AS, M&S, Wash.
Attn: Capt. D.P. Meeker, Devel. Eng. Br.
(File: Central Files)

Res. Control Sec. (WF) estimated deliveries of Azon controllable bomb tail fins to be 1800 in Aug., 3700 in Sept., 5500 in Oct., 8000 in Nov., 10,000 in Dec. 1944, and 10,000 a month thereafter until Aug. 1945 when the total of 110,600 would be completed. Provided reduction was necessary, deliveries would be cut-back to 8000 per month from Nov. 1944 to the completion date in Oct. 1945.

100. (S) 2nd Ind. 1 Sept. 1944
Fr: Col. R.C. Wilson, Chief, Devel. Eng. Br., Mat. Div., AC/AS, M&S, Wash.
To: CG, Mat. Com., WF
Attn: Tech. Exec.
(File: Central Files)

Devel. Eng. Br. desired that a study, not to interfere with those for reduction in dispersion of Azon, be made to decide whether or not the available light seeking device could be installed in place of radio in Azon tail to home on flare of preceding bomb. A report on progress of such a study was to be submitted by 1 Oct. 1944. By 3rd Ind. dated 22 Sept., Eng. Div. stated that the study had been made and that the discussed equipment could be utilized with Azon, although other studies of relative attitude of bombs in train and their trajectories indicated a need of a new flare seeker; it was possible to use the new design but it was more complicated than radio equipment and the type of flare seeking equipment then in use in Azon.

101. (U) Record of Tel. Conv. 2 Sept. 1944
Maj. J.R. Copeland, AAFTAC Proj. Officer, Orlando, Fla. and Lt. Col. P.F. Helmick, Chief, Non-Powered Weapons Unit, Equip. Lab., WF
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Maj. Copeland, AAFTAC (Orlando), phoned to report radio failures which were disrupting progress on the VB-1 tests for elimination of dispersion. He requested that a man from ARL be sent to Orlando to correct the radio troubles. Like difficulties had also been encountered at Tonopah.

102. (C) CTI-1350, Add. 9, 21 Sept. 1944
Fr: Col. T.A. Sims, Chief of Adm., ATSC, WF
To: Proc. Div., WF
(File: Central Files)

Add. 9 to CTI-1350 directed Proc. Div. to cancel all future VB-1 tail assembly production, with exception of the radio equipment. Addenda 1, 3, 5 and 7 to subject CTI called for procurement of 110,600 Azon tails; before cancellation, at least 13,800 would already be purchased. Add. 9 cancelled Add. 3, 5 and 7.

103. (U) Record of Tel. Conv. 22 Sept. 1944
Mr. Nichols, NDRC and Capt. (J.H.) Evans, Non-Powered Weapons Unit (Equip. Lab., WF)
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Mr. Nichols of NDRC phoned Capt. Evans to report the unsuccessful VB-1 anti-dispersion tests held at Orlando. It was believed that the cord used was not strong enough to hold the bombs in a tight cluster. NDRC claimed responsibility ~~of~~ VB-2 and further tests of that bomb were to be conducted. Future tests at Orlando would attempt to move pattern in azimuth rather than to reduce dispersion of the bombs. Col. Helmick, Chief of Non-Powered Weapons Unit, added a little note saying that in Italy receivers of low

sensitivity had "chattered" considerably on right signals when there was a noisy servo or gyro, so it was quite possible that the tugging between bombs was due to failure of radio receivers to respond to signals after bombs had fallen a few thousand feet.

104. (C) R&R-1, 28 Sept. 1944
Fr: Brig. Gen. F.O. Carroll, Chief, Eng. Div., WF
To: Chief, Prod. Div. (WF)
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

A brief account of relationship of all parties involved in the Azon (VB-1) development was given by Chief, Eng. Div., as follows: NDRC sponsored the development and let a contract to Gulf Research & Devel. Co. who manufactured the first item tested; after successful experimental tests, NDRC gave Union Switch & Signal Co. the job of furnishing production drawings; Union Switch & Signal Co. sub-contracted for gyros, batteries and servos with Schwien Eng. Co., Willard Battery Co. and White-Rodgers Motor Co.; NDRC procured 200 production models and tested them with AAF equipment; although AAF had been very much interested in the development, no agreements had been entered into and NDRC had financed the project up to that time; then, after the tactical value of the bomb was proved by tests of production models, AAF negotiated a contract with Union Switch & Signal Co. for 10,000 VB-1's.

105. (C) Ltr. 28 Sept. 1944
Fr: Brig. Gen. F.M. Hopkins, Jr., Chief, Res. Div., OAC/AS, M&S, Wash.
To: ATSC, WF
Attn: Chief, Proc. Div.
(File: Central Files)

Res. Div., M&S, forwarded PEC Form D to Proc. Div. This was the authorization to cut-back production of Azon tails. Immediate cancellation was to be made of 22,000 items on Union Switch & Signal Co. contract and 14,300 under G&A Aircraft Co. contract.

106. (S) Ltr. 29 Sept. 1944
Fr: Maj. F.C. Ziglar, Proj. Officer, 446th Bombardment Sqd. (M) AAF, 321st Bombardment Group (M) AAF, APO #650
To: Chief, Non-Powered Weapons Unit, Equip. Lab., WF
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

In a report on Azon project in Corsica, Maj. Ziglar explained that it was very likely the target would be completely destroyed if large groups of planes attacked in a column of 3 flights of 6 planes each with interval between them equal to or greater than time of fall; fuses with .01 second delay were recommended for use on the bombs. Approximately 75% of the Azons dropped controlled properly; a number of the failures were with flares. Maj. Ziglar emphasized the immediate need of 6 B-25 crews to fly Azon missions in that Theater. He stated that there were enough Azon tails on hand (183) and enroute from Naples (1112) to fly missions every day for 3 months, weather permitting.

107. (S) Ltr. 3 Oct. 1944
Fr: 1st Lt. J.S. Capps, Sqd. H, 903rd AAF Base Unit (Bombardment), Test & Dev. Sec., Pinecastle, Fla.
To: Dir., ATSC, WF
Attn: Capt. J.H. Evans, Special Weapons Br., Equip. Lab.
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Special Weapons Br. was advised of the arrival at Pinecastle of 29 new style VB-2's. Those units had fuse arming motors, 20° rudder operation, and brackets for the 3 inch flare. In order to mount Azons in B-17's those flares were necessary, although it was hoped that bombs with 5 inch flares would fit into the B-24's rear bomb bay. The T-59 tail fuses for VB-2's were expected to be available soon.

108. (S) Ltr. 6 Oct. 1944
Fr: L.S. Taylor, Chief, Operational Research Sec., Ninth Air Force, APO #696
To: Hq., AAF, Wash.
Attn: Col. R.E. Elwell, Actg. Chief, Operations Analysis Div.
(File: M&S)

Operations Research Sec., Ninth Air Force, reported that after one mission the Azon program had been abandoned because heavy flak had been encountered and the results obtained with Azon were no better than those with ordinary bombs.

109. (C) Ltr. 7 Oct. 1944
Fr: Col. G.E. Price, Chief, Prod. Sec., WF
To: CG, AAF, Wash.
Attn: Maj. V.A. Stace, Radio & Radar Sec., Devel. Eng. Br., Mat. Div., OAC/AS, M&S
(File: M&S)

In compliance with telephone request, Prod. Sec. submitted a summary of Azon production status. On Union Switch & Signal Co. contract AC-3187, 3471 tail assemblies had been completed and there were sufficient Schwien gyros, White-Rodgers servos and other parts on hand to assemble 1000 more units at $100 each; there were enough partially completed parts available to finish the contract for 10,000; besides those 4471 mentioned above, 10,600 had been delivered on another contract and a small number delivered on experimental contract. Total estimated termination cost was $4,000,000 to $5,000,000 and Union Switch & Signal Co. was requesting a $2,000,000 partial payment. Schwien Eng. Co. had laid off about 175 people and had 550 completed gyro assemblies ready for shipment. White-Rodgers Co. intended to lay off 300 employees; they had 412 undelivered complete servo units and 8000 more in process (costing $150,000 to complete), and action with DFC for increased facilities was in progress but Res. Control Sec. was taking action to stop that expense. G&A Aircraft Co. would not finish any Azons. On 28 Oct. 1944, Eng. Br. wrote Proc. Div. advising against assembling of the 1000 additional units from components on hand.

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110. (C) Memo 7 Oct. 1944
Fr: Dr. E.L. Bowles, Special Consultant to CG, AAF, Wash.
To: [Brig.] Gen. RM. McClelland [Air Comm. Officer, Wash.]
(File: M&S)

Dr. E.L. Bowles, Special Consultant to CG, AAF (Wash.), stated that there was no existing requirement for White-Rodgers servo motors and Schwien gyros due to cut-back of Azon program. He further stated that if production of those articles was cancelled, the two companies (only sources for those components) would be forced to reconvert; then, if Azon components were later needed, facilities would have to be recreated. Final development and testing of some new missiles using Azon components were progressing and there was possibility that a requirement would be established; therefore, it was felt that the only sources for the items should be maintained. Dr. Bowles wrote Air Comm. Officer thus:"in accordance with a directive of the Chief of Air Staff chargin you with responsibility for all phases of controlled missiles, requirements, development, experiment and procurement, I am instructing you to take necessary action to insure that facilities are maintained for the production of the above mentioned types of components, at least until such time as a definite requirement exists for such components or until it is apparent to you that no such requirement is likely to arise in the forseeable future."

111. (C) R&R-1, 8 Oct. 1944
Fr: Brig. Gen. T.C. Rives, Dep. Air Comm. Officer, Wash.
To: AC/AS, M&S, Mat. Div., Wash.
(File: M&S)

Dep. Air Comm. Officer requested Mat. Div. to take action to continue deliveries of Azon servo motors and gyros at rate of 2000 a month for 6 months period; in order to keep the White-Rodgers and Schwien Companies operating until a definite decision was reached as to whether or not there would be further requirement for the devices. The Memo was forwarded to Req. Div. for comment. In Comment #3, Req. Div. replied that no comment was appropriate since military requirements had already been examined and settled, and propriety of continuing manufacturing facilities was not within the Div. jurisdiction.

112. (S) IDM 10 Oct. 1944
Fr: Col. J.F. Phillips, OAC/AS, M&S, Wash.
To: Maj. Gen. O.P. Echols, [AC/AS, M&S, Wash.]
(File: M&S)

Col. Phillips informed Gen. Echols that procurement and delivery of 50,600 Azon tails in 1944 and 60,000 in 1945 had been authorized; orders for 35,600 from Union Switch & Signal Co. had been placed and 14,070 delivered as of 4 Oct., but none of the 15,000 on order from G&A Aircraft Co. had been delivered; there were enough components available for 1000 - 5000 additional tails. Air Comm. Officer had requested on 19 Sept. immediate cancellation of all further Azon production, ATSC was notified that same day and sent out cancellation notices on 4 Oct. Reasons for

the above cancellation were: (1) Wide dispersion caused by unsuccessful "train" drops, (2) Azon was only a "good weather" weapon requiring observation from time it left plane until impact, (3) bridges in France were taboo as targets, and (4) U.K. still had an 8 month's stock of Azons and had asked that shipments ~~to them~~ cease.

113. (C) Ltr. 13 Oct. 1944
Fr: Col. G.E. Price, Chief, Prod. Sec., Proc. Div., WF
To: AAF Sub-Area Representative, Pittsburgh, Pa.
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

In attached letter, NDRC asked WF to furnish Union Switch & Signal Co. with 30 AN/CRW-2 or AN/CRW-2A radio receivers for the VB-2 bombs. Proc. Div. advised that Union Switch & Signal Co. had a number of those receivers which were originally intended for the VB-1 bombs; therefore, it was believed the requested receivers should be transferred from VB-1 to the VB-2 program.

114. (S) 4th Ind. 18 Oct. 1944
Fr: Col. R.C. Wilson, Actg. Chief, Eng. Br., Mat. Div., OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
Attn: Eng. Div.
(File: Central Files)

Eng. Br. advised Eng. Div. that the reason for using a flare seeker instead of radio in Azon bombs was to reduce dispersion when bombs were dropped in train. It was agreeable to Eng. Br. to drop the study if other methods were found more practicable for controlling dispersion of vertical bombs.

115. (U) Ltr. 20 Oct. 1944
Fr: Col. G.E. Price, Chief, Prod. Sec., Proc. Div., WF
To: CG, AAF, Wash.
Attn: Maj. V.A. Stace, Radio & Radar Sec., Devel. Eng. Br., Mat. Div., OAC/AS, M&S
(File: M&S)

Proc. Div. advised Devel. Eng. Br. that 6529 of the 10,000 Azons on contract AC-3167 would be cancelled, and that none of those 30,000 on contracts AC-4307 and AC-4458 would be finished; Dayton Signal Corp Supply Agency and Ord. Officer had been likewise informed. It was also stated that Property Disposal Sec. (WF) wanted advice concerning disposition of 10,000 gyros, 6000 servos and quantity of batteries then on hand. By 1st Ind. dated 14 Nov., Eng. Br. answered that the surplus items were to be held for use in the 3000 Razon tails being procured by NDRC and ATSC and in the 1000 Felix equipments being procured by NDRC.

116. (C) Memo Rpt. 25 Oct. 1944
TSELA-4C-673-16-X
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Twelve VB-2 bombs carried externally on B-17's were dropped at Tonopah in Aug. and Sept. 1944. In order to estimate control, two bombs were dropped at same time and their parallel flight paths observed and photographed. A brief outline of results of the aerodynamic charactistics test were given and proved the VB-2 to be satisfactory in that respect. Action to set up program for testing the new flare and tail fuse for the bomb ~~has been~~ initiated by NDRC, as recommended.

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117. (C) Ltr. 27 Oct. 1944
Fr: Dr. L.O. Grondahl, Chief, Sec. 5.2, NDRC, Union Switch & Signal Co., Pittsburgh, Pa.
To: CG, ATSC, WF
Attn: Capt. J.H. Evans, [Special Weapons Br., Equip. Lab.]
(File: Central Files)

Chief, Sec. 5.2 of NDRC, had discussed the electric arming of VB-2 with Mr. Spencer [also of NDRC], who thought things should proceed as started and that any changes should be made by Army. Capt. Evans was asked whether the test of the VB-1 tail fuse would be included in first part of program at Wendover since that information was needed due to its bearing on the Razon project.

118. (U) Ltr. 28 Oct. 1944
Fr: L.N. Schwien Eng. Co., Los Angeles, Calif.
To: CG, Mat. Com., WF
Attn: Radio Br., Prod. Sec., Proc. Div.
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Schwien Eng. Co. notified Proc. Div. that their claim for materials already purchased, processed parts, and sub-contractor's claims due to cancellation of contracts AC-4458 and AC-4307 amounted to $809,293.32. Provided, however, they were permitted to complete 12,000, 18,000 or 24,000 gyros the claim would be reduced accordingly ($108.90 for each item). It was stated that those gyros on hand at prime contractors were usable in VB-2's and with slight modification could be utilized in Razon or Felix.

119. (C) E.O. #673-52, 31 Oct. 1944
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

E.O. #673-52 dated 31 Oct. 1944 was issued, with authority contained in letter 26 June 1944, to cover close liaison with NDRC in Azon VB-2 (2000 pound) bomb development and experimental testing of the equipment. The development was to be financed, for most part, by NDRC but ATSC was expected to take care of expenses for AAF advisory assistance and government equipment needed to expedite development; funds for experimental tests and covering transition of missile from experimental to production status would be required; no outside purchases would be made.

120. (C) TT 8 Nov. 1944
Fr: Wash.
To: ATSC, WF
Attn: Maj. H.F. Marshall, Proc. Div.
(File: Central Files)

Wash. granted WF Proc. Div. authority to declassify all contract documents and termination papers, except engineering data and specifications, pertaining to the Azon tail assemblies.

121. (C) Ltr. 15 Nov. 1944
Fr: Brig. Gen. F.O. Carroll, Chief, Eng. Div., WF
To: CG, AAF, Wash.
Attn: Chief, Eng. Br., Mat. Div., M&S
(File: Central Files)

Upon information from ATSC Supply Div., Eng. Div. found only a limited number of VB-1 tail assemblies were available from Gadsden, Ala. That stock was expected to be deleted within 60 days and there was none available elsewhere in continental U.S. Eng. Div. requested allocation of 200 units to be held at Gadsden AAF Specialized Depot until they were needed for experimental Spazon and tail fuse projects.

122. (C) Memo Rpt. 22 Nov. 1944
TSEPL-3-673-16-A-2
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

A number of Azon (VB-1) tests, including train drops, anti-dispersion, dispersion, and moving pattern in azimuth, were conducted by AAF Board during Sept., Oct. and Nov.; attached Appendices contain detailed results of each of those tests. Conclusions reached after the tests were: (1) wide dispersion resulted from Azons dropped in train from single plane, (2) difficulty in control was encountered when bombs were tied together to reduce dispersion, (3) dispersion caused by bomb irregularities could not be corrected by careful construction or assembly of the tails, (4) a single bomb dropped from 15,000 - 25,000 feet would be more effective against maneuvering ships than a number of standard bombs, and (5) Azon mass drop from formation of planes flying at 15,000 - 25,000 feet eliminated azimuth error found in similar drops of standard bombs.

123. (U) R&R-1, 28 Nov. 1944
Fr: Col. B.L. Boatner, Actg. Chief, Proc. Div., WF
To: Office, Chief of Adm., WF
Attn: Maj. W. Barstow
(File: Central Files)

Proc. Div. stated that cancellation of VB-1 tail assemblies, as directed by Add. 9 to CTI-1350, had been effected with delivery of 14,071 tails; therefore, the closing of that Add. was requested. The contractor stored a large number of Azon gyros, servos and batteries which would be used with future projects.

124. (S) 6th Ind. 7 Dec. 1944
Fr: Col. D.C. Doubleday, Chief, Eng. Br., Mat. Div., OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
Attn: Eng. Div.
(File: Central Files)

Eng. Br. understood that a study of advantages of light seeker for Azons and Razons would be made by Eng. Div. In 7th Ind. dated 22 Dec. 1944, Eng. Div. said the above study was progressing; FCIC flare seeker was being procured for tests, and other companies were contracted to develop a device just for Azons and Razons.

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125. (C) E.O. #673-21, 13 Dec. 1944 (File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

E.O. #673-21 authorized that $5,500 ($3,500 for outside purchase of target seeking unit) be spent for study, adaptation and tests of a light sensitive device for use as an anti-dispersion measure on the VB-1. After satisfactory tests of the experimental model, a quantity would be procured for service tests.

126. (U) Ltr. 13 Dec. 1944
Fr: R.D. Wyckoff (Gulf Research & Devel. Co.)
To: Dr. L.O. Grondahl, Union Switch & Signal Co., Pittsburgh, Pa.
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

VB-1 fuse tests were conducted at Wendover, Utah. Both fuses and tail units were prepared under direction of Special Weapons Br. officers. Five of the six bombs dropped on first two missions, when dug up, revealed that all fuses had armed and fired; however, that did not prove whether or not the fuses had any bad effect on the bomb's aerodynamic behavior. Radio failures and malfunctions of other equipment were believed to be causes of troubles encountered, so it was decided to run another mission with application of control according to pre-set schedule. Four bombs were dropped on that mission but results obtained were unsatisfactory.

127. (S) Ltr. 13 Dec. 1944
Fr: 1st Lt. J.S. Capps, Sqd. H (Bomb), 903rd AAF Base Unit (Bombardment), AAF Tactical Cen., Orlando, Fla.
To: Dir., ATSC, WF
Attn: Capt. J.H. Evans, Special Weapons Br., Equip. Lab.
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

AAF Board conducted tests had indicated that the VB-1 operated satisfactorily at 15,000 feet but not at 25,000 feet, so future tests would be made to determine a practical ceiling, between those limits, for mass drops. Unless modified to permit internal use in B-17's, the VB-2 was considered by the AAF Board, to be impractical for combat use.

128. (S) Ltr. 14 Dec. 1944
Fr: Col. W.W. Momyer, Tactics Div., AAF Board, Orlando, Fla.
To: Dir., ATSC, WF
Attn: AAF Board Liaison Officer (Capt. Evans, Special Weapons Br.)
(File: Central Files)

At a conference on 14 Dec. 1944 attended by AAF Board, NDRC and tactical testing agencies personnel, it was agreed that 350 VB-1 bombs would be required for AAF Board tests; 200 were requested at that time. By 1st Ind. dated 29 Dec., Equip. Lab. said shipping instructions for 200 had been issued 16 Dec., and further allocation of 360 had been requested on 19 Dec.

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(AFR 11-30)

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129. (C) Ltr. 15 Dec. 1944
Fr: Col. G.V. Holloman, Chief, Equip. Lab., Eng. Div., WF
To: CG, AAF, Wash.
Attn: Air Ord. Officer, OAC/AS, M&S
(File: Central Files)

Air Ord. Officer (Wash.) was informed that in early 1944 an electrically armed flare for high angle bombs was developed and accepted, but the bomber crews, among others, had never liked it. ~~Because of~~ 2 minor accidents, when those flares were unintentionally ignited; it was believed the development of a mechanically armed flare would prevent that from happening in the future. It was desired that Chief of Ord. design a suitable mechanically armed flare to meet requirements set forth in a letter dated 14 Dec. 1943.

130. (C) R&R-1, 20 Dec. 1944
Fr: Brig. Gen. F.O. Carroll, Chief, Eng. Div., WF
To: Office, Chief of Adm., WF
(File: Central Files)

Eng. Div. advised Office, Chief of Adm., that CTI-1350 should be closed out because "a high angle bomb controllable in azimuth, designated as VB-1 has been developed, tested, accepted, and standardized." It was further stated that AAF contracts had been placed, part of the VB-1 equipment had been manufactured and used in combat, and contracts had been terminated about 1 Oct. 1944. In attached letter dated 6 Jan., Chief of Adm. notified Mat. Div. that CTI-1350 should be closed for reasons stated above.

131. (R) Hq. Office Instruction #20-79, 1 Jan. 1945
Fr: Lt. Gen. B.M. Giles, Dep. Com., AAF, and C/AS, Wash.
(File: M&S)

Hq. Office Instruction #20-79 was issued by Gen. Giles, Dep. Com. of AAF and C/AS, for purpose of placing guided missiles responsibilities in same channels applicable to aircraft. His definition of guided missiles was "all missiles controlled in direction after launching by equipment in or remote from the missile." Offices of Hq., AAF, were assigned responsibilities ~~of~~ guided missiles program according to AAF regulations #20-1 and 20-46, except that the Air Comm. Officer was charged with completion of work through test introduction into the Theaters on those guided missiles projects which were already started (those having electronic system of flight control but not requiring any propulsion units).

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132. (C) Ltr. 13 Jan. 1945
Fr: Col. G.V. Holloman, Chief, Equip. Lab., Eng. Div., WF
To: CG, AAF, Wash.
Attn: Maj. J.F. Vogel, AC/AS, M&S, Mat. Div., Eng. Br.
(File: Central Files)

Development of the anemometer type air-stream arming tail fuse (T-75) for the VB-1 was completed. Eng. Div. requested information on number and location of VB-1 units in U.S. and Theaters in order that the production quantity necessary for all those existing units could be determined.

133. (C) 1st Ind. 19 Jan. 1945
Fr: Lt. Col. J.M. Gruitch, Chief, Tech. Dev. Br., Ord. Dept., Wash.
To: Dir., ATSC, WF
Attn: Special Weapons Br., Equip. Lab.
(File: Central Files)

In accordance with Equip. Lab.'s request, Chief of Ord. had been asked to investigate means of mechanically arming and igniting flares for the high angle bombs. It was believed that military characteristics of the flares should be restated because (1) all T-6, T7 and T8 guide flares in use on VB-1's were to be replaced with T6E1, T7E1 and T8E1 flares; production of flares for discontinued VB-1 units and for 3000 VB-3 units was expected to be furnished by last of Jan. 1945; (2) flare production would be completed before a decision on mechanical arming was reached, so electrical ignition of the flares with air activated arming appeared advisable; and (3) limited space would affect the design of mechanical ignition of the flares.

134. (S) R&R-1, 27 Jan. 1945
Fr: Col. S.F. Giffin, AC/AS, OC&R, Req. Div. (M&S, Wash.)
To: AC/AS, M&S, Eng. Div., (Wash.)
(File: M&S)

Req. Div. requested that the 1000 complete Azon tail units be assembled from those components which were in storage. The request was made in order to have these assemblies ready for shipment whenever requirements were received from CBI Theater.

135. (S) Progress Rpt. 28 Jan. 1945 "AAF Guided Missiles Development Status and Availability"
(File: M&S)

It was reported that the Tenth Air Force was very much impressed with results obtained with VB-1 in that Theater. Tenth Air Force planned to equip both B-24 and P-38 (Droop Snoot) aircraft for Azon missions. It was found, by inventory, that MTO had 4607 VB-1 tail units on hand but wanted to keep them for a while. 600 of the 3167 available in MTO were already packed for shipment to CBI and 300 had already been sent from continental U.S. to CBI, 360 units in U.S. had been allocated to ATSC for Spazon tests. There were 5500

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red, 5500 white and 4000 green flares of a new and improved design under procurement for use on Azon and Razon; also procurement of T-75 tail fuses was being initiated. A definite date had not been set for service and evaluation tests of the VB-2 equipment then on hand at Orlando because of scheduled tests on projects with higher priority. It was believed VB-2 production could begin within 90 days after receipt of production version. Because of CBI's interest in securing 300 VB-2's a month, it was quite probable that a higher priority would be placed in order to expedite tests and get the missile into production.

136. (S) Ltr. 1 Feb. 1945
Fr: Col. D.C. Doubleday, Chief, Eng. Br., Mat. Div., OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
Attn: Asst for Tech. Matters Office, Chief of Adm.
(File: Central Files)

Eng. Br. asked that immediate action be taken to furnish India-Burma Theater with 65 aircraft installations (50 as requested and 15 as spares) for Azon operations, tools and test equipments, and 100% spare antennas. [TI-2003, Add. 17 covering the above items, was closed because required action had been accomplished.]

137. (S) Memo 5 Feb. 1945
Fr: Brig. Gen. E.M. Powers, Dep. AC/AS, M&S, Wash.
To: Budget & Fiscal Office, AAF, Wash.
(File: M&S)

Dep. AC/AS, M&S, pointed out the fact that no definite requirement could be established at that time because most guided missiles were rather new and research must be continued in order to complete the development. It was estimated that, other than research and development contracts, $100,000,000 would be required to cover guided missiles procurement for FY 1945; of that amount $17,000,000 would be used for VB-1, 2, 3 and 4's; in FY 1946, $18,000,000 of the estimated $150,000,000 was for procurement of VB-1, 2, 3 and 4's. Those figures include both Air Force and Signal Corps equipment; the bombs used were to be standard so no further procurement was necessary.

138. (U) Memo [approx. 10 Feb. 1945]
Fr: Maj. J.F. Vogel, Mat. Div., Wash.
For: Record
(File: M&S)

A meeting to set up a policy to be followed by Div. 5 of NDRC for its duration was held on 8 Feb. 1945. There were no provisions for NDRC's continuance after the war, but Div. 5 expected to continue those developments already started, to furnish control equipments to services, and to act in advisory capacity to the services. The activities of various groups in connection with NDRC projects were explained by Drs. Dryden, Grondahl, Mertz and Boyce. The Pittsburgh Project, under Dr. Grondahl's direction, included the Azon (VB-1 and VB-2); the VB-1 had given excellent

performance in CBI; AAF tests of VB-2 were scheduled to begin shortly and the possibility of shortening the VB-2 was under consideration.

139. (C) Memo Rpt. 13 Feb. 1945
TSEPL-3-673-52
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

NDRC and ATSC personnel visited Pinecastle Army Air base from 22 Nov. to 6 Feb. for purpose of deciding the modification needed in order to expand VB-2's possible uses. They finally concluded (1) that the B-17 would not accommodate any VB-2's of the original design, B-24 would take two in rear bomb bay only, one in B-25, and eight in B-29; (2) changes in overall dimensions and arrangement of parts would permit the bomb to be placed in either bomb bay of B-17 or B-24; (3) no great change in bomb's controllability was noticed in first drop of the new design; and (4) tail fuse and anemometer for arming purposes would not be affected by proposed changes contained in the Appendices to this report.

140. (S) R&R-2, 13 Feb. 1945
Fr: Col. D.C. Doubleday, Chief, Eng. Br., Mat. Div., OAC/AS, M&S, Wash.
To: Munitions and Missiles Unit, OAC/AS, OC&R, Wash.
(File: M&S)

Eng. Br. said the stock of VB-1 components had been frozen for 30 days. The quantities of gyros, servos, batteries and radio receivers on hand were listed; there were enough components, with exception of radio receivers and tail housing assemblies, to complete 5000 VB-1's. A restated requirement for VB-1's was to be submitted by OC&R; it was also necessary that Eng. Br. know whether that was just an interim requirement until the VB-3 was ready, or a supplement to the VB-3. By Comment #3, OC&R requested that 1000 VB-1 units be assembled.

141. (S) Ltr. 17 Feb. 1945
Fr: Lt. Col. H.M. Schwab, Adj. Gen., Hq., AAF, India-Burma Theater, APO #671
To: CG, Fourteenth Air Force, APO #627
(File: M&S)

Adj. Gen. in India-Burma Theater wrote Fourteenth Air Force describing the Azon (VB-1) and explaining its operation. He stated that individually operated single bombs produced best results because, when more than one was dropped at same time, the bombardier experienced difficulty controlling his own bomb because it was hard to observe it for the whole run. The height of flare ignition and control period had to be considered when determining the bombing altitude--average 10,000 feet. Electric jamming of the transmitter frequency and smoke pots were two enemy counter-measures to be expected. VB-1 missions from 27 Dec. through 7 Feb., during which time 103 bombs were expended, resulted in destruction of 13 bridges in that Theater.

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142. (C) Ltr. 19 Feb. 1945
Fr: 1st Lt. J.S. Capps, AAF Tactical Cen., Pinecastle Army Air Field, Pinecastle, Fla.
To: Dir., ATSC, WF
Attn: Capt. J.H. Evans, Special Weapons Br., Equip. Lab.
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Equip. Lab. was informed that 8 modified VB-2's had been dropped individually to determine maximum available control, and also to try and hit line targets. Maximum available control was 1100 - 1800 feet from 15,000 foot altitude; control appeared to be quite good. Other tests were scheduled for a later date.

143. (C) 2nd Ind. 21 Feb. 1945
Fr: Col. G.V. Holloman, Chief, Equip. Lab., Eng. Div., WF
To: CG, AAF, Wash.
Attn: Air Ord. Officer, OAC/AS, M&S
(File: Central Files)

Equip. Lab. informed Air Ord. Officer that modification of T6E1, T7E1, and T8E1 flares would present some difficulties, but mechanical means of ignition should be incorporated in future flares. Military characteristics including candlepower, maximum dimensions of flare minus arming device, general shape, maximum altitude for ignition, distinctive colors, type ignition, delay before ignition and minimum burning time were outlined. Detailed information on development of an electrical ignition for use with an air arming device was also contained in this Ind.

144. (C) Memo 1 March 1945
Fr: H.H. Spencer, Chief, Div. 5 of NDRC, MIT, Cambridge, Mass.
To: Div. Personnel and Liaison Officers
(File: Central Files)

Chief, Div. 5 of NDRC, quoted from report sent by Mr. T.J. O'Donnell on activities in the India-Burma Theater concerning the Azon project. Mr. O'Donnell said Commander of Strategic Air Force, who assigned missions and targets to 7th Bomb Group (to which Azon had been assigned), was very much interested in use of Azon. The targets were for the most part Jap lines of communication (particularly the Burma-Thailand railroad and bridges). The 7th Bomb Group had little faith in the Azon at first because of previous disappointments with other new projects, but after considerable talking a group was finally organized and placed in operation. Seven missions were run, 154 bombs expended, and 14 bridges destroyed; a number of the 154 bombs were wasted for various reasons but at least 35 made direct hits; that figured approximately 1 hit out of every 5 bombs dropped, while an optimistic guess for standard bombing of bridges in that Theater was 1 out of 50.

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"On this basis conservative for AZON, optimistic for standard bombing, AZON is ton times as effective against bridges as standard bombing or one AZON squadron is equivalent to two and a half standard groups." After the successful mission, the whole Theater as well as the 7th Bomb Group became enthusiastic about the whole project; it was requested that following shipment of equipment be made so more bombing missions could be run before the monsoon season (May): 1 maintenance team, test equipment, tools, modification kits; also, 700 VB-1's and 300 VB-2's each month. The VB-2's were not to be produced, however, unless that requirement was increased.

145. (S) Memo 2 March 1945
Fr: Brig. Gen. W.F. McKee, Actg. AC/AS, OC&R, Wash.
To: AC/AS, M&S, Wash.
(File: M&S)

OC&R reminded M&S that a survey of controlled missiles field had been made; it was found that lack of military characteristics and requirements had hindered the development of those missiles; therefore, OC&R had established pertinent characteristics which would be forwarded to M&S in the near future. It was pointed out that the missiles should have the following qualifications: be suitable for all-weather use, especially for bad weather; be designed to be carried inside aircraft; have target-seeking controls whenever possible; and be suitable for multiple release and control. OC&R recommended further development of Azon VB-1 bomb to be used in connection with the Spazon; the Azon VB-2 was expected to be used for tactical purposes.

146. (C) Memo 8 March 1945
Fr: Brig. Gen. L.W. Miller, Chief, Budget & Fiscal Office, Wash.
To: Budget Officer for War Dept., Wash.
Attn: Lt. Col. McConahay
(File: M&S)

Chief, Budget & Fiscal Office, submitted data on amount set up for research and development of guided missiles during the FY 1946, as follows:

Fundamental Research	None
Development	$4,503,000
NDRC	None
Research Board for Natl. Security	$50,000

[redacted]

147. (C) Ltr. 9 March 1945
Fr: Col. G.V. Holloman, Chief, Equip. Lab., Eng. Div., WF
To: CG, AAF, Wash.
Attn: Maj. J.F. Vogel, Eng. Br., Mat. Div., M&S
(File: Central Files)

Equip. Lab. stated that 140 of the requested 200 VB-1 tail assemblies were available for reallocation to Fort Dix for training purposes. Three hundred sixty had been allotted to Equip. Lab. for Spazon tests; 20 of those had been expended, and 200 were needed for further tests up to middle of April.

148. (S) 1st Ind. 10 March 1945
Fr: Maj. Gen. C.L. Chennault, CG, Fourteenth Air Force, APO #627
To: CG, Hq. AAF, India-Burma Theater, APO # 671
(File: M&S)

Gen. Chennault, Fourteenth Air Force, repeated a requirement in that Theater for three replacement planes modified with complete Azon equipment, and for 150 Azon tails (VB-1) for tests. He expressed appreciation for assistance of India-Burma personnel in the development and felt it would result in successful operations "against the Japanese by the Fourteenth Air Force." Further requirements of Azon would be furnished upon completion of tests.

149. (C) TT 10 March 1945
Fr: Col. H.A. Shepard, Actg. Chief, Prod. Sec. WF
To: CG, AAF, Wash.
Attn: AC/AS, M&S, Eng. Br.
(File: Central Files)

Prod. Sec. advised Eng. Br. that procurement had been initiated for 500 Azon bomb tails to be delivered in June and 500 in July 1945; another 2500-3000, with deliveries beginning 500 in Aug. and continuing at that rate, were expected to be produced from available components and a few additional items. Those servo motors and gyros used on Razon would be replaced by a new procurement for Azon. Ord. Sec. had advised of availability of red, green and white flares--green was undesirable, so information on quantity and color needed for Azon was requested. See attached CTI-2003, Add. 22 dated 2 March 1945.

150. (S) IDM 12 March 1945
Fr: V.A.S. (Maj. V.A. Stace, OAC/AS. M&S, Wash.)
For: Record
(File: M&S)

Maj. Stace, M&S, wrote that favorable tests of the 2000 pound Azon (VB-2) had been made by AAF Board; 2 of the 20 bombs dropped failed due to antenna trouble. OC&R was awaiting report of the completed tests before initiating procurement.

[redacted]

151. (S) Operations Analysis Rpt.
21 March 1945
(File: M&S)

All Azon-equipped B-24's of the 7th Bomb Group (India-Burma Theater) were concentrated in the 493d Squadron. Difficulties were encountered in the way of dispersion of bombs when dropped in trains of four and of following the flight of bombs through an undercast, but ten to fifteen per cent of bombs dropped on bridges had been direct hits. It had been decided to try Azon equipment in P-38's acting as droopsnoot squadrons, the bombardier in the leading plane controlling the flight of bombs from the other planes.

152. (C) TI-2003, Add. 27
19 April 1945
Fr: Col. T.A. Sims,
Chief of Adm., WF
To: Supply Div., WF
(File: Central Files)

TI-2003, Add. 27, was issued 19 April 1945. Supply Div. was instructed to take action to assemble and ship the listed signal equipment, power supply, special Azon equipment and tools to the India-Burma Theater in time to meet the deadline of 1 May 1945. Authority contained in letter dated 9 April from Chief, Comm, Equip. Sec., M&S, Wash.

153. (C) R&R-1, 21 April 1945
Fr: Col. S.R. Stewart,
Chief, Equip. Lab.,
Eng. Div., WF
To: Electrical Br., Prod.
Sec., Proc. Div., WF
Attn: Mr. Stevison
(File: Vertical Bomb Unit,
Special Weapons Br.,
Equip. Lab.)

Equip. Lab. urged expeditious delivery of 410 type S relays which were necessary for modification of VB-1 radio controlled bombs. It was desired that those missiles be returned to combat as soon as was possible.

154. (C) Ltr. 30 April 1945
Fr: Col. H.Y. Smith, Chief,
Eng. Standards Sec.,
Eng. Div., WF
To: Pres., AAF Board,
Orlando, Fla.
Attn: Lt. Col. E.R. Tash
(File: Central Files)

AAF Board was requested to furnish 10 VB-2 tail fin assemblies, either original or shortened version, to WF for modification and drop tests. The drop tests were to be made in order to check reliability of operation of the VB-2 units, which incorporated AN/CRM-7 radio receivers, before the articles were released for combat use.

[redacted]

155. (C) Ltr. 1 May 1945
Fr: A.J. Wollan, Tech. Aide, Sec. 5.2, NDRC, Wendover Field, Utah
To: Div., ATSC, WF
Attn: Capt. J. H. Evans, Special Weapons Br., Equip. Lab.
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

Tech. Aide, Sec. 5.2 of NDRC, was very much in favor of getting the 16mm movie camera into combat use with Azon. Suggestions for formation of a photographic unit for 7th Bomb Group, Tenth Air Force, were submitted for Special Weapons Br. consideration. In the first Azon combat planes, GSAP cameras had been used with little success. Movies taken of those first missions in CBI were ruined due to inexperienced personnel, poor development facilities and lack of film; so, unless better conditions could be provided, it was useless to attempt getting movies of the Azon missions.

156. (C) Memo Rpt. 5 May 1945, TSEPL-3-673-A-4
(File: Vertical Bomb Unit, Special Weapons Br., Equip. Lab.)

The purpose of the vertical bomb development was to design a bomb which could be controlled in its drop and thus correct common sighting errors. It had been originally intended that the bomb be controllable in range and azimuth but first an attempt at one-axis control had to be made and the 1000 pound VB-1 was the result. The VB-1 was entered in standard classification on 21 April 1945. Since development was completed and the bomb considered satisfactory for combat use, action has been initiated to close E.O. #673-21, as recommended.

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November 14, 1941

Dr. J.G. Trump
Technical Aide, Division D
National Defense Research Committee
1530 P Street, N.W.
Washington, D.C.

Re: Army Project No. AC-1

Dear Dr. Trump:

As you know, Section E of Division A has been engaged with RCA in the development of aerial torpedoes (dirigible bombs) which are winged bombs with control surfaces actuated from the bombing plane, through a radio connection, in accordance with television intelligence transmitted from a pickup on the bomb to a receiver in the plane. Division D is pushing similar developments along somewhat different lines.

Army Project No. AC-1 was referred to this Division last March by Dr. Stewart. After consultation with Air Corps Liaison Officers, we returned it to Dr. Stewart under date of March 10 with the comment that none of the activities of Division A came under this project. It has come to our attention, however, that work by both Divisions D and A of the nature indicated above is carried on the records of Dr. Stewart, Colonel Dix, and Major Chidlaw under Project No. AC-1.

Following is the description given for AC-1:

> "The investigation of means and methods of a solution to the problem of precision bombing while flying above or in an overcast. This problem involves an investigation of means and methods of precise airplane orientation without visual reference to the ground."

I have discussed this description, and the anomalous situation of the preceding paragraph with Lieutenant Powers, assistant to Colonel Dix. He advised me to contact the Air Corps Liaison Officers and, if necessary, work out with them a description of a project which would more accurately cover work on dirigible bombs. Captain William Brown, of Major B.W. Chidlaw's Experimental Engineering Section, Office of the Chief of Air Corps, agrees that the description given above for AC-1 is meant to apply only to methods of precision bombing with conventional

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bombs. That is, the description calls for the development of non-visual means of contact with the ground and/or a non-visual bomb-sight rather than for development of control gear on bombs. It is clear that while our developments of television directed bombs may represent a way around this problem, they are definitely not solutions of the problem described by AC-1.

This situation is undesirable for three reasons, as follows:

1. No work is being done on the problem given;

2. The records show incorrectly that work is being done on the problem;

3. The work which is being done on dirigible bombs is not properly covered by an Army Project.

Captain Brown agrees that corrective action should be taken. He has written to Major Holloman at Wright Field to call his attention to the situation. He suggested that if Divisions D and A would write up a project description which would accurately describe our work on television bombs, the Air Corps would very probably accept it.

Since reports and correspondence on the television bomb project are already entered under AC-1 on the records of several offices, it appears desirable to retain this number, and to write a new description, if this procedure is acceptable to the Air Corps. A new number would be then assigned by the Air Corps to the description now designated AC-1.

For the new description I would suggest the following:

> AC-1 Controlled Trajectory Bombs
> Development of devices which will enable the bombardier to control the direction of fall of a bomb during its flight, and of devices to indicate to him the need for and effect of such control.

Additional information as to operating conditions and restrictions might be supplied by the Air Corps. I shall appreciate it if you will let me know if you find this description satisfactory, or suggest another which better fits the work of Division D, in order that we may relieve the present confused state of the records.

Sincerely yours,

EBB

E.B. Bradford
Technical Aide
Division A

CC Major B.W. Chidlaw
Capt. Wm. Brown
Major G.V. Holloman
Dr. Irvin Stewart
Lt. Col. H.W. Dick
Dr. H.L. Dryden
EBB:al A. Ellett

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December 30th, 1941

AC-36 Controlled Trajectory Bombs

Brig. Gen. G.M. Barnes, Ordnance,
War Department Liaison Officer,
National Defense Research Committee,
Social Security Bldg., Washington, D.C.
(Thru: The Adjutant General)

1. It is requested that the following project be submitted for consideration to the National Defense Research Committee:

a. AC-36 Controlled Trajectory Bombs
Development of devices which will enable the bombardier to control the direction of fall of a bomb during its flight, and of devices to indicate to him the need for and effect of such control. (4-E-3)
MPB:lgs

2. Research on controlled trajectory bombs has been carried on by the National Defense Research Committee under AC-1. Mr. [illegible] Bradford, Technical Aide, Division A, in a letter dated Nov. 14th, 1941 to Dr. J.C. Hunsaker, Technical Aide, Division B, called attention to the fact that AC-1 as stated, did not cover controlled trajectory bombs.

3. Research on precision bombing should be carried on under AC-1, as it is now stated. Any research on controlled trajectory bombs should be transferred to AC-36.

B.F. SNIDLAR, LT. COL., A.C.
Air Corps Representative
National Defense Research Committee

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(AR 11-30)

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Experimental Engineering
Materiel Division, OCAC

2

AC-266-A-WF-6-27-41-60M

CONFIDENTIAL

WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

MEMORANDUM REPORT ON

WRD:ms:54:212

Date
May 2, 1942

SUBJECT: Controllable Bomb, High Angle.

SECTION Experimental Engineering

SERIAL No. EXP-M-~~42~~-673-16

Contract No.
Expenditure Order No. 673-1-21
Purchase Order No.

A. Purpose.

To report on the flight testing of the National Defense Research Council high angle, controllable bomb at Eglin Field, Valparaiso, Florida.

B. Factual Data.

1. Drop tests of the National Defense Research Council type high angle controllable bomb were conducted at Eglin Field, Florida from April 19, 1942 to April 23, 1942 inclusive.

2. Four experimental units were flight tested. All four units were of the same type. The drop tests were made from a B-23 type airplane, flying at an altitude of 13,000 ft. at an indicated speed of 150 m.p.h. The gross weight of each unit was 380 pounds. The bombs were equipped with moving picture cameras located in the nose of the bomb. The purpose of this camera was to record the position of the controls, the time and the relative position of the ground target. This information was needed in order to prove the effectiveness of the controls. Each test consisted of different pre-set control movements. The controls were actuated by electric motor servos.

3. From the air it was possible to observe the maneuvers of the bomb for a short period of time. The bomb responded to the controls according to the pre-set sequence in two of the four tests. Difficulty in observation was encountered on the remaining two tests due to an inherent roll caused by fabrication imperfections which changed the lateral trim. The bomb was extremely sensitive to roll so these slight imperfections caused a slow rolling motion about the longitudinal axis of the bomb.

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Experimental Engineering Section
Memorandum Report No. EXP-M-94-673-16
May 2, 1942.

4. Those present at the tests were:

Materiel Center	National Defense Research Council
Capt. P. F. Helmick	Dr. E. A. Eckhardt
Capt. R. W. Gustafson	Dr. L. O. Grondahl
Mr. W. M. Darling	Dr. J. P. Molnar
Mr. E. A. Knox	Dr. C. F. Squire
	Prof. H. Mueller

Gulf Research & Development Co.

Mr. T. B. Pepper
Mr. C. A. Gustavason

C. Conclusions.

1. That it was possible to control the trajectory of the bomb.

2. That conclusive data on the quantitative success of these tests awaits the development and study of the film from the bomb cameras.

D. Recommendations.

1. That pending a successful outcome of the study of the bomb camera film, further testing of the National Defense Research Council controllable bomb, high angle type, should be made with radio and television equipment in order to establish the tactical value of this weapon.

FWA 13 1945 15 23 bW

W. M. DARLING

RANDOLPH F. WILLIAMS, Col.A.C.
Equipment Laboratory

F. O. CARROLL, Colonel, A.C.
Chief, Exp. Engrg. Section.

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C.G.AAF.M.C., Att: Exec.
Central Files

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WAR DEPARTMENT
WAR DEPARTMENT GENERAL STAFF
SUPPLY DIVISION, G-4
WASHINGTON, D.C.

May 15, 1942.

MEMORANDUM FOR MATERIEL COMMAND,
ARMY AIR FORCES:

Attention: Experimental Engineering Section.

Subject: Controlled Missiles.

It is desired that the information required by the attached correspondence, together with such comments as you desire to make on the subjects as presented by Doctor Bush, be furnished this office at the earliest practicable date and not later than May 21, 1942.

Earl S. Hoag

EARL S. HOAG,
Colonel, General Staff Corps.

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THE JOINT CHIEFS OF STAFF

Washington

May 13, 1942

MEMORANDUM FOR BRIGADIER GENERAL R. G. MOSES

Subject: Controlled Missiles Project

1. In accordance with the directive of the Committee, there is attached hereto the classification of controlled missiles prepared by Dr. Bush and furnished to you as agreed at the meeting of May 12.

2. It is requested that the following information be obtained with regard to the items contained therein on which the Army has projects in progress.

a. A prompt summary of the status of the projects.

b. A statement as to the advantages and disadvantages, and defense of the particular approach to solution.

c. The results of any tests that have been made to date.

d. An estimate as to the time of completion of development to the point where procurement could be undertaken.

e. An estimate of what can be done to accelerate that date of completion.

3. The Committee desires that this information be in the hands of the Secretary, if possible, before Sunday, May 17.

4. The next meeting of the Committee is scheduled for 9:40 a.m. May 19, 1942.

1 Incl:
Cpy "Controlled Missiles"

(Signed) H. L. CLARK
H. L. CLARK,
Secretary.

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CONTROLLED MISSILES

Classification of controlled missiles, that is of bombs or torpedoes in which the trajectory is modified after launching or release.

Controlled fuses, such as the pulse-type proximity fuse, are omitted, since the instant of burst, not the trajectory, is controlled.

Also omitted are such devices as combinations of ASV and bomb-sight, for bombing through overcast, since there is here no trajectory control.

Classification is possible on the basis of the nature of the missile, the form of remote control, and the physical basis for control information, and in the following the nature of the missile is made the primary base.

I. Marine Torpedoes.

a. Automatic homing.

1. Acoustic.

This becomes important where the noise of a launching ship is avoided. Launching from planes or blimps against submarines is primarily considered, but other applications are possible.

Being developed by Section C-4 of NDRC, and Bureau of Ordnance of Navy. Tests possible in a few months.

2. Magnetic, etc. Not interesting.

b. Remote control.

1. By sound pulses, etc. Not apparently being followed up.

II. Robot planes, with motors.

a. Automatic homing.

Many suggestions of this, with acoustic or radar controls. None has so far appeared attractive.

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b. Remote radio control.

1. Viewed from ground or another plane. Well developed as drones for target purposes. As bomb-carrying devices, in this form, of apparently limited utility. Kettering development seems to be in this class at present, as possible added features not determined.

2. Carrying television for information of operator in guiding. Development well advanced in Navy as bomb-carrying device. Separate elements, such as radio control, television equipment, well in hand, at least for take-off, landing, and moderate maneuvers. This equipment may take different forms, according to method of use, as follows:

(1) Take-off from land or ship.

(2) Initially towed as gliders and released near target.

(3) Carrying marine torpedoes instead of bomb.

III. Robot gliders, no motors.

a. Automatic homing. Of less interest than corresponding class IIa.

b. Remote radio control.

1. Including television. Being developed by Division A, NDRC, in close liaison with Army. Radio control and television seem to be in hand. Model at 0.7 scale dynamically stable in recent tests, but glide path too steep and this now being corrected. Designed to be carried by plane (not towed as glider) and released near target. Development capable of being accelerated. Planned to carry bomb, not torpedo.

c. No control. The British apparently had experience with glider without remote controls for carrying marine torpedo. This apparently designed merely to increase torpedo range against large targets, and allow release from greater elevation. Wings detached on hitting water. Under gyro control both in air and water. All glider forms, and apparently some motor forms, need this stabilizing control, entirely apart from possible remote control. Present status not clear. Not strictly under present classification, but closely allied thereto.

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IV. Guided bombs. Steep angle bombs with minor modification of trajectory.

a. Homing devices. Not highly active. Proposal by Hammond for automatic control by thermal device against ships apparently being developed somewhat by him.

b. Remote radio control.

1. Including television. Being developed by Division D, NDRC, in liaison with Army and Navy. Separate parts well advanced, and development capable of being accelerated. Sufficient control of path seems to be in hand.

2. Combination with ASV. Since ASV can give relative position of target and bomb at all times, there is a possibility of providing corrections by radio control on basis of information from this source. This would omit television. It also allows use in fog, or at night without flares. Does not seem to be actively pursued.

NOTES:

1. Minor variations not included in above summary.

2. All devices listed subject to jamming or diversion in some manner. As enemy is probably active in this field, this aspect warrants attention.

3. Analysis of probabilities involved in performance has apparently not been approached generally.

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BWC/wc

May 21, 1942.

MEMORANDUM FOR: Colonel Earl S. Hoag,
G-4 Section,
General Staff.

SUBJECT: Controlled Missiles.

1. Attached hereto is a copy of Material Center Report covering historical resume of the Air Force Special Weapons program, as requested in your memorandum of May 15, 1942, and the Joint Chiefs of Staff memorandum of May 13, 1942, same subject, copies attached. This report is being transmitted in the First Indorsement form, in which it was received from the Material Center, and by special messenger in order to comply with the date set in your memorandum.

2. It might be noted that some of the projects are not listed in exact accordance with the summary as previously submitted by Dr. Bush, nor, likewise, are the Air Force views in exact agreement with those brought out in Bush's report.

Inclosures -
Memo.5/15/42 fr.G-4;
Memo.5/13/42 fr.Jnt.C's/S;
Resume,5/19/42 fr.M.C.,
T.T., (11 Pgs.)

C. P. EGNOLD,
Major General, USA,
Commanding General,
Material Command.

RET TO EXP ENGR SECTION AFAMC

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Directive from Joint Chiefs of Staff Reference
Report on Controlled Missiles Projects.

1st Ind. RFW:hc:54

Experimental Engineering Section, Wright Field. May 19, 1942.
To: Commanding General, AAF Materiel Command, Washington, D. C.

1. Reference is made to basic communication. The following report covering the items outlined in paragraph 2 a, b, c, d and e of directive memorandum is submitted:

a. Historical Resume -

(1) For several years the Materiel Center has been engaged in research and development leading to automatic flight and landing equipment, radio airplane targets, land borne and water borne remotely controlled bombing targets. These devices involved gyro stabilizing mechanisms and servo control equipment developed in the Instrument & Navigation and Special Weapons Units, Equipment Laboratory of this Office and radio controls developed by the Aircraft Radio Laboratory of this Office.

(2) The application of the radio controlled target as an offensive weapon has long been recognized. In 1918 Mr. Kettering experimented with such a non-man-carrying airplane with appreciable success. In 1941 ten articles of an improved version of this weapon were contracted for by the Materiel Center with the Research Laboratories Division of the General Motors Corp., of which Mr. Kettering is the President. This weapon will be described later.

(3) In the spring of 1941 the Materiel Center entered into a greatly expanded program of development and procurement of remotely controlled targets and weapons. This program was carefully coordinated with the United States Navy and Sections D-3 and Division A of the National Defense Research Committee, with a view to the elimination of duplication of effort and mutual assistance through exchange of information. A proper classification was determined for the various forms of controllable weapons. This nomenclature has been standardized and in use for over a year.

b. Special Weapons Program -

(1) Attached hereto, marked Exhibit "A", is the program of special weapons approved by the Commanding General, Army Air Forces to be developed for use by the Air Forces. Since this program was

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approved controlled glider bombs (explosive carrying gliders to be towed by controlling aircraft and released for attack against bombardment objectives) have been added to the special weapons projects. The nomenclature used in Exhibit "A" is that standardized in 1941 by the War and Navy Departments.

(2) At a conference held in the spring of 1941 between representatives of the Army and Navy, it was decided that the development of the glide torpedoes referred to in Exhibit "A" would be the responsibility of the Navy, although the wing structure of the glide bomb under Army development might be utilized by the Navy for glide torpedoes.

(3) In order to accelerate development the Materiel Center had previously requested Section D-3 of the National Defense Research Committee to investigate and develop the high angle controllable bomb referred to in Exhibit "A". To avoid duplication the Materiel Center has refrained from activity in this development other than to assist Section D-3 of the National Defense Research Committee in various ways, including flight testing the practice models.

c. Status of Army Program -

(1) Targets (Robot planes with motors)

(a) The type OQ-2A target is a 12 foot monoplane non-man-carrying designed for small arms antiaircraft firing practice. It has been standardized and is in production. This target is launched by catapult and landed by parachute. It attains an airspeed of approximately eighty-five miles per hour at 5,000 feet. It is controlled by radio and does not employ gyro stabilization. The performance characteristics of this item have been favorably received by the using Services. Actual firing has been conducted on this target by ground forces. Although standardized and in production minor changes are currently in progress to improve reliability.

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(b) The type PQ-8 target is a commercial monoplane adapted to target use by the installation of servo assemblies with three axis gyro stabilization and radio control equipment. This target operates at 116 M.P.H. at 13,500 feet and can be airchecked by a safety pilot. This target has been standardized and is in production. The control system has been simplified in operation to minimize the time of student pilot training. This target has been fired on by C.A.C. antiaircraft and has been found satisfactory with respect to controls. Its performance characteristics are less than desired insofar as speed and altitude are concerned, and for this reason service test quantities of improved types are being procured, designed as follows:

(1)	50 ea.	PQ-9,	capable of	200 MPH	at	17000	ft.
(2)	50 "	PQ-10,	" "	275 "	"	"	"
(3)	50 "	PQ-11,	" "	160 "	"	"	"
(4)	50 "	PQ-12,	" "	165 "	"	"	"

It is estimated that a radio controlled target capable of sufficient speed and altitude will be standardized during the current calendar year after completion of the service test of the above equipment.

(c) Control airplanes for the man-carrying targets are obtained through conversion of standard military aircraft.

(2) Controllable Bombs (High Angle)

(a) This type of equipment has been developed by Section D-3, National Defense Research Committee with the cooperation of the Special Weapons Unit, Equipment Laboratory of this Office. Numerous flight tests have been conducted at Eglin Field, Florida, to obtain data necessary for proper control. The information requested in basic communication should be obtained directly from Section D-3, National Defense Research Committee. During flight tests conducted at Eglin Field, Florida, usable control modifying the normal trajectory of the bombs was attained. It is understood that the next flight tests will incorporate the use of radio controls. The principal advantages of this form of special weapon are that it may be carried in the bomb bay of standard bombardment aircraft, and is practically immune to defensive fire during descent.

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1st Ind. to Commanding General,
AAF Materiel Command
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(3) Controllable Bombs, Glide, Preset Data

(a) This bomb, described in Item 10, Exhibit "A", is given highest priority of all special weapons by the Commanding General, Army Air Forces. To date thirty odd bombs have been dropped (many with radio control) to develop adequate stabilized flight. One thousand of these wing structures and control equipments are on order. Delivery is expected in about ninety days. Roughly seventy experimental models of 1000 and 2000 pound sizes and embodying low, mid and high wing types are on hand. Tests to date have been successfully conducted with two axis stabilization, and show the feasibility of this weapon in mass flat trajectory bombing attack. An advantage of this weapon is that standard bombs are utilized in conjunction with cheap, readily procured glide structures. The gyros and electric servos are also inexpensive and will be in mass production in sixty to ninety days. Another advantage is that there is no radio control to be jammed. The bomb can be used against targets within the operating range of the carrying bomber, reduced somewhat by the added drag of the glide bomb structure. An important advantage of this weapon is that it can be issued to existing bomber organizations for use without special pilot training in radio control. It is anticipated that final flight testing will be initiated in June 1942, to ascertain the improvement obtainable in directional accuracy through the use of directional gyroscopic control. Standardization of this item for mass procurement is expected in August 1942.

(b) A glide bomb is being developed by Division A, National Defense Research Committee, in connection with RCA. This Office has assisted by flight testing unstabilized models of this bomb. Although these flights were not successfully stabilized, it is understood that recent flight tests conducted through the cooperation of the Navy, utilizing gyro stabilization in roll and yaw (one gyro), resulted in stabilized flight.

(4) Controllable Bombs, Glide, Radio Controlled (Remote Control).

(a) As mentioned above, many of these bombs, described in Item 11, Exhibit "A", have been dropped equipped with stabilization and radio control. This version is intended to achieve greater precision by flight corrections indicated as necessary by television

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equipment. Flight testing has shown the inadequacy of visual remote control of this bomb in precision bombing. Modification of the flight path has been achieved by radio control. Testing with television equipment is planned in June 1942. Standardization of this item is expected within this calendar year. The advantage of this weapon over the power driven version is that radio silence can be maintained until the bomb is dropped. Disadvantages as opposed to the preset data glide bomb are that only a small number can be dropped simultaneously in one locality due to limited radio channels, and that a certain amount of radio control training must be given bombardiers.

(5) Controllable Bombs, Glide, Target Seeking (Automatic Homing).

(a) This bomb is described in item 12, Exhibit "A". The status of the target seeking devices is described later herein, including flight tests thereof in airplanes. Flight tests of target seeking equipment installed in glide bombs have not been performed. Advantages of these target seeking bombs include radio silence, greater security in immediate escape after the bomb is dropped and lack of need for radio control training.

(6) Controllable Glider Bombs

(a) This weapon consists of a gyro stabilized glider which will carry explosive, be towed by standard bombers and controlled by radio and television or by target seeking devices after release. Ten airframes of this type to carry a standard 2000 pound bomb have been purchased. The first article of this contract, less servo and radio equipment, was recently test flown under full load conditions at Muroc Lake. Equipment for radio controlled stabilized flight is expected within two weeks. Three glider structures designed to carry two 2000 pound bombs each are on order.

(b) The glider bomb was developed since all types of bombers (due to inadequate ground clearance) cannot carry the glide bomb. Radio silence can be maintained during the route out. The additional drag will decrease to a limited extent the range of the towing bombardment airplane.

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(7) Controllable Bomb, Power Driven, Ground Launched.

(a) This gyro stabilized weapon, as described in Items 13, 14 and 15, Exhibit "A", can be utilized with preset data, radio and television or target seeking controls. Various versions of this weapon have been procured or are on contract, as follows:

(1) Ten each from the Research Laboratories Division of the General Motors Corp.

These bombs are capable of carrying a 500 pound bomb load at 200 MPH for 400 miles. Seven of these have been tested. Stabilized flight and radio control has been achieved on five articles. Additional tests utilizing television equipment are planned within two weeks. Standardization of this item is anticipated during the summer or early fall of 1942.

(2) 50 each Type PQ-12 radio airplane targets on current contract with Fleetwings, Inc. will be delivered capable of carrying a 500 pound bomb 700 miles. Delivery of the first item is expected within thirty days.

(3) 65 each Type PQ-11 A radio airplane targets on current contract with Fletcher Aviation Corp. will be delivered capable of carrying a 1000 pound bomb 700 miles. Delivery of the first item, less servo and radio equipment, is expected within three days.

(4) Negotiations are being conducted with the Research Laboratories Division of the General Motors Corp. for two bimotored power driven bombs capable of carrying a 2000 pound bomb load 1000 miles at 150 MPH or better cruising speed. This bomb is non-man-carrying and both the engines and the airframe are designed for mass and economical production. This weapon is being procured to determine the feasibility of operation of the non-man-carrying type which of necessity cannot be flight checked prior to use. This has been accomplished in the single engine version, and results in substantial economy. The bimotored bomb is designed to break down into four parts for shipment, thus facilitating overseas movement. Delivery can be expected in six to nine months after the contract is awarded.

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May 19, 1942.

(5) Procurement has been initiated with Fleetwings, Inc. for two power driven bombs capable of carrying a 2000 pound bomb 1700 miles at 215 MPH at 17,000 feet. This bomb can carry one man for aircheck and is capable of being ferried minus explosive during daylight hours. Delivery of the first article can be expected within nine months from date of contract.

(6) Negotiations are in progress with Fairchild Aviation Corp. for two power driven bombs capable of carrying two 2000 pound or one 4000 pound bomb 1700 miles at 230 MPH at 15,000 feet. This bomb will carry one or two men for aircheck and ferrying. Delivery of the first article can be expected within six months of date of contract.

(7) It will be seen that the field of bomb loads from 500 to 4000 pounds and ranges from 400 to 1700 miles is spread by existing contracts or initiated procurement and negotiations. This has been done to cover the variations in tactical requirements in various theatres. It is planned to extend the bomb load to 8000 pounds or more as soon as possible.

(8) Controllable Bombs, Power Driven, Air Launched.

(a) These bombs, described in Items 17 and 18, Exhibit "A", can likewise be equipped with television and radio controls, or target seeking devices. The feasibility of this item has not been demonstrated. It is visualized for use against enemy aircraft. Development studies as to the aerodynamic structure, engine and control components have been in progress in the Laboratories of this Office for several months. Test models are planned for procurement during this calendar year.

(9) Radio Control Equipment.

(a) The development of many different types of radio control equipment has been carried on by the Aircraft Radio Laboratory of this Office since 1937. For the small radio targets this equipment is in production. This same type of equipment will be used for radio controlled glide bombs. Radio control equipment for large airplane targets is also in production. This type will be used in all versions of power driven bombs. Development continues with many different radio equipments with a view to increasing performance at lessened cost.

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(10) Television Equipment.

(a) A joint development program has been conducted by the Army and Navy with the RCA to obtain a suitable television equipment. Testing at Wright Field and recent tests by the Navy indicate the equipment to be well suited for the purpose intended. Seventeen transmitters with necessary receiving and monitoring equipment are on hand and will be tested in special weapons in the near future. An order has been placed for eighty additional equipments. To accelerate the production program a joint contract between the Army and the Navy has been initiated with RCA to tool the industry for a production rate of 250 equipments per month starting approximately January 1, 1943. Expansion of this program is understood to be capable of being readily effected by the RCA.

(11) Target Seeking Devices.

(a) These devices assume one of four forms, employing heat, sound, light or Radar methods. Progress on these items is as follows:

(1) Heat - Several versions have been constructed at the Materiel Center and are under test at Wright Field. These equipments are still in the experimental stage. Cooperating with the Materiel Center on these items are the Eppley Laboratories, Offner Laboratories, Edgerton Laboratories, Harvard University, Weston Electrical Instrument Co., Massachusetts Institute of Technology and numerous individuals. An additional research program on this type of equipment is being conducted by the Research Laboratories Division of General Motors Corp. Models have been built and tested on surface craft with promising results. Tests on aircraft will be initiated in the near future.

(2) Light - Versions of light sensitive devices are being developed experimentally at Wright Field. Cooperation is being furnished by scientific centers. One item developed by the Hammond Instrument Co. has been flight tested. Under favorable conditions this device has operated for a distance of eleven miles. Considerable work will be required before the apparatus could be practically applied to bombing. Contracts have been let to the Delco-Remy Corporation for experimental quantities of light sensitive equipment. Ground and flight testing has been accomplished on the latter during the past few months. Although the equipment warrants continued development its utility has not yet been proven.

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1st Ind. to Commanding General,
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May 19, 1942.

(3) Sound - Of many sound sensitive devices presented, only one item, proposed by the Pioneer Instrument Division of Bendix Aviation Corp. has warranted development. A contract has been let for five articles.

(4) Radar - At a recent conference with representatives of the Radiation Laboratories of the Massachusetts Institute of Technology, which includes members of Section D-1, National Defense Research Committee, this Office was informed that the Radar developments being carried on by that Laboratory had sufficiently advanced to warrant their immediate application to special weapons. To accelerate the program it is planned to make available on type PQ-8 airplane for test and to request Section D-1, National Defense Research Committee to expedite the development. Equipment suitable for flight test is expected to be available within thirty days.

2. Summarizing the progress to date:

a. Controllable glide bombs for mass stabilized flight attack should be standardized in August 1942.

b. Controllable glide bombs, radio and television controlled for precision bombing should be standardized during the present calendar year.

c. Controllable glider bombs are in the experimental flight stage. Further flights will be necessary to determine the feasibility of towing remotely controlled gliders.

d. Power driven controllable bombs, delivered, or in process of development, are of two types, single and bimotored, and vary in loads and range from 400 to 4000 pounds and from 400 to 1700 miles. A single engine version should be standardized for production if such is desired by the end of the calendar year. Bimotored experimental types will be delivered by the winter of 1942 - 1943. These bombs are designed to use controls similar to the other special weapons.

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May 19, 1942

e. Radio and television equipment is well developed. Target seeking devices are promising in some instances, but require further technical development and flight testing to determine tactical utility.

F. O. CARROLL,
Colonel, Air Corps,
Chief, Experimental
Engineering Section.

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1 Incl. #4 added -
Program - Exhibit "A"
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 Signature _____

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Quantico,
DC-36-5-31-17, 1947
R.L. DCG

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EXHIBIT "A"

A. CONTROL TARGETS FOR [illegible] TARGET. These targets are to be used for the [illegible] of the Navy. Large and special Radio Airplane Target.

B. [illegible] AIRPLANE TARGETS FOR [illegible] AIRPLANE TARGETS. [illegible] Airplane Targets required [illegible] the [illegible] which will be [illegible]

C. RADIO AIRPLANE TARGET, [illegible]. This development will include [illegible] design, and [illegible] methods employed in the type A-9 and type A-9A Radio Airplane Targets. An attempt will be made to [illegible] the performance and to reduce the initial cost and the maintenance problems in the field. This may require changes in the basic design of the target. The purpose of this target is to provide a controllable air target for small arms anti-aircraft practice. It is expected that the design will be simplified in such a manner that the target may be turned over to Ground Troops for operation and maintenance.

D. RADIO AIRPLANE TARGET, TYPE [illegible]. This development includes the procurement of [illegible] Airplane Targets from commercial manufacturers. These targets will be designed to meet specific military characteristics. An example of this type of target is the type A-8 now being built by the Culver Aircraft Corporation. It is planned to procure a [illegible] test quantity of the type A-9 targets which will have a speed of [illegible] at 17,000 ft. and a service test quantity of type [illegible] targets, [illegible] will have a speed of [illegible] mph at 17,000 ft. This is necessary in order that the targets may approach the performance of the present day military aircraft.

E. RADIO AIRPLANE TARGET, SPECIAL. This development will include the conversion of military airplanes of present design such as the T-33 and B-11. This will include the development of means of actuating the various control surfaces in response to the command from the radio control equipment. The purpose of the development is to continue certain phases of the flight test, (such as pull outs), fire control studies, and other uses and tests of these airplanes which would be impractical with personnel aboard.

6. [illegible] LABL NOTHING PRESENT DATA. [illegible]

RADIO AIRPLANE TARGETS

TARGETS

EXHIBIT "A"

RADIO AIRPLANE TARGETS

SPECIAL WEAPONS

control equipment to be installed in a commercial truck chassis. This will permit this truck to be used as a prime mover to pull target trailers over a pre-set course. This type of equipment may be used for bombing practice on dry lake surfaces, such as is found on Muroc and Rosamond and in the Salt Lake area. This control equipment will be of a pre-set nature by which the target will be made to follow any desired pre-set track.

XX-102

7. TARGET, LAND BORNE, RADIO CONTROLLED. This development will be similar to that described in paragraph 6 above, except that radio control will be provided by which the land borne target may be directed from a controlling ground station or a controlling airplane over any desired track rather than over a pre-set track.

XX-103

8. CONTROLLABLE BOMB, HIGH ANGLE, RADIO CONTROLLED. This development will provide a bomb similar in appearance to the tactical bombs now used by the Air Corps. This bomb may be carried in the bomb bay of any of the new standard bombardment aircraft. It will be provided with radio control equipment by which small changes may be made in the trajectory of the bomb by the controlling bombardier. It is hoped that it may also be equipped with television or radio sighting equipment by which the controlling bombardier will be made aware of the changes necessary in the trajectory of the bomb to increase its accuracy.

XX-104

9. CONTROLLABLE BOMB, HIGH ANGLE, TARGET SEEKING. This development will provide an article similar to that described in paragraph 8 above, except that no television, radio sighting or radio control equipment will be provided. There will be substituted therefor, a heat, light or radio detection and directing equipment which will be connected directly to the servo mechanisms of the bomb in such a manner that the bomb will seek the source of the sound, heat, light or the object from which the radio reflections are being obtained.

XX-105

10. CONTROLLABLE BOMB, GLIDE, PRE-SET DATA. This development will lead to equipment which will consist of a wing structure which may be attached to a standard 1000 and/or 2000 lb. bomb. The wing structure will contain the necessary servo control mechanism and a stabilizing gyro. This bomb, with special sighting equipment, may be dropped from relatively long distances from the target and it will then glide toward its target. It is anticipated that this bomb may be made to glide at a minimum angle of about 1 to 5.

XX-106

11. CONTROLLABLE BOMB, GLIDE, RADIO CONTROLLED. This development is a combination of that described in paragraph 10 above, except that radio control equipment will be installed, by which the range and deflection of the glide bomb may be changed remotely by the controlling bombardier. This bomb may also be equipped with television or radio sighting equipment by which the controlling bombardier will be made aware of the changes necessary in range or deflection to increase the accuracy of the bomb.

LAND BORNE

HIGH ANGLE

CONTROLLABLE BOMB GLIDE

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GLIDE TORPEDO MISCELLANEOUS EQUIPMENT

18. CONTROLLABLE BOMB, POWER DRIVE, AIR LAUNCHED, TARGET SEEKING. This development will lead to a [illegible] similar to that described in paragraph 15 above, except that it will be specifically designed for release from aircraft instead of being launched from the ground.

MX-54

19. GLIDE TORPEDO, PRE-HIT DATA. This development is similar to that described in paragraph 10 above, except that a standard Naval torpedo will replace the bomb in the wing structure.

MX-55

20. GLIDE TORPEDO, RADIO CONTROLLED. This development is similar to that described in paragraph 11 above, except that a standard Naval torpedo will replace the bomb in the wing structure.

MX-56

21. GLIDE TORPEDO, TARGET SEEKING. This development is similar to that described in paragraph 12 above, except that a standard Naval torpedo will replace the bomb in the wing structure.

MX-57

22. MISCELLANEOUS EQUIPMENT, MISCELLANEOUS ITEMS. This provides for the investigation of ideas submitted by private individuals and organizations outside the Materiel Division. With a program having the scope covered in this outline, it will be necessary to construct, and purchase models for test of some of the ideas submitted. In the past a great number of ideas, which were considered logical, have been submitted which have direct bearing on the various projects listed hereon, but due to the lack of available funds, development was not initiated on these items.

23. MISCELLANEOUS EQUIPMENT, BOMB SIGHTS. The tactical use of controllable bombs and glide torpedoes, described above may require a modification of the present bomb sighting equipment or the development of new equipment in order that increased accuracy may be obtained.

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INTER-OFFICE MEMORANDUM

WAR DEPARTMENT, AIR CORPS
Office, Assistant Chief
Materiel Division

GVH:AN:ms:54
Wright Field, Dayton, Ohio

Date May 26, 1942

TO: Director, Aircraft Radio Laboratory, Wright Field.

SUBJECT: Television

1. Section D-3 of the National Defense Research Committee has been engaged during the past year in developing a high angle controllable bomb. The development of this project has now reached the stage in which radio control equipment will be incorporated in the bomb for drop tests. Immediately following these tests television equipment will be installed. The above mentioned Section wishes to use one of the available Army television equipments. Due to the fact that certain changes must be made to adapt this television equipment to the high angle bomb it is felt that one of the sets which is still at the R.C.A. plant in Camden, New Jersey, should be allocated for this purpose in order that the necessary changes may be made at that plant.

2. It is therefore requested that one of the television sets now at the R.C.A. plant be allocated to Section D-3 of the National Defense Research Committee of which Dr. George R. Harrison, Massachusetts Institute of Technology, Cambridge, Massachusetts is Chairman. It is further requested that R.C.A. be advised as to this allocation and requested to cooperate with the above Section in making the necessary changes.

3. It is understood that Section D-3 will furnish any funds which may be necessary to accomplish these changes.

4. Your comments as to the above plans are requested.

J. W. MUSSEN, Maj. A. C.
FOR F. O. CARROLL,
Colonel, Air Corps,
Chief, Experimental
Engineering Section.

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JUN 18 1942

National Defense Research Committee,
Section S-1,
Massachusetts Institute of Technology,
Cambridge, Mass.

Attention: Professor G.B. Harrison, Chairman

Gentlemen:

During a telephone conversation with a member of your Committee, it was learned that your Committee has obtained approval for an expanded program to accelerate the progress of Army Project SC-38. Further, it was learned that the Gulf Research and Development Laboratory, which has conducted a great amount of the testing as well as fabrication of equipment for this project, is contemplating constructing two buildings at their own expense for the expanded prosecution of this project.

In order to aid the Gulf Research and Development Laboratory in obtaining priorities on the materials needed for their buildings, it is requested that that organization forward to this office on priorities form PD-200 a list of critical materials needed for the buildings necessary for this project.

Very truly yours,

W. P. BROWNE
Capt., Air Corps
Asst. Executive
Material Command

Experimental Engineering
Material Divisions 1942

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

MEMORANDUM REPORT ON

Date July 21, 1942

SUBJECT: Controllable High Angle Bomb Project MX-229.

SECTION Experimental Engineering

SERIAL No. EXP-[illegible]-84-[illegible]-10 A

Contract No.
Expenditure Order No. [illegible]-21
Purchase Order No.

A. Purpose.

1. To report tests of Controllable High Angle bombs by the National Defense Research Committee, Section D-3 at the Aberdeen Proving Grounds, Maryland.

B. Factual Data.

1. Tests of the Controllable High Angle bombs were started on July 8, 1942. The bombs were dropped from a type B-24D airplane.

2. The types of bombs tested were as follows:

a. Ten (10) sand loaded (100 lb) practice bombs equipped with flares and dropped from high altitudes to test visual observation of fall paths.

b. One (1) small (100 lb) bomb equipped with a camera in the nose and a gyro for stabilization in the axis of spin, dropped from 5000 feet altitude.

c. Two (2) large (400 lb) bombs equipped with cameras in the nose, gyros for stabilization in the axis of spin, tail flares, and recovery parachutes for the cameras. One bomb was equipped with the elevator streamlined, the second with the elevator fixed at a predetermined angle for a dive path. The bombs were dropped from 15,000' altitude.

d. Two (2) large (500 lb) bombs equipped with television and radio controlled solenoids which actuated the ailerons and elevators. Two (2) television receivers were installed in the B-24 airplane, one to provide the image for visual observation by the operator of the radio controls and the other to provide an image which was photographed by a moving picture camera. These bombs were not dropped because the television equipment would not operate satisfactorily. It is anticipated that these units will be tested in the near future

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3. Present at the tests were:

Materiel Center

Colonel J. S. Mills
Lt. Colonel J. E. Davis
Captain J. M. Pomykata

Massachuttes Inst. of Technology

Dr. C. F. Squire
Dr. R. C. Lord
Professor S. F. Warren
Mr. N. J. Oliver
Mr. W. Mallenbach

N. D. R. C. Section D-3

Dr. L. O. Grondahl

Gulf Research Corporation

Dr. J. P. Molnar
Mr. R. D. Wyckoff
Mr. T. B. Pepper

Hazeltine Corporation

Mr. A. V. Lovghren
Mr. J. A. Rado
Mr. J. A. Hansen
Mr. R. Janson

C. Conclusions.

1. That the results of the tests cannot be fully determined until the pictures taken from the bombs in flight have been developed.

2. That information as to the progress and results of the N. D. R. C. Controllable High Angle bomb tests at this stage of development can best be obtained from photographic records of the N. D. R. C.

D. Recommendations.

1. That no Materiel Center Personnel be sent to observe Controllable High Angle bomb tests until the subject bomb development has reached the point where its effectiveness can be demonstrated unless the presence of such personnel would aid in carrying out the tests as the Materiel Center

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CONFIDENTIAL

Experimental Engineering Section
Memorandum Report No. EXP-M-54-673-16 A
July 31, 1942

is extremely interested in this project and desires to cooperate to the fullest extent possible in its development. At the present time very little information is gained by observing the present tests and the results and progress of the experiments can best be shown by the moving pictures taken by the camera in the nose of the bombs.

J. M. KONYKATA, Capt. A. C.

for W P Lester
G. V. HOLLOWAY, Col. A. C.
Equipment Laboratory

M. Hayward
P. O. CARROLL, Col. A. C.
Chief, Exp. Engrg. Section

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MX-225

Tech. Staff
Chief of Staff, AAF Mat.Com.
Central Files
N. D. R. C. Section D-3 N.D.R.C. Liaison, E.S.S.

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MDAC-266-A-WF-6-27-41-60M

CONFIDENTIAL

10

WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

MEMORANDUM REPORT ON

Date August [illegible], 1942

SUBJECT: Tests of High Angle Controllable Bombs

SECTION Experimental Engineering

SERIAL No. [illegible]

Contract No.
Expenditure Order No. [illegible]
Purchase Order No.

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OTHERS

A. Purpose:

To report on drop tests of controllable high angle bombs conducted by the National Defense Research Committee, Section D-3 at Eglin Field, Florida.

B. Factual Data:

1. Drop tests of the controllable high angle bombs were conducted at Eglin Field, Florida on July 16, 1942 and July 17, 1942.

2. Two bombs were dropped. (See attached exhibit I.)

3. Present at the tests were:

Material Center	NDRC Section D-3
Lieut. N. N. Zimmerman	Mr. F. W. Cronkhl
Gulf Research and Development Corporation	Massachusetts Institute of Technology
Dr. J. P. Wolner	Mr. [illegible] Squire
Hazeltine Service Corporation	
Mr. A. C. Burhen	
Mr. J. A. Kado	
Mr. J. A. Hansen	
Mr. H. G. Jensen	

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C. Conclusions:

1. That the television equipment as used on these bombs was not satisfactory.

2. That the effectiveness of the radio control apparatus and mechanical controls in the bomb will be determined by moving pictures taken from the airplane.

D. Recommendations:

1. That further tests of the controllable high angle bomb be conducted using the direct sight method of control rather than television sight.

M. H. Zimmerman
M. H. ZIMMERMAN, 2nd Lt. A.C.

G. V. KOLLOMAN, Col. A.C.
Equipment Laboratory

F. O. CARROLL, Col. A.C.
Chief Exp. Engrg. Section

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Tech. Staff
Chief of Staff AAF Materiel Command
Central Files

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F.G
AC-36

INTER-OFFICE MEMORANDUM

WAR DEPARTMENT, AIR CORPS
Office, Assistant Chief
Materiel Division

DS/beg/50

[redacted]

Wright Field, Dayton, Ohio
Date November 26, 1942

TO: Commanding General, Materiel Command,
Headquarters Army Air Forces,
Washington, D. C.
(Att: Ass't. Chief of Staff (E))

SUBJECT: NDRC Project AC-36.

1. Reference is made to your IDM dated November 18, 1942, forwarding information on glide bombs being developed by the NDRC.

2. The project is mentioned as AC-36, however, it is believed that no development of glide bombs has been requested by the Materiel Center in this project. AC-36 was to deal only with high angle controllable bombs as are being developed by Section D of the NDRC. The glide bomb being developed by Section A of the NDRC is not considered vital since the Materiel Center has already developed this type of bomb to the point of standardization.

3. It is therefore believed that all effort should be made to develop the high angle bomb even to the extent of dropping the glide bomb development. It is also believed that it should be made clear that the Army Air Forces is not interested in the glide bomb.

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Experimental
Engineering Section.

cc - Equipment Laboratory, Wright Field.

[redacted]

Signature.....

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ADDRESS REPLY TO
HEADQUARTERS OF THE ARMY AIR FORCES
WAR DEPARTMENT
WASHINGTON, D. C.

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

January 2, 1943

SUBJECT: [illegible]

TO: [illegible]

SECRET
By Authority of
The Commanding General
Army Air Forces
AFHQM
1/4/43
Date Certificate

Inter. S.
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J. Advoc.
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Adj. Gen.
Ltr. Pl.
Stat. Pl.
Mtg. Pl.
Mtg. C.
A. S. C.
F. C.

It is requested that the Air Forces Proving Ground Command institute the experimental dropping tests of the NDRC glide bomb of Mr. [illegible] and the glide and controllable bomb of Mr. [illegible]. It is understood that these tests are to be conducted at Eglin Field under the supervision [illegible]. It is further [illegible] that prompt reports be obtained and forwarded to the [illegible] of Military Requirements.

By command of Lieutenant General [illegible]:

[illegible]
Colonel, A.G.D.
Adjutant General

Norman B. Ross
Norman B. Ross
Colonel, A.G.D.
Executive
War Organization & Movement

RECEIVED
AIR FORCES PROVING GROUND
EGLIN FIELD, FLA.
1943 JAN 8 AM 10:59

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1st Ind.

HEADQUARTERS, ARMY AIR FORCES, PROVING GROUND COMMAND, Eglin Field, Florida,
January 13, 1943.

TO: Headquarters of the Army Air Forces, Washington, D. C.
Attention: Director of War Organization & Movement.

1. The test program referred to in Dr. Dryden's letter has already been completed, and Dr. Dryden was his assistants left the Proving Ground on December 28, 1942. Dr. Dryden and his assistants left on January 22, 1943.

2. The Proving Ground furnished only such assistance and facilities as were requested by Dr. Dryden and Dr. [illegible], consisting principally of working space and a B-23 airplane with crew for the actual flight tests. Both were advised that we wanted [illegible] such assistance as was required, and it is believed that they received everything they [illegible] necessary.

3. Three of the Dryden bombs were dropped, two of which were observed by the Commanding General of the Proving Ground, one from an accompanying airplane and the other from the television station on the ground.

4. The equipment used for this test was essentially the same as that used by Colonel Hallowan, although the actual aerodynamic design was somewhat different. Colonel Hallowan attached a wing and tail [illegible] frame to the standard bomb and has plans for further attachment of television equipment, while Dr. Dryden inclosed the bomb with television attached in a fuselage. Dr. Dryden's design was also of the tailless variety and, therefore, quite different in appearance from that used by Colonel Hallowan.

5. These weapons flew very well, the radio control was good, and the television gave a good representation of the landscape in front of the weapon. Positively identifying the target in the television picture in the short time the missile was in flight was not particularly easy and of course, without experience it was not possible to fly the missile so as to conserve its altitude and finally direct it to the target. It is believed that Dr. Dryden considered the test a very satisfactory one and the data to be obtained therefrom will undoubtedly advance the development a very great deal.

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6. The Grondahl bomb drops similarly to a conventional high angle bomb but transmits a television picture of the landscape in the direction of the bomb axis, and has control surfaces to make small corrections in the bomb trajectory while it is in flight. The television transmissions were equally as good as those of Dr. Dryden's unit, and the whole test was considered quite satisfactory. This unit is more difficult to control than the missile equipped with conventional wings because of the fact that the axis of the bomb is not pointed toward the target until it is near the ground, traveling at a very high speed. The time remaining after the trajectory becomes reasonably straight is very short, and possibly too short to allow for the corrections that are desired.

7. Complete data including moving pictures of the television screen were obtained from both of these tests, but none of the records were retained by this Command.

8. It is understood that both of these groups will return in the near future with improved models, and both Dr. Dryden and Dr. Grondahl were advised that the Proving Ground would continue to assist with the future tests.

[illegible]

Grandison Gardner
GRANDISON GARDNER,
Brigadier General, U. S. Army,
Commanding.

Intel.
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Leg. Pl.

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

MEMORANDUM REPORT ON

File: 54-235 862 5213

SUBJECT: Controllable High Angle Bomb

Date March 11, 1943

SECTION: Equipment Laboratory

SERIAL No. ENG-M-54-673-16 K

Contract No. 673-71
Expenditure Order No.
Purchase Order No.

A. PURPOSE:

To report on tests of controllable high angle bombs by the National Defense Research Committee, Section 5.2 at Eglin Field, Florida.

B. FACTUAL DATA:

1. Personnel present at the tests were:

Materiel Center	Wulf Research & Development Co.
Major T. L. Wayrach	Dr. J. P. Molnar
Lt. E. W. Boorman	Mr. F. C. Rockoff
Major D. L. Anderson	Mr. T. H. Ranger
	Mr. C. A. Gustavson
Section 5.2, N.D.R.C.	Mr. L. D. Palmar
	Mr. A. P. Lindeberg
Mr. A. J. Bollan	

2. Tests on ten (10) radio controlled high angle "Azon" bombs were conducted at Eglin Field, Florida from February 1, 1943 to February 20, 1943. These bombs were controllable in azimuth by radio from the carrying airplane. Also, tests were made on two (2) special type bombs having cylindrical control surfaces. All bombs were lead loaded to 1000 pounds and were equipped with tail flares. The drops were made from a B-23 type airplane at an altitude of 15,000 feet and an indicated air speed of 150 M.P.H. Details of the tests are given in Appendix 1 attached.

3. Stabilization of the bomb in flight was obtained by means of a roll gyro and a rate of turn gyro. Gyro contacts controlled the movement of a solenoid which actuated the ailerons. The rudders

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were actuated by a 12-volt servo motor controllable by radio from the airplane.

[illegible] of the bomb in flight was recorded by means of a movie camera in the airplane.

C. CONCLUSIONS:

1. That the gyro stabilization of these bombs is insufficient.

2. That the pivot point on the rudders is located too far from the leading edge.

E. G. MORGAN, 2nd Lt., A.C.

[redacted]

MX-225

E. V. ROLLOCK, Colonel, A.C.
Equipment Laboratory,
Engineering Division.

P. C. CARROLL, Brig. General, USA
Chief, Engineering Division

C.G., Mat.Com. Att: Chief of Staff
Central Files

APPENDIX 1

1. The results of the tests by the National Defense Research Committee, Section 5.2 are as follows:

a. Excellent control was obtained in one flight. The radio control operator was able to make several passes with the bomb back and forth across a road.

b. A definite lateral deflection was obtained in two (2) of the flights, but the control mechanisms seemed to have stuck and no further control could be applied. It is thought that after the rudder has been turned through its maximum angle, the force of the relative wind on that portion between the leading edge and the pivot point is too great to be overcome by the servo motor.

c. The results of one (1) flight are uncertain due to a flare failure, and one (1) bomb was lost because of a misunderstanding between the bombardier and the radio operator.

d. Five (5) of the bombs definitely spun. These rolled over slowly as they left the airplane and no control could be applied.

d. The tests of the two bombs having cylindrical control surfaces showed this type to be very stable in the axis of spin. However, no control could be applied because at terminal velocity the hinge movements of the pivoting cylinder were too great to be overcome by the servo motor.

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NATIONAL DEFENSE RESEARCH COMMITTEE
Of The
Office of Scientific Research and Development

[redacted]

70 State Street
Cambridge, Massachusetts

May 21, 1943

Lieutenant Colonel William G. Brown, A.A.F.,
Room 5D-860
Pentagon Building
Washington, D.C.

Dear Brown:

When you were up here I told you that a report was being prepared that would receive somewhat restricted circulation before the Division Meeting on June ninth. There is attached a preamble or introduction to that report. It is the only copy being released and is for your personal use and not for circulation.

The reason I am sending this to you is the subject matter beginning with the middle of page two and continuing through page three. There are two problems involved. The more elementary one of budget would be greatly affected if pilot procurement were to be handled through NDRC and not by the Army. The second and real reason, and the one on which I would like your help, is the reference to having the guided missiles program for the Air Forces headed up by a single person.

I suppose this is done theoretically by Colonel Holloman at the present time, but this is just one of his many duties. The Army Air Force glide bomb is headed up, under Colonel Holloman, by Colonel Young, who is in turn Liaison Officer for Division 5, at least as far as the scope of the work coming under Colonel Holloman is concerned. Do you think what has been written would be offensive particularly to these men? It is intended to help rather than hinder, and I do not want the wrong statement to be made.

I firmly believe that this guided missiles program is at a point showing sufficient promise where real thought must be given to coordinating its many phases. I well recognize that there are the various sections within the Army Air Forces who can handle design, procurement, operations, and so forth. Nevertheless, I still feel vigorously that there should be one person with appropriate authority, which would be a minimum of a colonelcy and preferably that of a brigadier, whose sole job it is to get the equipment designed, procured, and used in the right place. Certain development work would continue under NDRC, but I believe that whoever is heading the group for the Air Forces should be sufficiently sympathetic to the program so that it would be almost indistinguishable as to where civilian activities ended and the Army began.

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Lieutenant Colonel William C.Brown -2- 5/21/43

I do not want to imply that the people at Eglin Field have not been cooperative in the conduct of tests. General Gardner has been outstandingly helpful. The whole group have accorded the NDRC all privileges at their disposal. In fact, I think that the personnel has gone out of its way to show special favors that have not been accorded at times to Colonel Young and his group. This, however, does not answer a comprehensive test program.

Fortunately, Colonel Holloman and his associates are exceedingly cooperative. As you may know, there is a real dispute as to whether or not accurate homing in range is possible for Colonel Holloman's device. Unofficially, but within the broad scope of the development of a glide bomb, Division 5 is outlining with Colonel Holloman specific tests to be made of Colonel Holloman's device. We have come so close together and the work of Dryden's glide bomb has progressed to such a point that a marriage between the two units seems practical.

I am not asking that you reply to this letter. I am leaving tomorrow for Philadelphia and Camden, and will be in Washington next Wednesday. If you will be in on that date, I will plan to come over to Pentagon, if convenient for you, and actually discuss this matter. I have no objection to your showing this letter and the first part of the draft report to any of your associates, but as it is the only copy out, I would not like it officially discussed. I would not want the Navy feeling that they had been slighted, because a step of this sort could easily impair the delicate liaison relations that always exist in that quarter.

I expect to arrive in Washington the middle of Tuesday afternoon in time for a conference with Commander Tucker of the Bureau of Ordnance on the Pelican device. If you do not plan to be around next Wednesday you can reach me, after three-thirty, care of Commander Tucker, whose extension number is 4760 on the Navy switchboard.

Sincerely yours,

/s/
H.B.Richmond
Chief, Division 5, NDRC.

Enc.
HBR:AEL

General Radio Company
30 State Street
Cambridge, Massachusetts

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[redacted]

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NATIONAL DEFENSE RESEARCH COMMITTEE

[redacted]

Dr. R. C. Tolman, Chairman
Dr. K. T. Compton
Dr. F. B. Jewett

Reviewing Committee for Division 5, NDRC

Gentlemen:

This is a summary report of the status of the general problems within the cognizance of the New Missiles Division. It is to be used as a general basis for discussion at the Division Meeting to be held on June ninth, and for the Reviewing Committee Meeting to be held following the general meeting. This report and the Reviewing Committee actions will be the basis for recommendations to be made to NDRC, at its meeting on June eighteenth, for the future conduct of the work of the Division .

When the Division was formed six months ago it was exceedingly difficult to determine which of the vehicles showed promise, and what detecting or homing devices might be available for association with them. It is believed that a similar statement could be made of corresponding projects handled directly by the Services. A preliminary survey of the situation convinced the Division that all of the projects within its cognizance showed enough promise to carry them along for at least a few months. Some program changes were made, and as far as was practical, and endeavor was made to establish a continuous evaluation of all new missile projects of the type assigned to this Division, whether or not the Division actually had cognisance over them.

At this point it should be pointed out that the Services have been exceedingly helpful regarding the interchange of information, and special praise is due the personnel of the Office of the Navy Coordinator of Research

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Reviewing Committee
Division 5, NDRC.

and Development, of the Office of the War Department Liaison Officer with NDRC, and the Army Air Force Materiel Command Liaison Officer for NDRC. Had the relations with these groups been simply formal yet fully efficient, not nearly as much would have been accomplished as has been possible by the superb personal interest that has been taken by the above-mentioned personnel.

The time has now come to evaluate the projects at hand so as to determine which of them are sufficiently near completion to be put into actual pilot production, and to have their tactical uses defined. The field appears to be sufficiently well covered so that items showing only remote promise can well be re-appraised with a view to dropping them.

In reviewing this program it seems desirable to comment on its priority status. This consideration appears to apply more particularly to the Army than to the Navy. Because of their weight and size, effective use of un-powered guided missiles, particularly of the large glide bomb type, is closely associated with land-based planes of the Fortress type. In many types of equipment development the need and use is well established in advance so that appropriate material priorities can be assigned. The equipment can also be tested before presenting it to the Services. The guided missiles work falls into an entirely different category. Only now is it passing from the highly speculative stage into a reality. It is felt that the problem should be re-evaluated on this basis and if the missiles, as detailed in this report, are considered to have tactical value of sufficient importance to justify their prompt use, that they be given appropriate material and personnel priorities which would enable their prompt procurement and use.

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Reviewing Committee
Division 5, NDRC

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While the actual use of these missiles does not come within the scope of the Division it is believed that the glide bomb in particular is at a point which justified the establishment of a unit under appropriate rank, with adequate personnel and field test facilities, whose sole activity would be to clear up expeditiously the technical and procurement problems. The immediate solution of these problems appears both practical and necessary if guided missiles are to have a place in near-term combat action. The results of development work carried out by NDRC could be placed in the hands of this group for field tests. The high-angle bomb program could be handled by this same group.

In essence, the program, both within the Army and within NDRC, has arrived at a point where a single military head, with sufficient rank, whose sole duty is to arrange to carry current developments through pilot production and into combat, is in order. Developments concerning the Navy appear to be set up in such a manner, for example, the Navy's own development on the program now headed by Commodore Oscar Smith. Even this program, it might be observed, could be accelerated if more commissioned technical (particularly electronics) personnel were available. While the operational features of the Army are not the direct concern of NDRC, how the future program, and pilot production and field testing in particular, are handled will have a very direct bearing on the future budget for the New Missiles Division. A corresponding specific example is the direct procurement by the Navy Bureau of Ordnance of pilot models, including the supplying of working and test personnel, on one missile project in which that Bureau has a special interest. [redacted]

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HEADQUARTERS ARMY AIR FORCES

INTERDESK MEMORANDUM (AFDMA-2B)

15

TO: Lt.Colonel W.G.Brown May 24, 1943

SUBJECT: Letter May 21, 1943 from Mr.Richmond, Chief Division 5, NDRC.

1. At your request, I have read the subject letter, in which Mr. Richmond points out the desirability of the designation of a Project Officer to sponsor and coordinate the various phases of the guided missiles program. I note also a remark in the inclosure to the letter to the effect that Commodore Oscar Smith is doing this for the Navy.

2. About ten months ago when the whole subject of rocket propulsion began to assume large proportions, I recommended the creation of a special section at Wright Field to carry on the work. This was put in charge of Major H.L.Donicht. I note that Mr. Richmond would like to have a Brigadier General designated as Project Officer on guided missiles. I do not know how General Chidlaw will react to that, but to me it seems at least farther than the Material Command has gone to date in sponsoring and promoting experimental work relating to armament.

3. Undoubtedly large sums of money will be spent on the NDRC guided missiles program. Personally, I think that the expenditure of such sums justifies the appointment of a Project Officer. Moreover, the Chief of the Army Air Forces should have someone to evaluate and recommend to him with respect to setting up manufacturing programs on new armament such as this, rather than leaving it to the inventors and promoters who come forward with their own ideas and without sufficient informed military opinions to evaluate them.

4. At the same time I have my doubts whether any of the guided missiles will materially influence the outcome of the present war. In other words, if we were to wipe out all the experimental programs now carried on by Division 5, I doubt if any one would know the difference as far as the outcome of the war is concerned. Assuming, however, that these projects will be carried on, the character of their NDRC sponsorship warrants the Army Air Forces showing a continued and very live interest in their accomplishment.

W.H.J. /s/
W.H.JOINER,
Colonel, Air Corps,
Chief, Armament Section

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ADDRESS REPLY TO
HEADQUARTERS OF THE ARMY AIR
WAR DEPARTMENT
WASHINGTON, D. C.

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

June 1, 1943

SUBJECT: Direct Sight - High Angle Bomb Controllable in Azimuth. Project AC-36.

TO: Commanding General
Materiel Command, Wright Field
Dayton, Ohio
Attention: Technical Executive

1. Dr. Grondahl of the N.D.R.C., Section 5.2, showed motion pictures in this Headquarters May 13, 1943, of tests recently conducted at Eglin Field, Florida, with a high angle controllable bomb (in azimuth) direct sighted. As a result of these pictures and tests, the Assistant Chief of Air Staff, Operations, Commitments and Requirements issued a directive to the effect that this project be expedited and expressed an immediate requirement for this equipment. They indicated their belief that this bomb would materially increase the accuracy of bombing of limited classes of objectives, such as maneuvering ships, bridges, and other targets of this nature.

2. In view of the requirement expressed by the Assistant Chief of Air Staff, Operations, Commitments and Requirements, the following action will be taken by your office in close coordination with the N.D.R.C.-

a. A program will be immediately initiated and expedited to prepare a quantity of these bombs for test purposes. These bombs will be made up and have the following characteristics:

(1). Standard bomb cases will be used and if possible both the nose and tail fuzes will remain unchanged, that is, the equipment to be attached to the bomb will be so designed, if at all possible, in order that present standard fuzes may be used.

(2). The first objective will be to design around the 1000 lb. G. P. bomb. Every effort will be made to have the final bombs with controls, etc. loadable on all 1000 lb. bomb stations of heavy and medium bombardment airplanes. These bombs will be carried internally.

(3). The bombs will be controlled in azimuth only. It will be highly desirable to have them controlled in both directions, however, the prosecution of this project will not be delayed pending the time control and sighting in both directions becomes feasible.

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(4). The finished bomb will have good ballistic characteristics.

(5). Suitable radio control apparatus will be included.

(6). Every effort will be made to obtain the simplest and most durable components possible.

(7). A means will be included for visually following the bomb in flight, such as a flare or smoke trail.

b. Development will proceed at the same time for a device to be installed in the airplane to aid in visually controlling the flight of the bomb when the target is an isolated point. It is visualized that this development could take the form of a rotatable screen similar to a drift meter. What is really desired is some means of maintaining a line of sight from the operator to the target so that when and if the airplane should change direction or vary its position in azimuth a line of sight for the bomb could still be maintained.

c. The development and engineering of this phase of project AC-36 will be considered as an interim only and will not stop or hinder the development and successful conclusion of the radar or television controlled versions with two-axis control.

3. During the development and engineering of this equipment around the standard bomb, consideration will be given to the preparation of manufacturing drawings so that after the completion of the final test phases of this project immediate production could be anticipated if and when Requirements Division indicated a quantity required for operational use.

4. Upon the completion of this development a quantity will be procured for test purposes and a program will be prepared anticipating the attendance by the various offices concerned. It is desired that this program include bombing of actual or facsimile targets over water and land.

5. Various agencies of the N.D.R.C. concerned will be contacted immediately for the purpose of pursuing and expediting this project. Attached for your information is a copy of a letter addressed to Major General C. C. Williams, War Department Liaison Officer with the N.D.R.C.

By Command of General ARNOLD:

B. W. CHIDLAW
Brig. General, U.S.A.
Chief, Materiel Division
Office of Assistant Chief of Air Staff
Materiel, Maintenance and Distribution

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(AFR 11-30)

Incl.
Cy ltr to Maj. Gen. Williams

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June 1, 1943

Direct Sight - High Angle Bomb Controllable in Azimuth. Project AC - 36.

Major General C. G. Williams
War Department Liaison Officer with N.D.R.C.
Headquarters Army Service Forces
Room 4E633, Pentagon Building
Washington, D. C.

1. On May 13th Section 5.2 of the N.D.R.C. showed motion pictures in this Headquarters of tests accomplished at Eglin Field with subject bomb as developed by that Section. Representatives of the various interested offices of the Army Air Forces and the Ordnance Department were present.

2. As a result of this showing, the Assistant Chief of Air Staff, Operations, Commitments and Requirements expressed a requirement for this type of bomb and requested that this phase of project AC-36 be expedited with a view towards making it available for early usage. They also stated however that the acceptance of this bomb should be considered as an interim and should in no way stop or hinder the development of radar or television controlled versions with two-axis control.

3. As a result of this expressed requirement by the Assistant Chief of Air Staff, Operations, Commitments and Requirements, a directive has been issued to the Materiel Command, who initiated project AC-36, to pursue this phase to an early completion. Attached is a copy of this directive.

4. It will be noted that the characteristics desired are contained therein with a statement that a quantity of these bombs be procured for extended tests and that engineering be accomplished so that when the test articles have proven themselves satisfactory production could be accomplished without delay.

5. It is requested that the proper agencies of the N.D.R.C. be advised of the Army Air Forces desire and that they coordinate closely with personnel of the Materiel Command in order that this project may be expedited.

For the Commanding General, Army Air Forces:

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(AFR 11-30)

J. CHILDS
Brig. General, U.S.A.
AAF Liaison Officer with N.D.R.C.

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WAR DEPARTMENT
HEADQUARTERS, MATERIEL COMMAND

SECRET
AUTH: C. G., AAF Materiel Command
DATE: 6-1-43
INITIALS: B.W.C.

TECHNICAL INSTRUCTIONS

Serial No.: CTI-1350

Wright Field, Dayton, Ohio
June 5, 1943.

Subject: High Angle Controllable Bomb in Azimuth.

TO: 13180 Engineering Division.

AC-36

1. Problem Presented:

a. That a program will be immediately initiated and expedited to prepare a quantity of high angle controllable bombs (in azimuth) direct sighted for test purposes. These bombs will have the following characteristics:

(1) Standard bomb cases will be used and if possible both the nose and tail fuzes will remain unchanged, that is, the equipment to be attached to the bomb will be so designed, if at all possible, in order that present standard fuzes may be used.

(2) The first objective will be to design around the 1000 lb. G. P. bomb. Every effort will be made to have the final bombs with controls, etc. loadable on all 1000 lb. bomb stations of heavy and medium bombardment airplanes. These bombs will be carried internally.

(3) The bombs will be controlled in azimuth only. It will be highly desirable to have them controlled in both directions, however, the prosecution of this project will not be delayed pending the time control and sighting in both directions becomes feasible.

(4) The finished bomb will have good ballistic characteristics.

(5) Suitable radio control apparatus will be included.

(6) Every effort will be made to obtain the simplest and most durable components possible.

(7) A means will be included for visually following the bomb in flight, such as a flare or smoke trail.

b. Development will proceed at the same time for a device to be installed in the airplane to aid in visually controlling the flight of the bomb when the target is an isolated point. It is visualized that this development could take the form of a rotatable screen similar to a drift meter. What is really desired is some means of maintaining a line of sight from the operator to the target so that

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when and if the airplane should change direction or vary its position in azimuth a line of sight for the bomb could still be maintained.

c. The development and engineering of this phase of project AC-36 will be considered as an interim only and will not stop or hinder the development and successful conclusion of the radar or television controlled versions with two-axis control.

2. Factual Data:

a. In a letter dated June 1, 1943 received by this office from Chief, Materiel Division, Office of Asst. Chief of Air Staff, Materiel, Maintenance & Distribution, it was stated that the Asst. Chief of Air Staff, Operations, Commitments and Requirements, has issued a directive to the effect that this project is to be expedited and expressed an immediate requirement for this equipment. They indicated their belief that this bomb would materially increase the accuracy of bombing of limited classes of objectives, such as maneuvering ships, bridges, and other targets of this nature.

3. Authority:

a. Commanding General, Army Air Forces. By letter dated June 1, 1943 from Chief, Materiel Division, Office of Asst. Chief of Air Staff, Materiel, Maintenance & Distribution, subject: Direct Sight - High Angle Bomb Controllable in Azimuth. Project AC-36.

4. Action Desired:

a. To accomplish that which is stated under paragraph 1 of Problem Presented.

b. During the development and engineering of this equipment around the standard bomb, consideration will be given to the preparation of manufacturing drawings so that after the completion of the final test phases of this project immediate production could be anticipated if and when Requirements Division indicated a quantity required for operational use.

c. Upon the completion of this development a quantity will be procured for test purposes and a program will be prepared anticipating the attendance by the various offices concerned. It is desired that this program include bombing of actual or facsimile targets over water and land.

d. Various agencies of the N.D.R.C. concerned will be contacted immediately for the purpose of pursuing and expediting this project. Attached for your information is a copy of a letter addressed to Major

[redacted]

10

SECRET

Serial No. CTI-1350

Subject: High Angle Controllable Bomb in Azimuth.

General C. C. Williams, War Department Liaison Officer with the N.D.R.C.

By Command of Brigadier General BRANSHAW:

C. K. MOORE,
Colonel, Air Corps,
Asst. Technical Executive.

Incl.:
Cy. ltr. to Maj. Gen. Williams

Distribution:
Production Division
Aircraft Radio Lab.
Air Service Command.

Distribution by Engin. Division:

Orig. Armament Laboratory (2)
Cys: General Carroll
Technical Staff
Airc. Proj. Section
Equipment Lab.
N.D.R.C. Lia. Br.
Flt. Res. Lia. Br.
Airc. Lab. (2)

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[redacted]

Corrs Miscellaneous 471 GE
CG AAF-64-4/3 (1)
AAFMC-304-WF-16-71-(1-500)M

Address reply & ENVELOPE to:

Commanding General
AAF Materiel Command
Engineering Division
Reference: WRW:hle-54
Wright Field, Dayton, Ohio.

CONFIDENTIAL

ARMY AIR FORCES
MATERIEL ~~EXECUTIVE~~ COMMAND

EV 509

Wright Field, Dayton, Ohio
24 AUG 1943

Subject: High Angle Controllable Bomb in Azimuth.
CTI No. 1350,
(Project AC-36).

To: Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Assistant Chief of the Air Staff,
Materiel, Maintenance and Distribution.

1. A conference was held at Wright Field on 6 August 1943 with personnel of the Engineering Division, the Ordnance Aircraft Service, and the Union Switch & Signal Company, contractors to the N.D.R.C. for production of prototype high angle controllable bombs (Azon). The conference related to the fusing of the bomb and to the arming of the flare which is necessary for observing the fall of the bomb. It is understood that engineering decisions on the design of the weapon are the responsibility of the N.D.R.C., it being their policy to coordinate all details with the Army Air Forces.

2. It was agreed that no provision for tail bomb fuses should be made in this particular weapon, based on the reasoning outlined below:

a. Available information on bomb fuses:

(1) With nose fuses only, the percentage of fuse failures is approximately 1%. Delays available for nose fuses are instantaneous and 0.1 second.

(2) Tail fuses, when used, serve to practically eliminate the 1% of failures and to increase the selectivity of delay by providing additional values of 0.01 second, 0.025 second, 4.0 to 5.0 seconds, and 8.0 to 11.0 seconds.

(3) A new nose fuse is currently under development which will provide all of the delays now provided by both nose and tail fuses. It is anticipated that the new fuse will be available by the time this weapon is used in large quantities.

[redacted]
BX-225

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0771

CF, AAF-690/3pp)

[redacted]

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MM & D.
High Angle Controllable Bomb in Azimuth.
CTI No. 1350,
(Project AO-36).
24 AUG 1943

(4) Whatever fusing scheme is decided upon, it should allow the use of standard fuses as issued, without the necessity of machine work or other alterations not already provided for.

b. The use of a tail fuse would require considerable and difficult redesign of the experimental control equipment developed by N.D.R.C., since no space has been provided for a tail fuse. The equipment must be compact and must be located entirely behind the bomb proper. The design problem is further complicated by the necessity of providing a means, as yet untried, of turning a spinner which would either be submerged within the control unit or would have to be located on an extension shaft behind the control unit. If located behind, it would interfere with the flare as now designed and/or any arming scheme for the flare that required air travel for actuation. It might also interfere with the radio antenna, which is an important but relatively fragile element of the weapon.

c. The use of a tail fuse with this equipment would considerably complicate the assembly work to be performed in the field when bombing up an airplane, whereas efforts are now directed toward making the equipment as simple as possible in this respect.

d. The urgency of completing the engineering and experimental tests on this weapon does not appear to justify an attempt to incorporate a tail fuse, especially in view of the small and even doubtful advantage to be gained by so doing.

3. It was also agreed that any flare used on the weapon should be so designed that the igniter cord would not be pulled until a reasonable amount of air travel of the bomb had occurred. This is to minimize the hazard incident to accidental pulling of the flare arming wire in emergencies such as take-off crashes. At present it is anticipated that this safety feature can be accomplished by using a simple drag disc attached to a long cord to actuate the igniter, the disc to be released by withdrawal of an arming wire.

[redacted]

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CF, AAF-69-3/3pp)

54

CONFIDENTIAL

C.G., AAF, Washington 25, D. C.,
Atten: AC/AS, MW & D.
High Angle Controllable Bomb in Azimuth.
CTI No. 1350,
(Project AC-36).

24 AUG 1943

4. Approval of the agreements stated in paragraphs 2 and 3, above, is requested.

For the Commanding General:

H. Z. BOGERT,
Colonel, Air Corps,
Acting Chief,
Engineering Division.

[redacted]
MX-225

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(AFR 11-30)

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18

Union Switch & Signal Company

Union Switch & Signal Construction Company

SWISSVALE, PA.

September 3, 1943

CONFIDENTIAL

Commanding General,
Materiel Command,
Wright Field, Ohio.

Dear Sir: Attention - Captain John H. Evans

In our discussion concerning project AC-36 before we left for the field tests at Muroc, it was suggested by Ordnance men that it is possible that Azons can be built without tail fuses. If that is accepted it will result in a considerable simplification of the Azon construction, and we are therefore very anxious to have authoritative approval of that omission.

We shall appreciate it a great deal if Captain Evans will give us such approval.

Very truly yours,

L. O. Brondahl

Director, Research & Engineering

LOG/RP

OCT 4 1943

ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON, D. C.

CONFIDENTIAL 19

AFMA-2B

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON, D. C.

8 September 1943

SUBJECT: High Angle Controllable Bomb in Azimuth.
CTI-1350 (Project AC-36).

15534

20

TO: Commanding General
Materiel Command, Wright Field
Dayton, Ohio
Attention: Special Weapons Unit

1. Reference is made to letter from your office dated August 24, 1943, subject as above, in which permission was requested to delete the tail fuze provisions for the high angle controllable bomb.

2. After review with ACAS/OCR, authority to delete the tail fuze is given only because it is desired that this project be completed at least to a workable stage at the earliest possible date. ACAS/OCR still feels that tail fuzes as well as nose fuzes are a requirement and therefore, consideration will still be given to the incorporation of a tail fuze at a later date and/or on all future developments of this type bomb.

3. In this connection, it is desired to advise that altho nose fuzes with various time settings are under development there are none available except instantaneous and .1 second delay. These may or may not suit the tactical usage to which the bomb will be put. Furthermore, in most cases the percentage of duds is greater than 1%.

4. Information is requested as to the status of this project and it is requested that any reports available on recent tests be forwarded at the earliest practicable date.

By Command of General ARNOLD:

E. Elliot Jr.
for R. C. WILSON
Colonel, Air Corps
Chief, Dev. Eng. Branch, Mat. Div.
Office of Assistant Chief of Air Staff
Materiel, Maintenance and Distribution

[redacted]

Ca-351

A-71920

0775

Original Cont. Miniles
70.2/10 Mins - 14 (1/4 M)
AAFMC-R&E-WF-S-S-42-2006M
R+RS. 52B
M+S

D

422.1

CONFIDENTIAL

F-1

ARMY AIR FORCES
MATERIEL CENTER COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

6155
JHE:hle:54-6707
Date 23 September 1943

SUBJECT: Project MX-225 (Direct Sight Bomb)

SECTION Equipment Laboratory

SERIAL No. ENG-54-673-16 M

Contract No.
Expenditure Order No. 673-21
Purchase Order No.

A. PURPOSE:

To report on a trip to Eglin Field, Florida, 23 June 1943 to 7 July 1943.

B. FACTUAL DATA:

1. Personnel present at the tests were:

Materiel Command

Captain J. H. Evans
Captain M. A. Chiba
Lt. A. E. Hamilton

N. D. R. C.

Dr. L. O. Grondahl
Mr. A. J. Wollan

Gulf Research & Development Co.

Mr. H. O. Wyckoff
Mr. E. W. Palmer
Mr. C. A. Gustavson
Mr. W. E. Wickerham
Mr. A. Carnvale
Dr. J. F. Molnar

2. The purpose of this series of tests was neither to determine the accuracy of the bomb, nor the accuracy of this type of bombing, but first to test the roll stabilization when the bombs were launched at 45 degrees, and second to check the performance of the apparatus.

3. For this series of tests twelve (12) bombs, constructed by The Gulf Research & Development Company were dropped. The twelve units were of two types, six of which were single axis (Azon) provided with radial fins and controlled in azimuth only. See Appendix I attached for detailed data of drops. The remaining six (Raaz) were direct sighted and controlled in both range and azimuth. They were provided with

[redacted]

MX-225

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21

Avg. Cost Missile
70 & 10 Mile
14 (2/4 M) R & R S, 2213

Engin. Div. Memo. Report No. ENG-SL-673-16 M
23 September 1943

cylindrical lift shrouds and octagonal tail shrouds. The overall dimensions of the Raaz are approximately equivalent to those of a standard 2000 pound demolition bomb. See Appendix II attached for data and Raaz drop. All bombs were fully loaded to 1000 pounds and dropped from 15,000 feet from a B-23 airplane.

C. CONCLUSIONS:

1. That malfunctioning of the radio equipment was the chief cause of failure in both types of bombs.

2. That the flare in its present form is not satisfactory.

3. That the testing program was considerably delayed because of poor weather.

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the organizations designated below:

a. Engineering Division, Materiel Command, Equipment Laboratory:

(1) That a more favorable testing location be selected. (accomplished).

b. National Defense Research Committee:

(1) That possible flare improvements be investigated by the manufacturer. (action initiated).

c. Signal Corps, Aircraft Signal Service, Aircraft Radio Laboratory:

(1) That the Aircraft Radio Laboratory be consulted concerning radio modifications. (action initiated).

Prepared by J. R. EVANS, Capt., A.C.
(Name)

Approved by G. V. HOLLOMAN, Colonel, A.C.,
Chief, Equipment Laboratory,
Engineering Division.

Approved by T. O. MARSHALL, Brig. General, USA
Chief, Engineering Division.

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(AFR 11-39)

Concurrence:

[redacted]

Distribution:
Ch. Mat. Div. AC/AS MM & D

MX-225

44

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Engin. Div. Memo. Report No. ENG-54-673-16 M
23 September 1943

APPENDIX I

SCHEDULE & TEST RESULTS
SINGLE AXIS CONTROL (AZON)

Date	Bomb No.	Flight No.	Time	Remarks
6-24-43	46	1		Bomb taken up but mission cancelled because of clouds.
6-25-43	46	1	7:50 A.M.	Fell 600 ft. short, but correct in azimuth.
6-26-43	48 & 49	1		Clouds cancelled mission.
6-27-43	48 & 49	1	6:15 A.M.	Bombs returned to ground after air check. Rudders failed to operate.
6-27-43	50 & 47	2	8:40 A.M.	Only #47 was dropped. Radio failure caused raiders to stick in hard left.
6-28-43	50 & 45	1	6:00 A.M.	#50 was 720 ft. short in range, but on line in azimuth. #45 fell 36 ft. short and 21 ft. from a point target.
6-28-43	48 & 49	2	9:30 A.M.	Bombs returned to ground because of clouds.
6-28-43	48 & 49	3	1:00 P.M.	Bombs dropped on clear range. Flare failed to light on #48.

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(APR 11-50)

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MX-225

Engin. Div. Memo. Report No. ENG-54-673-16 M
23 September 1943

APPENDIX II

SCHEDULE & TEST RESULTS
TWO AXIS CONTROL (RAAZ)

Date	Bomb No.	Flight No.	Time	Remarks
6-1-43	44	1	10:00 A.M.	Mission cancelled after take-off-weather.
6-2-43	44	1	7:30 A.M.	Fell 160 ft. off in range and 55 ft. in azimuth.
6-2-43	42	2	6:00 P.M.	Bombardier selected wrong target - result unknown.
6-3-43	40	1	8:00 A.M.	Radio failure.
6-4-43	39	1	7:30 A.M.	Cancelled mission - weather.
6-5-43	39	1	7:40 A.M.	Radio failure.
6-5-43	41	2	10:00 A.M.	Radio failure.
6-5-43	43	3	3:30 P.M.	Radio failure. - Bomb returned to manufacturer.

[redacted]

2

Arthur C. Mc L.
Date 5 Oct 1943
Initials

ARMY AIR FORCES
MATERIEL COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

Attached

SUBJECT: Radio Controls

Date 5 October 1943

SECTION: Equipment Laboratory

SERIAL No. [illegible]

Contract No.
Requisition (Job) No. 673-12
Purchase Order No.

A. Purpose:

1. To report on conferences and discussions concerning radio controls for use on guided bombs and high angle bombs.

B. Factual Data:

1. A conference was held at the Emerson Radio & Phonograph Corporation in New York on 21 September 1943.

2. Present at the conference were:

Material Command	Emerson Radio & Phonograph Corp.
Lt. Col. A. Nyman	Mr. D. L. Israel

3. The system devised during a conference with Mr. Israel at Wright Field on 15 September was discussed. Mr. Israel subsequently consulted with Mr. L. Hammond of the Hammond Instrument Company concerning manufacturing a chemical element of this system and with representatives of the Aircraft Radio Laboratory concerning their interest in this system.

4. Mr. Israel indicated that the research facilities of Emerson Radio & Phonograph Corporation have been completely tied up and work to develop this new system could not be undertaken. He agreed that an N.D.R.C. agency undertake this development and promised consulting technical cooperation.

5. A variant to the original system was discussed. The original and the variant are described in Appendices 1 and 2.

6. A conference was held at the Massachusetts Institute of Technology on 23 September with the following personnel present:

Material Command	Division 5 N.D.R.C.
Lt. Col. A. Nyman	[redacted]
	Wallace McKeehan

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(AFR 11-30)

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3

[illegible]

[illegible] [illegible]

[illegible]

[illegible]

[illegible] systems being developed by [illegible] particular [illegible]

The immediate needs [illegible] latter will be filled by an [illegible] two channel device being developed for Division 5.

9. [illegible] system being developed by the Federal Telegraph Company [illegible] will be started [illegible]

10. The following systems and [illegible] were discussed for [illegible] alternative control systems when the [illegible] available will be jammed by the enemy.

a. Federal Telegraph Co.: No action until Aircraft Radio Laboratory development is satisfactorily demonstrated.

b. Colonial Radio Co.: No action until Aircraft Radio Laboratory development is satisfactorily demonstrated.

c. Hammond Research Corp.: The model to be submitted to Aircraft Radio Laboratory for tests.

d. Hammond Research Corp.: A simplified two channel system is being developed for use on Azon.

e. Polarizing system based on suggestion of Hammond Research Corporation. Application of this system to ultrashort waves is not considered as practical as for microwaves. The Polaroid Corporation has developed a technique in connection with project NR-208, as applied to infra-red pulses which would be directly applicable to microwaves. Mr. [illegible] will consult with Dr. [illegible] of the Radiation Laboratories on the possibilities of this system.

f. Polaroid system (NR-208): This system is being applied to G.B. 2 but is not directly applicable to Azon on account of the presence of flare. Further consideration will be given by Polaroid Corporation.

g. Laurens Hammond system: The present development is directed to use on G.B. 2, eventually it may be applicable to Azon.

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Engin. Div. Memo. Report No. [illegible]
9 October 1943.

h. Naval Research Laboratory pulse system. This is being investigated by the Aircraft Radio Laboratory.

i. Lawrence Hr and Pulse system. A proposal has been received from the Barber Electric Company of Chicago which is being considered by the Aircraft Radio Laboratory.

j. Emerson pulse system. The alternate system is outlined in Appendix 2 and is developed for use both as a four channel or a three channel device. The Crosley Corporation was also asked to submit a proposal. Research and [illegible] action on this system is being considered by Division 6.

11. A development conference was held on [illegible] between the Massachusetts Institute of Technology [illegible] Material Command [illegible] Lt. Colonel A. Hyman and Mr. [illegible] representing Division 6 of N.D.R.C. at which the above program was discussed. It was suggested that [illegible] cooperation will be useful in developing the systems [illegible] 10.8. and 10.1. This development should be carried out with the [illegible] dispatch to other interim control systems until more elaborate Federal and Colonial systems have been completed.

C. Conclusions.

1. That Division 6 of N.D.R.C. has [illegible] completion for use on Azon and has the other [illegible] development.

2. That the Aircraft Radio Laboratory has two secure control systems under development but with little prospect of early availability.

3. That Division 6 of N.D.R.C. realizes the urgent requirement for substitute secure control systems to replace those that are [illegible] the enemy and will attempt to speed up the development of [illegible] two new systems as mentioned in Paragraphs 10.8. & 10.1.

D. Recommendations.

1. It is recommended that the following action be taken by the organizations designated below:

a. Engineering Division, Material Command, Wright Field, Laboratory, and the Aircraft Radio Laboratory:

Page 2

Engin. Div. Memo. Report No. EX-54-6-13-6-1-1
6 October 1943

(1) That the National Defense Research Committee be requested to develop two alternative radio control systems as described in paragraphs 10.a. and 10.j. (action to be initiated.)

Concurrence:

Prepared by A. AYMAR, Lt. Colonel, A.C.
(Name)

Approved by G. W. HEDDEMAN, Colonel, A.C.
Chief, Equipment Laboratory
Engineering Division.

Distribution:
Material Division, AC/AS,MMD
AAF,W.D.R.,Lia.AC-35 AC-41;
N.D.R.C.Div. 5

Approved by F. [illegible] CARROLL, Brig.Gen.U.S.A.
Chief, Engineering Division

MX-106 MX-108

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7

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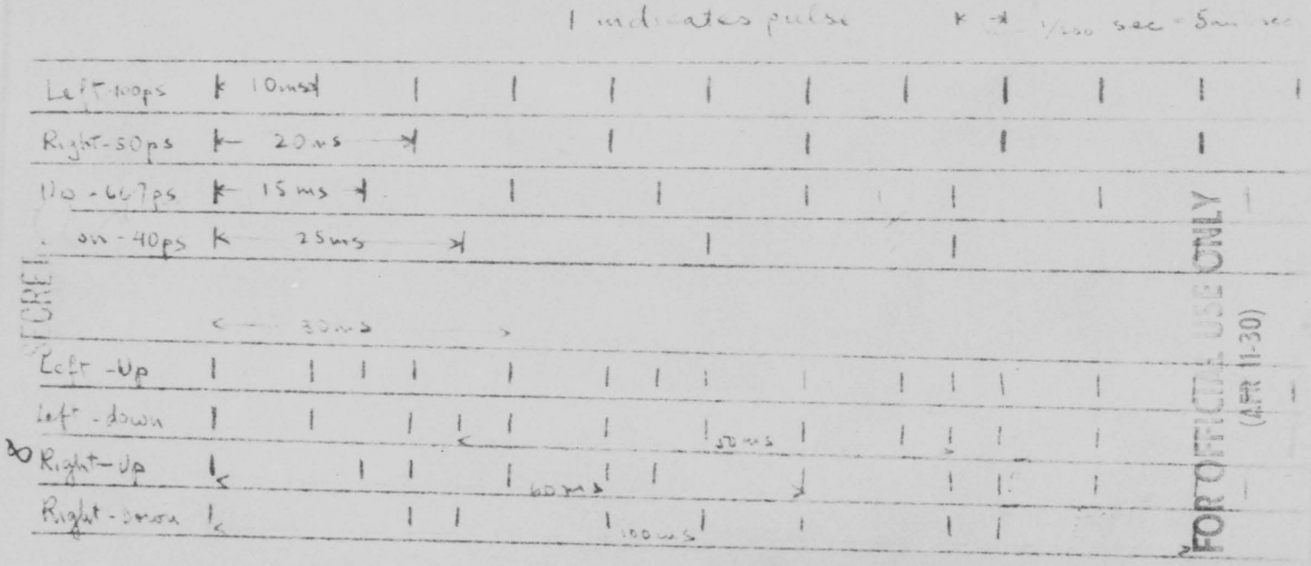
Time relation of pulses for different channels

| indicates pulse ← → 1/200 sec = 5ms sec



Fundamental	Left-Up	30 milliseconds	(33.3 cycles/sec)
"	left-Down	50	(20 cycles/sec)
"	Right-Up	60	" (16.7 cycles/sec
"	Right-Down	100	" (10 cycles/sec)

[redacted]

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(APR 11-30)

AN

9/29/63

Address reply & ENVELOPE to:

CONFIDENTIAL

Commanding General
AAF Materiel Command
Engineering Division
Reference: JHE:hle:SA-11043
Wright Field, Dayton, Ohio

xxxxxxx COMMAND

Wright Field, Dayton, Ohio

High Angle Controllable Bomb in Salvoes,
XBT-1[illegible] (Project AC-[illegible]).

Commanding General
Army Air Forces
Washington 25, D. C.

Attention: Development Engrg. Branch,
Mat. Div., AC/AS WD.

Feb 1943

1. Reference is made to letter, Office of Commanding General, Army Air Forces, dated 6 September 1943, subject as above, granting approval of deletion of the tail fuse and requesting information as to the status of the subject project.

2. Since permission has been granted to delete the tail fuse, the first article of the pre-production lot of two hundred will be released by the manufacturer on or about 1 November 1943. The remainder to follow and be tested by 1 January 1944.

3. As a result of information obtained from tests at Eglin Field, Florida, from 23 June to 7 July 1943, and tests at the Materiel Command Flight Test Base, Muroc, California, in August and September, this Office feels that it can release the Azon bomb for final ballistic and evaluation tests and possible training purposes to a tactical group upon completion of a test of about twenty-five units to be made late in November or early in December of this year. It is recommended that Army Air Forces School of Applied Tactics set up and monitor the final tests.

4. The reports of the above mentioned tests and future tests will be forwarded to your Office as soon as practicable.

For the Commanding General:

F. O. Carroll,
Brig. General, U. S. A.,
Chief, Engineering Division.

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(AFR 11-30)

[redacted]

VX-225

AAFMC-190-WF-5-28-42-2 M&C

CENTRAL FILES

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG. CK
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS
23

ADDRESS REPLY TO
HEADQUARTERS OF THE ARMY AIR
WAR DEPARTMENT
WASHINGTON, D. C.

22/7446

SECRET

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES AFDMA-2F
WASHINGTON, 25

23 October 1943

SUBJECT: High Angle Controllable Bomb in Azimuth C.T.I. No. 1350

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio.

ATTN: Technical Executive

1. A directive has been received from the Air Communications Officer who has been appointed monitor for the Special Weapon Program to procure 10,600 control and flare assemblies for the high angle controllable bomb. 10,000 of these assemblies are for Army use and the other 600 for the Navy. This equipment will be suitable for use with standard 1,000 lb. bomb.

2. Necessary radio equipment for use in connection with these tail assemblies is being procured by the Signal Corps and information is available to the effect that the anticipated production schedule for the radio receiver is 50 sets per day, starting on or about 15 January 1944. Necessary action is being taken by the NDRC to turn over this development of the radio equipment to the Signal Corps. The transmitter, it is understood, is an Aircraft Radio Laboratory development and 100 units are on order.

3. Necessary contacts will be arranged with NDRC representative and release for this equipment will be made in order that procurement by the Army Air Forces may be established at the earliest practicable date.

4. This office will be advised as to when delivery may be anticipated in order that necessary shipping instructions for both the Army quantity and the Navy may be supplied.

By command of General ARNOLD:

R. C. Wilson

R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Div.
Office, Asst. Chief of Air Staff
Materiel, Maintenance and Distribution

By Authority of [redacted]
The Adjutant General
Army Air Forces
23 Oct 1943 MCD
Date Initials

[redacted]

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(AFR 11-30) E 24

A 7625

0788

Orig. Com. Mission
70.2/8 Mine 15(2/11 MM)
R+R's, DCB.

HEADQUARTERS ARMY AIR FORCES 47

ROUTING AND RECORD SHEET

[redacted]

TALLY NO.	
FILE NO.	

SUBJECT: Azon

TO: Asst C/AS, M&R&D, Radio & Radar, Material Division, Development & Engineering Branch, ATTN: Major R.H.Richardson

DATE 23 Oct 43

FROM: Air Communications Officer

COMMENT NO. 1

Capt Lavery:amb 71658

1. It is requested that the necessary action be taken to procure the tail assemblies, less radio equipment, for the 1,000 lbs. Azon bombs.

2. The total quantity required is 10600 assemblies, 10000 for the Army and 600 for the Navy. The anticipated production schedule for the radio receiver is a minimum of 50 sets per day, starting approximately 15 January, 1944.

3. Inclosed are copies of correspondence to the Signal Corps and Scheduling Division pertaining to the procurement of the radio equipment.

DANIEL C. DOUBLEDAY
Colonel, Air Corps

3 Incl
1. M&R to Scheduling Div. dtd 23 Oct 43
2. Ltr to OCSigO dtd 23 Oct 43.
3. Ltr to OCSigO dtd 23 Oct 43.

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(AFR 11-30)

[redacted]

PAGE 1

3-1109 A.F.

0789

23 SECRET

m-225

Wright Field, Dayton, Ohio.
28 October 1943

CTI-1350, Addendum 1

SECRET
Comm. C. G. AAF
Material Command
10/23/43

High Angle Controllable Bomb
in Azimuth.

Production Division

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
25
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS
25

1. **Problem Presented:**

a. To procure 10,600 control and flare assemblies for the high angle controllable bomb.

2. **Factual Data:**

a. Necessary radio equipment for use in connection with these tail assemblies is being procured by the Signal Corps and information is available to the effect that the anticipated production schedule for the radio receiver is 50 sets per day, starting on or about 15 January 1944. Necessary action is being taken by the NDRC to turn over this development of the radio equipment to the Signal Corps. The transmitter, it is understood, is an Aircraft Radio Laboratory development and 100 units are on order.

b. Necessary contacts will be arranged with NDRC representative and release for this equipment will be made in order that procurement by the Army Air Forces will be established at the earliest practicable date.

3. **Authority:**

a. Commanding General, Army Air Forces. by letter dated 23 October 1943, subject as above, from Chief, Development Engineering Branch, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance & Distribution.

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[redacted]

AAF-MC-198-WF-5-20-42-2 MD.

CENTRAL FILES

0780

27 SECRET

JHO:jjb:HQP
//////////////// Page 2
Wright Field, Dayton, Ohio.
28 October 1943

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS

TSFI-1350, Addendum I (Continued)

High Angle Controllable Bomb
in Azimuth.

Production Division

4. Action Desired:

a. To procure 10,600 control and flare assemblies for the high angle controllable bomb. 10,000 of these assemblies are for Army use and the other 600 for the Navy. This equipment will be suitable for use with standard 1,000 lb. bomb.

b. The Chief, Development Engineering Branch, Materiel Division, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution, is to be advised as to when delivery may be anticipated in order that necessary shipping instructions for both the Army quantity and the Navy may be supplied.

By Command of Major General BRANSHAW:

T. A. SIMS,
Colonel, Air Corps,
Deputy Chief of Staff.

Distribution:
Aircraft Radio Laboratory
Engineering Division
Air Service Command (2)

[redacted]

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SECRET

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HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

AFACO

10 November 1943

SUBJECT: Air Force Control Agency for Guided Missiles

TO:

1. The Commanding General, Army Air Forces, has directed that the Air Communications Officer assume complete responsibility for monitoring all projects for the development of guided missiles and the counter-measures against such missiles.

2. In compliance with the directive cited in paragraph 1 above, a Guided Missiles Section has been set up in the Air Communications Office. Lieutenant Colonel Stewart F. Wright has been placed in charge of the Special Projects Section and Major William L. Norvell and Captain H. J. Ward have been assigned to this activity.

3. It is requested that the names of the above-named officers be placed on your records and that proper clearances be given them.

4. Correspondence in connection with guided missiles should be addressed "Special Projects Section, Air Communications Officer, Headquarters of the Army Air Forces, War Department, Washington, D. C."

NO AAF
[illegible]

H. H. McCLELLAND
Brig. Gen., U. S. A.
Air Communications Officer.

Distribution as attached list:

Dispatched NOV 12 1943
[illegible]

[redacted]

TO AAF FILES
DIR/COMM

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(AFR 11-30)

26

Union Switch & Signal Company

Union Switch & Signal Construction Company

SWISSVALE, PA.

W. H. CADWALLADER
VICE PRESIDENT AND GENERAL MANAGER

November 10, 1943

Col. S. R. Stewart,
Special Weapons Branch,
Materiel Command, A.A.F.,
Wright Field, Ohio

[redacted]

Dear Sir:

In accordance with your telephoned request of yesterday, we have prepared a very brief set of general specifications for the Azon tail structure, Type AZ-1, for a 1000 lb. AN-M65 bomb. The specifications are necessarily very general, because the building of the 200 samples which the N.D.R.C. has ordered from us is just getting under way.

Accompanying the specifications are five drawings. The specifications, drawings, and the following general description may be adequate for your purpose.

The Azon tail structure consists of the following component parts:

(1) The general mechanical structure itself consists of a box which contains the apparatus and to which are attached fins and control surfaces.

(2) The gyro assembly consisting of two gyros arranged so as to keep the bomb from rotating out of position about its own axis.

(3) The two-channel radio receiver which receives the control messages from the plane and translates them into the operation of primary relays.

(4) The Servo motor, which is energized by the local battery, and the energization of which is controlled by messages sent out from the plane through the radio receiver and associated relays.

(5) Two double acting solenoids which control the ailerons in response to the action of the gyroscopes.

(6) A 24-volt battery which furnishes power for the radio set, the Servo motor, gyroscopes, and relays

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COPY

Col. S. R. Stewart: -2- 11/10/43

(7) An electrically ignited flare attached to the tail of bomb, and also energized from the 24-volt battery.

The 5 drawings are identified as follows:

G.O. 506350-sheet 1 is a general drawing showing the assembly of the tail structure and the bomb.

G.O. 506350-sheet 32 is a plan view of the rear compartment of the tail structure showing the arrangement of the Servo motor and solenoides, and their couplings to the control surfaces.

G.O. 506350-sheet 33 is a cross-section showing the solenoid mountings.

G.O. 506350-sheet 34 shows the arrangement of apparatus in the forward compartment of the tail structure, including the location of the gyro assembly, the radio, and the battery.

L.N.Schwien Engineering Company's drawing 45600 shows the general assembly of the gyro equipment.

Detailed drawings are not available at the present time, but we shall be glad to supplement the information given by additional drawings, descriptions, or conferences as you may require.

Very truly yours,

s/s W. H. Cadwallader

Vice-President & General Manager

LOG/RP

Att. Specifications (8 sheets)
Drawings - (1 copy of 5 dwgs.)

57 2./

CONFIDENTIAL

ARMY AIR FORCES
MATERIEL COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

JHE:hle:54
Date 22 November 1943

SUBJECT: Project MX-225 (AC-36)

Equipment Laboratory

SERIAL No. ENG-54-673-16N

Contract No.
Expenditure Order No. 673-21
Purchase Order No.

A. PURPOSE:

To report on a trip to the Materiel Command Flight Test Base, Muroc, California, from 10 August 1943 to 30 August 1943.

B. FACTUAL DATA:

1. Personnel present at the tests were:

Materiel Command	Gulf Research & Development Co.
Captain J. H. Evans	Mr. R. D. Wyckoff
Captain M. A. Chiba	Mr. C. A. Gustavson
Captain H. M. Campbell	Mr. A. B. Lindeborg
Captain A. E. Hamilton	Mr. E. M. Palmer
	Mr. A. Carnvale
N.D.R.C.	Mr. R. K. Crooks
Dr. L. O. Grondahl	
Mr. A. J. Wollan	

2. Twenty-four Azon bombs were prepared by the Gulf Research & Development Company for general testing of apparatus performance and possible steering accuracy. A cross-shaped target was used which had one arm extended to about 4000 feet. All bombing approaches were to be made on a 270° heading above and parallel to this long arm. The bombardier was instructed to try to hit the center of the cross with emphasis on range, while the control operator tried to keep the bomb along the line of the long arm of the cross. The control operator's station was in the rear of the airplane where he observed the bomb's descent through a window installed where the lower turret was normally located.

[redacted]

MX-225

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No. of pages - 5
Page 1

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Orig. Cont. Wheeler
70.210 Mine 10/2/57
R.R.S. DEB

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Engin. Div. Memo. Report No. ENG-54-673-16N
22 November 1943

3. Two drops were made from 22,000 feet and in both cases the flare failed. The remaining twenty-two drops were made from an altitude of 17,000 feet which is 15,000 feet above the level of the target. A B-25D airplane was used for all drops flying with a true air speed of 250 MPH, and carrying two bombs per mission.

4. Out of twenty-four drops:-

a. Twelve were apparently launched properly and controlled throughout the flight.

b. Three experienced flare failures and could not be seen long enough to control properly.

c. Nine failed to control properly, apparently because of radio failure. This failure always occurred near the end of the flight, and caused the bomb to veer to the left, thus spoiling otherwise well-controlled drops.

d. One was dropped a part of a pair of two bombs released simultaneously and controlled by the same radio signals. The other bomb was followed by the control operator and made to go along the long arm of the cross. This bomb at first stayed close to the other one, but then it missed the road by several hundred feet. For detail of the hits, see Appendix I attached.

5. This series of bombs was stabilized with air-driven gyros and it was intended that these tests should ascertain whether the air-driven or the electric-driven gyro was preferable.

6. The flare ignition system was tested.

7. The reliability of the radio was closely observed.

C. CONCLUSIONS:

1. That the electric-driven gyro is preferable to the air-driven gyro. It was found that more than two air-driven gyros will not operate on the vacuum available in most standard airplanes.

2. That the flare as used is not satisfactory.

3. That the radio is satisfactory providing rigid tail bracing is used.

[redacted]

Orig. Cont. Mundy
20 Dec. 1946
R&R 3, EEB

59

[redacted]

Engin. Div. Memo. Report No. ENG-ML-673-16N
22 November 1943

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the organization designated below:

a. Union Switch & Signal Company, Pittsburgh, Pennsylvania:

(1) That the electric-driven gyro be substituted for the air-driven gyro in all future articles of the Azon type. (action initiated)

(2) That further investigation and testing of a satisfactory flare be made. Flare to be electrically ignited and capable of functioning at 30,000 feet of altitude. (action initiated)

(3) That rigid tail bracing be substituted for present tail bracing. (action initiated)

John H. Evans CK

Prepared by JOHN H. EVANS, Captain, A.C.
(Name)

G. W. Holloman Major AC

Approved by G. W. HOLLOMAN, Colonel, A.C.,
Chief, Equipment Laboratory,
Engineering Division.

G. H. Windsor Capt. A.C.

Approved by F. O. CARROLL, Brig. General, USA
Chief, Engineering Division.

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Concurrence:

[redacted]

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Ch., Mat. Div., AC/AS MM & D

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Engin. Div. Memo. Report No. ENG-54-673-16N
22 November 1943

APPENDIX I

SUMMARY OF AZON BOMB DROPS
MUROC ARMY AIR BASE, AUGUST, 1943

A. Controlled all way

Bomb No.	Dropping Order	Range Error	Deflection Error	
69	4	314 ft. under	35 ft.	Left
59	5	1595 ft. over	51 ft.	Right
56	7	45 ft. under	56 ft.	Right
68	10	415 ft. over	39 ft.	Left
73	11	551 ft. over	59 ft.	Left
64	13	140 ft. under	40 ft.	Right
53	14	125 ft. over	60 ft.	Right
63	17	605 ft. under	55 ft.	Left
70	18	1095 ft. over	4 ft.	Right
62	20	15 ft. under	1 ft.	Right
58	21	10 ft. under	22 ft.	Right
54	23	217 ft. under	2 ft.	Right
		mean deflection error	35 ft.	

B. Flare Failures

67	9	1100 ft. under	172 ft.	Right
75	15	far left		Under (Impact point not spotted, released from 22,000 ft.)
60	16	475 ft. over	117 ft.	Left (released from 22,000 feet)

C. Radio Failures

55	1	350 ft. over	1050 ft.	Left
65	2	455 ft. over	295 ft.	Left

[redacted]

Orig. Cont. Missiles
70.210 Misc. (6/5/54)
R+R S, 22B

61

[redacted]

Engin. Div. Memo. Report No. ENG-54-673-16N
22 November 1943
Appendix I

Bomb No.	Dropping Order	Range Error	Deflection Error	
74	3	112 ft. under	91 ft.	Left
72	6	125 ft. over	390 ft.	Left
66	8	320 ft. under	272 ft.	Left
61	12	328 ft. over	113 ft.	Left
57	19	165 ft. under	315 ft.	Left
76	22	259 ft. over	121 ft.	Left

NOTE: All radio failure went left.

D. Part of Dual Drop - other bomb, No. 63, was controlled by operator to hit target.

71	(17)	1000 ft. under	630 ft.	Left

[redacted]

MX-225

28

[redacted]

Ref: WOC:gk-70-50

25 November 1943

Dayton Signal Corps Procurement District
355 S. Main Street
Dayton, Ohio

Radio Receiver, AN/CRR-2 for Installation in Azon Tail Structure AZ-1.

Attention: Colonel Daw

1. The Production Division, Materiel Command has placed an order for 10,600 Azon Tail Structures, AZ-1 with the Union Switch and Signal Company, Swissvale, Pennsylvania, on Contract W33-038-AC-1706. It will be necessary for the Dayton Signal Corps Procurement District to make available to this manufacturer 10,600 each Radio Receiver, AN/CRR-2 for installation in these Azon Tail Structures.

2. The Union Switch and Signal Company has promised to at least meet the following schedule:

Jan.	Feb.	March	April	May	June
600	1200	1800	2200	2400	2400

This Company has expressed its desire to exceed the acceleration indicated and this authority will be granted if it appears to be desirable.

3. This procurement is covered by CTI-1350, Addendum No. 1 dated 28 October 1943, and is of a very high priority.

4. It is requested that appropriate action be taken and that this office be notified if the above shipping schedule cannot be met.

C. Stanley McKinley, Capt. A.C.
For W. M. MORGAN
Colonel, Air Corps,
Chief, Production
Engineering Section.

cc: Radio Liaison Unit, RCS.

[redacted]

COM. GEN.
TECH. EXC.
ADM. EXC.
C. G.
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EXP. ENG.
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PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS

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C-168-V

[redacted]

WOC:gk-70-SC
AN/CRW-2
(25 Nov. 43)

1st Ind.

Dayton Signal Corps Procurement District and Depot, 355 South Main Street, Dayton, Ohio. 25 November 1943.

TO: Army Air Forces, Material Command, OIC, Production Engineering Section, Wright Field, Dayton, Ohio. Attn: Capt. W. O. Castleberry.

1. This office has under contract 10,600 of subject receivers on order 472-DAY-44, with Emerson Radio & Phonograph Corp. However, in conversation 24 November 1943, between Colonel W. J. Daw and Brig. Gen. H. H. McClellan, it was indicated that until a definite decision is reached regarding what design receiver is to be used, that the Signal Corps is not to allow the contractor to begin production of the AN/CRW-2. This decision was reconfirmed this date in telephone conversation between Colonel T. C. Rives, Deputy Air Communications Officer, and Colonel Daw.

2. It is understood that there is a development contract placed by WDRC with the Photo-Switch Co., Boston, for a superheterodyne receiver, which if proven satisfactory may be used in place of the AN/CRW-2 super-regenerative type of received currently on contract with Emerson. It should be pointed out that though there is an indication that Emerson could meet the delivery schedule required in basic communication, a minimum period of an additional sixty days will be involved if the design is changed.

For the Commanding Officer:

CHARLES P. PATTERSON,
Major, Signal Corps,
Technical Executive.

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Address reply to _____

29

Commanding General
AAF Materiel Command
Engineering Division
Reference: JHB:hle:9A
Wright Field, Dayton, Ohio

[redacted]

123

Requirements for Special Flare
for High Angle Bomb, Project MX-225

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Chief Ordnance Officer,
Ext. 74, MTS.

1. A new requirement exists for a special flare for high angle bombs under Project MX-225, in particular the high angle bomb designated as the Azon type AB-1. This bomb is under the final stages of development by the National Defense Research Committee through the Union Switch & Signal Company in Pittsburgh, Pennsylvania. For the development of the Azon bomb, a flare incorporating a pull-match type arming has been used, but this flare is unsuited for tactical use by the services. The flare as used was supplied by the Kilgore Manufacturing Company, Tipp City, Ohio.

2. It is therefore requested that the Chief of Ordnance be asked to design and make the necessary ordnance tests of a suitable flare according to the characteristics listed below and to make available sufficient quantities to meet the Azon production schedule as set up by the Production Division, Materiel Command. Procurement has been initiated for 10,000 complete units; [illegible] units in January, 1200 in February, 1400 in March, 2000 in April, 2400 in May, and 2400 in June 1944.

3. It is further requested that authorization be secured for direct communication between the Engineering Division of the Materiel Command and the appropriate ordnance activity on the technical details of this project in order to secure the optimum results in the minimum time.

[redacted]

MX-225

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C 12-777

AAFMC-190-WF-5-20-42-2 MIL

CENTRAL FILES

COM. GEN.
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PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS
O.O. Cont
31

[illegible], [illegible], Washington [illegible], D. C.
Attn: [illegible] Ordnance Officer, [illegible]
"Requirements for special flares,
for right angle [illegible], Project [illegible]-225."

4. Herein are submitted two alternative suggestions on sketch No. [illegible]-[illegible]-121 and sketch No. [illegible]-[illegible]-[illegible] for the flare mounting and arming. In general the flare should have the following characteristics:

candle power	1,000,000 cp
maximum length	5-1/2 inches
maximum [illegible] diameter	[illegible]-1/2 inches
maximum altitude for use	35,000 feet
distinctive colors	3 colors

5. For the first alternative, sketch No. [illegible]-[illegible]-121, the flare should have the following additional characteristics:

type ignition	electrical (24 volts are available)
delay before ignition	10 seconds
minimum burning time	45 seconds

It should be noted that the four brackets shown in the sketch for the first alternative will be supplied by the manufacturer of the tail assembly in the position shown. The flare manufacturer should furnish the flare, screws in their proper holes, the squib, and plug M-302 [illegible] all in one unit ready to install.

6. Alternative No. 2 should have the same general characteristics as the first alternative with the exception that the items listed in paragraph 5, above, should be modified in the following ways:

type ignition	mechanical
delay before ignition	variable (set into the fuse)

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[illegible]-225
- 2 -
(APR 11-30)

[illegible]

[illegible] As do [illegible],
Att'n: [illegible] Ordnance Officer, [illegible]
"Requirements for Special [illegible]
for [illegible] angle [illegible], [illegible] of [illegible]."

[illegible]

[illegible] Uniform Burning Rate [illegible] seconds

[illegible] manufacturer should [illegible] to install [illegible] ordnance standard practice.

7. [illegible] should be noted that [illegible] No. 2, [illegible] No. [illegible], [illegible] of [illegible] should also be noted that [illegible] equipment and follows the ordnance [illegible].

8. [illegible] further [illegible] coordinated with [illegible] Division, [illegible], [illegible] of Special Weapons Projects.

[illegible] the Commanding General:

[illegible]

[illegible]

2 Incls.
Incl. 1 - Sketch [illegible]
Incl. 2 - Sketch [illegible]
Copy to:
Ordnance Section
Att'n: Lt. Col. [illegible]

[redacted]

 Contract XX-088 ac-1706

1872

Union Switch & Signal Company
Swissvale, Pennsylvania

X

X

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X

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X

X

Approval Recommended:
17 December 1943

W. F. VOLANDT
Colonel, Air Corps
Chief, Procurement Branch
Office, Assistant Chief of Air Staff
Materiel, Maintenance & Distribution

DEC 20 1943

APPROVED: _____
By direction of the Under Secretary of War

PHILLIPS W. SMITH, Colonel
~~ARTHUR J. BROWNING~~
~~Brig. General~~, General Staff Corps
Special Representative of the
Under Secretary of War

[redacted]

c 32

WF-9-21-43-10M
AAF Materiel Command
Letter Contract

4 CONFIDENTIAL

3

WAR DEPARTMENT
ARMY AIR FORCES
MATERIEL COMMAND
OFFICE OF THE COMMANDING GENERAL

87-4A:LAM:mcc

Contract No. W 33-038 ac-1706

Wright Field, Dayton, Ohio
24 November 1943

NAME: Union Switch and Signal Company

ADDRESS: Swissvale, Pennsylvania

Dear Sirs:

1. An order is hereby placed with you for the furnishing to the Government of the following supplies or services:

Item 1 - Ten Thousand Six Hundred (10,600) each Axon Tail Structure, Type AZ-1

At a total estimated price of $10,600,000.00

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2. You are directed, upon your acceptance of this order (or upon its approval if required by paragraph 9) to proceed immediately to procure the necessary materials, and to commence the manufacture of the supplies or performance of the services called for in paragraph 1, and to pursue such work with all diligence to the end that the supplies may be delivered or services performed at the earliest practicable date.

3. All applicable articles (other than the article "Termination for the Convenience of the Government") now required by Federal Law, Executive Order, or War Department Procurement Regulations to be included in contracts for supplies or services of the kind herein described are incorporated herein by reference.

4. By your acceptance hereof, you undertake without delay to enter into negotiations with the War Department looking to the execution of a definitive contract which will include all applicable articles then required by Federal Law, Executive Order and War Department Procurement Regulations to be included in contracts for supplies or services of the kind herein described. The definitive contract will also contain a detailed delivery schedule and prices, terms and conditions as agreed to by the parties, which may or may not be at variance with the provisions of this order. It is expected that such definitive contract will be placed with you prior to 1 February 1944

5. You are not authorized to expend or obligate, in furtherance of your performance hereunder, more than $ 5,300,000.00 in the aggregate. Pending the execution of a defin-

[redacted]

CA-9842

Officer not later than 4 December 5 1874, 1943. Such acceptance will constitute this order a contract on the terms set forth herein, subject to the written approval of the Secretary of War or such individual as said Secretary may designate.

10. This instrument is authorized by and has been negotiated under the First War Powers Act, 1941, and Executive Order No. 9001.

UNITED STATES OF AMERICA

By J. O. Hodges

J. O. HODGES, CAPTAIN, AIR CORPS
Contracting Officer

ACCEPTED December 1, 1943

UNION SWITCH AND SIGNAL COMPANY
(Contractor)

By W. H. Cadwallader
(W. H. Cadwallader)
Vice President & General Manager.

The Finance Officer U. S. Army, Public Ledger Bldg., Independence Sq., Philadelphia, Pa. is designated as the officer to make payments in accordance with this contract.

The sums to be expended by the Government hereunder are chargeable to the following allotments, the available balances of which are sufficient to cover the same:

ACA 1942-44, 2-4805 P 110-09 A 212/40705

Type Contract Contemplated Fixed Price
Authority for Purchase No. 378558
Priority Rating AA-1
Equipment Class 11-A
Classification Confidential
Program None

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(AFR 11-30)

[redacted]

C

SECRET

AFACO/M-2

20 Dec 43

CURRENT STATUS OF GUIDED MISSILES PROGRAM

The following outline reviews the results of tests, development, training, and expedition of production on guided missiles since the previous report furnished 1 December 1943:

1. AZON (High Angle Glide Bomb with azimuth control only)

a. Development: Development of the pre-production model of the 1000 lb. Bomb is continuing, with the tail and gyro-servo assemblies being done by the Union Switch & Signal Co., and the super-regenerative radio receiver being developed by General Instrument Co. and Emerson Radio. During the past week, General Instrument furnished ARL with a first model, which is now undergoing tests expected to be completed 24 December. The first developmental model from Emerson is expected to be in the hands of ARL for tests on or about 1 January 1944. Material Command has been requested to develop flares with three contrasting colors, and the Air Ordnance Branch is actively engaged on this project.

b. Tests: Seven (7) test drops of Azons with the General Instrument super-regenerative receiver were made at Field 1, Eglin Field, Fla. since the last report. None of these drops was entirely successful. Some failures were due to radio but the majority were caused by mechanical and other troubles. Subsequent revisions and corrections have been made, and fifteen (15) tail assemblies, complete with radio and gyro-servo mechanisms were sent to Field 1, Eglin, for further tests this week. No reports have as yet been received as to the outcome of these latter tests.

c. Training: Eight (8) enlisted men are now located at Field 1, Eglin, to be trained in the handling of radio links and gyro-servos for Azon. In addition, it has been requested that a B-17 airplane and crew be assigned to carry on tests and be trained in the operation of Azon bombing. A program is proposed for the over-all training of personnel which will eventually require the following:

Radio Control Bombardiers	- 48
Radio Maintenance Men	- 16
Servo Mechanics	-32

An R&R is being prepared for Military Training covering the fundamental estimated personnel requirements as outlined.

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33

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d. Procurement: Procurement on Azon remains the same as indicated in the 1 December report - namely, 10,600 total requirement for tail assemblies, gyro-servo mechanisms, and radio receivers. It should be noted, however, that in addition to this general Army procurement, an additional 2000 receivers have been ordered from the General Instrument Co. to serve as a stop-gap until the Emerson Radio production is under way. NDRC have also placed developmental contracts for 200 super-regenerative receivers with General Instrument Co. and for 200 super-hetrodyne receivers with Photo-Switch Co. Production by Emerson Radio is to be started as soon as ARL completes tests and submits a production model from which to work.

e. Remarks: Reviewing the development of Azon, it has been determined that:- The demonstration held at Muroc on 10 October 1943 was with Azon bombs which were purely experimental models. For example, the radio set was not installed in the tail assembly but inside the bomb proper and sand packed around it. The radio set used was not completed and ready for production. The tail assembly was circular in shape, whereas the present production model is square. These are only a few of the differences between the original experimental model and a model satisfactory for starting production. As a result, this Section has been primarily concerned with the expediting of necessary steps to bring that development has been completed up to a stage ready for production. It is estimated now that first completed deliveries may be available on or about 1 February 1944.

2. RAZON (High Angle Bomb designed for both azimuth and range control)

a. NDRC are continuing development of this bomb in both 1000 lb. and 2000 lb. sizes. No procurement beyond NDRC developmental contract is planned at present.

3. GLIDE BOMBS - GB-8 (Gyro-stabilized 2000 lb. glide bomb with radio control of both range and azimuth. A smoke trail or flare is used as visual aid in steering to the target. Formerly called GB-2)

a. Tests & Development: Tests were held last week at Muroc Lake to determine receiver type. There is some question now as to whether the SCR-185 standard receiver, which has been recommended by ARL, will be procured or whether a later development by Hammond may be better. Decision will be reached at a meeting 22 December. In the meantime, procurement of SCR-185 is held in abeyance. No further development is necessary on wing structures, or gyro-servos.

b. Training: Same conditions as outlined in preceding paragraph 1e, training for Azon.

c. Procurement: No change in original procurement requirements for 2000 completed units except as noted in paragraph 3a.

[redacted]

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Cont. Minutes
AC-36-65 (3 of 4)
RL, DSD

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d. Remarks: The SCR-185 receiver with slight modification, has been tested and recommended by ARL as satisfactory for operation with the GB-8. Recently, however, the Hammond Co., who make the gyros, have designed a new type of receiver equipment for use in conjunction with standard SCR-274 receiver component, which is intended to replace the SCR-185. Mr. Hammond prevailed upon Col. Hollomon of Equipment Laboratory to delay procurement of SCR-185 until he, Mr. Hammond, could appear to explain the advantages offered by his equipment. Consequently, Col. Hollomon requested a conference for final decision to be held in December 1943.

g. Conclusion: It is now estimated that 100 of the GB-8 glide bombs will be completed and delivered for operational tests about 1 March 1944. These tests will be conducted by the Army Air Forces Board, possibly at Tonopah, Nevada, with Proving Command and Wright Field personnel assisting and observing. An RAR covering the conditions of such tests is being forwarded to Orlando for coordination and comments.

4. GLIDE BOMBS - GB-4 (Television-radio controlled)

a. Development: A new wing structure has been designed and tested, with first models being manufactured by a West Coast company. The television, Block III equipment is a frozen design.

b. Tests: No tests have been made since the last report. Further tests are planned, using the new pre-production wing structure, at Field 1, Eglin, shortly after first of the year.

c. Training: A training plan is now being formulated to be covered by separate RAR to Training. For preliminary testing and operational work, personnel will continue to be drawn from Wright Field and Orlando.

d. Procurement: The purchase plan for 2000 transmitters and 110 receiver-monitors is now in hands of Signal Corps procurement at Wright Field for execution with manufacturers. Procurement for 2000 wing structures, complete except for television and radio, have been ordered through Materiel Command. The procurement of 2000 SCR-185 radio link receivers has also been ordered through Signal Corps, but actual procurement may be delayed until 22 December conference with Hammond. It should be noted that the Hammond equipment cannot be used in the GB-4, but total procurement of SCR-185 for GB-4 and GB-8 requirements will be affected by the decision reached on Hammond's device.

e. Remarks: 100 completed units are expected to be delivered and ready for operational test about 1 April 1944 in the same manner as tests on GB-8 described in paragraph 3g.

5. RHB (Radar Homing Bomb requiring special radar transmitter to illuminate the target)

a. Development: The Army is taking 200 only development models from Navy Bureau of Ordnance.

[redacted]

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(AFR 11-30)

Bomb. Missile
RC-36, 65 14/1/44
RL, 926

SECRET 1868

b. Tests: Expected some time during January.

c. Training: Joint with Navy.

d. Procurement: None beyond the 100 developmental models.

e. Remarks: Special Weapons Branch at Wright Field are following entire project.

6. GBB - "Beth" (Wing Receive Homing Bomb)

a. Development: Continuing through Navy Bureau of Ordnance.

b. Tests: No definite dates established. Estimated early 1944.

c. Training: No training program planned at present.

d. Procurement: The Navy will procure for the Army from Bell Telephone Laboratories a total quantity of 500 GBB units. 35 of these units will be pre-production models.

7. Beth (Bomb Designed to home on enemy radar antennae)

a. Experimental only. 15 units under construction at Wright Field (ARL), and 3 units at RRL. It is expected to have some models ready for tests during January.

8. Power Driven Bombs.

a. The first model XBQ-2 has been delivered from Fleetwing at Wright Field. No decision yet on to type for future procurement. The XBQ2 is designed for a 2000 lb. load.

CONCLUSIONS:

From the foregoing, it appears that the Razon may be ready for introduction to theatres about 1 March 1944. The GB-8 may be ready by July, and the GB-4 in August.

STUART F. WRIGHT
Colonel, Air Corps

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(AFR 11-30)
[redacted]

3

CONFIDENTIAL

Address reply to ENVELOPE to

Commanding General,
AAF Materiel Command,
Engineering Division,
Reference: ANrms:5,
Wright Field, Dayton, Ohio.

AC-36
Copy of
AC-42
AC-51

11 JAN 1944

National Defense Research Committee,
Division 5-5,
Massachusetts Institute of Technology,
Room 10212,
Cambridge, Massachusetts.
Attention: Dr. J. C. Boyce.

Gentlemen:

The object of this letter is to bring to your attention a pulse type radio control transmitter suggested by the Hammond Research Corporation for which R.C.A. would provide the necessary cooperation.

A demonstration of this system to a Materiel Command representative and the study of the circuits by the technical personnel of the Materiel Command indicates that the type of coding suggested is particularly suitable for Azon operation and can be eventually extended to glide bomb use. The description of the operating system as demonstrated to Materiel Command representatives appears to be technically sound and adaptable to relatively light weight transmitter and receiver with a considerable degree of immunity from enemy jamming.

A conference with R.C.A. representatives indicates that the following experimental elements will be developed by R.C.A. Laboratories in the event this project is activated:

1. A square wave generator.

2. A frequency shifter.

3. A coding device.

4. A complete receiver.

5. Drawings and diagrams for transmitter (modification of 100 K.W. radar transmitter).

6. Necessary transmitter tubes.

7. Test facilities for experimental adjustment of transmitter and receiver.

[redacted]

MX-108

PROJECT NO.

34

4

[redacted]

National Defense Research Committee,
Division 5.5,
11 JAN 1944

It is expected that the transmitter will operate up to altitudes of 30,000 feet without provisions for pressurization. The dimensions of the receiver will be held to the space available in Azon.

A six months development period is envisaged for this project.

It is recommended that Division 5.5 of N.D.R.C. consider carefully the operational advantages of a pulse type control system as suggested by the above Company for application to Azon and eventually to Razon and glide bombs, with a view of eventual sponsoring of this development for use in the Materiel Command controllable missile program.

Very truly yours,

F. O. MARSHALL,
Brig. General, U.S.A.,
Chief, Engineering Division.

Copy to:
R.C.A., Attn: Mr. L. F. Jones.
N.D.R.C. Liaison
AEL

[redacted]

PROJECT NO. M1-105

Orig. Cont. Miscellaneous
70.0210 Misc. 21 (1/3 pt)
R+R S, DEB
M+S

2.1 71

OFFICE FOR EMERGENCY MANAGEMENT
NATIONAL DEFENSE RESEARCH COMMITTEE
OF THE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P STREET NW.
WASHINGTON, D. C.

JAMES B. CONANT, Chairman
RICHARD C. TOLMAN, Vice Chairman
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MAJ. GEN. CLARENCE C. WILLIAMS

IRVIN STEWART, Executive Secretary

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(AFR 1-30)

[redacted]

Union Switch & Signal Co.
Pittsburgh 18, Pennsylvania

January 13, 1944

Colonel R. C. Wilson, A. C.
Chief, Devel. Engr. Br., Materiel Div.
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution
War Department
Headquarters of the Army Air Forces
Washington, D. C.

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Attention: Colonel M. C. Demler, A. C.

Dear Sir:

Please refer to your letter, Ref. AFDMA-2F.

We shall of course be very happy to get the additional data which you propose to give us on the ANM-65 bomb which was taken to Langley Field by Capt. Rand. We had no idea at the time that it would be possible to keep the bomb in the wind tunnel long enough to get aerodynamic data and so asked for data that could be obtained in a very short time.

As a matter of fact, we have not been worried about the question of whether we can get sufficient lift or sufficient controllability. Certainly as far as azimuth control is concerned there is no difficulty from this standpoint in the units that have been used previously. I believe that by this time Col. Greene and his men understand why we are not concerned about controllability. Mr. R. D. Wyckoff has shown them some of the moving pictures which record the demonstrations of controllability

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that we have made in the field. It is ample for our purposes. There are, however, many aerodynamic data which would be of very great help to us and principal among them is the question of hinge moments that are required at high speeds to operate our control surfaces. These hinge moments we have got only by very wide extrapolation from wind tunnel tests which never exceeded 150 m.p.h., and the quantitative extrapolation is probably not too reliable.

We have had no definite indication that the torques that we have provided are insufficient, but in some of the units that will be tried in the near future greater deflections will be necessary, and for that reason hinge moment measurements become exceedingly important. It is, of course, possible to build the apparatus for applying the torque so large and so powerful that there would be no question about their adequacy. There is only one difficulty with that solution and that is that the space available is limited. In order to properly engineer the job, you can see that it will be very valuable to us to know what torques are necessary.

While you are making the aerodynamic experiments, we should appreciate it very much if you can give us answers to the following questions:-

(1) How seriously is the effectiveness of our control surfaces altered by the presence of struts?

(2) How much would the situation be improved by removing the struts?

(3) Some of us believe that the structure is strong enough without struts. Can that be checked?

(4) If we should substitute a #8 wire or smaller instead of two of the struts to be used as antennas, how would that affect the aerodynamic behavior of the unit?

It is difficult for us to express strongly enough the delight that we feel at the possibility of getting the assistance of the N. A. C. A. wind tunnel, personnel, and

Orig. Cont. Minutes
70.210 Misc. 21 (1944)
R+R 2, DEB

2-173

[redacted]

apparatus. We have for a long time wished that we could get a complete set of aerodynamic data and at speeds that would mean something in our field experiments. All we can say is that we are very grateful for this opportunity and for your willingness to cooperate.

Your invitation for me to go to Langley Field to discuss the subject is also appreciated, but I believe the same purpose has been accomplished by the fact that Mr. Wyckoff, representative of our principal development contractor, the Gulf Research & Development Co., is spending some time with the men at Langley and has thoroughly discussed the subjects involved, giving them at the same time the record of our experience.

Yours very truly,

L. O. Grondahl

L. O. Grondahl
Chief, Section 5.2, NDRC

LOG:jem
cc: Dr. J. C. Hunsaker
Mr. H. B. Richmond
Mr. H. H. Spencer

2

14

AC-1706

EP:67-12

25 January 1944

Amendment No. 1 to Letter Contract
Special Form dated 24 November 1943
(W 33-038 ac-1706)

Union Switch & Signal Co.,
Swissvale, Pa.

AFF: 378558

1. The subject Letter Contract, dated 24 November 1943, accepted by you 1 December 1943, and approved by approving authority 20 December 1943, provided that in the event the formal contract for the supplies referred to therein was not planed with you prior to 1 February 1944 (or any subsequent date at any time mutually agreed upon), subject Letter Contract would terminate.

2. It is now considered that it will facilitate the prosecution of the War to extend the date of 1 February 1944, as set forth above, to 1 April 1944. Such date is hereby extended.

3. If the foregoing is acceptable to you, will you kindly so indicate on the original, the carbon-backed copy and one (1) copy of this letter and return to the Contracting Officer forthwith, thereby constituting this letter an Amendment to subject Letter Contract.

4. This Amendment was negotiated under the authority of the First War Powers Act, 1941, and Executive Order No. 9001, 27 December 1941.

J. R. WOHL,
Major, Air Corps,
Contracting Officer.

ACCEPTED: Jan. 28, 1944
(Date of Contractor)

Union Switch and Signal Company,
(Business Address)
Swissvale, Pa.

BY: W. H. Cadwallader
(Name) (Official Title)
(W.H.Cadwallader)
Vice President & General Manager.

[redacted]

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Carbon Copy
Coal Minutes
70.210 Min - 23 (1/2 M)
R.R.J. D.S.B.
M.J.

CONFIDENTIAL

(AFDMA-2F)

2 February 1944

SUBJECT: Change from Experimental to Production Prodedure on Azon

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Special Weapons Branch.

1. A copy of the letter to the Materiel Command of 1 February 1944, subject, "Azon Specifications and Drawings" is attached for your information.

2. Paragraph 3 of the above-mentioned letter is of particular interest since it states that the production order of 10,600 Azons is to follow standard Materiel Command Procurement and Engineering channels in all respects.

3. If any difficulties develop on the switch from the N.D.R.C. experimental procedure to the Materiel Command production procedure that might result in a production delay, information on these difficulties will be appreciated by this office.

By command of General ARNOLD:

R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Div.,
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

1 Att.
Ltr. dtd. 1 Feb. '44,
subj. as above.

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[redacted]

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0818

Carbon Copy
Corr. Minutes
70.2.10 Misc. 23 (2/8/44)
R+R 3, DEB

CONFIDENTIAL

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Copies to Maj. Norvell and Comm. Equip. Off. 4 Feb. 1944

(AFDMA-2F)

1 February 1944

SUBJECT: Azon Specifications and Drawings

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Aeronautical Equipment Br., Production Engineering Section, Capt. W.O. Castleberry

1. The following information is attached:

a. Letter of 19 January 1944 from Union Switch and Signal Company to Major Norvell.

b. Specifications of 18 January 1944 by L. O. Grondahl divided into the following three parts:

(1) "Requirements for 1000 lb General Purpose Azon, Type AZ-1."

(2) "Structure and Apparatus."

(3) "More Detailed Description of AZ-1."

c. The following Union Switch and Signal Company Drawings:

CO	506350	Sheet 1, Approved 1/19/44
CO	506350	Sheet 32, Approved 1/19/44
CO	506350	Sheet 33, Approved 1/19/44
CO	506350	Sheet 34, Approved 1/19/44
CO	406350	Sheet 43, Approved 1/19/44

d. The following L. N. Schwien Engr. Co. Drawing:

"Assembly - Flight Control Gyro", Drawing 45600, dated 9/16/43

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(AFR 11-30)

[redacted]

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Carbon Copy
Capt. Wheeler
70.210 Misc
23(3/3 M)
R+RS, DEB

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CONFIDENTIAL

TO CG, Mat. Com. Wright Field, ATTN: Capt. Castleberry Page 2.

2. These drawings and specifications have been held up until successful tests were made using mechanical linkage between the ailerons.

3. The development of the Azon has been an experimental project of N.D.R.C. The 10,600 procurement order by the Materiel Command, however, is to follow standard Materiel Command Procurement and Engineering channels in all respects.

4. It is requested that the approval or necessary corrections to the Union Switch and Signal Company specifications and drawings be expedited in order that their tentative plans of starting production on the Materiel Command order on approximately 10 February 1944 will not be delayed.

5. It is requested that this office be notified if there will be any delay in this approval that will hold up production.

By command of General ARNOLD:

H. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Division.,
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

[redacted]

1

NTER-OFFICE MEMORANDUM

ARMY AIR FORCES
MATERIEL CENTER
Office of The Commanding General

Capt. Castleberry
gk-70-5C Tel. 28228

Wright Field, Dayton, Ohio

[redacted]

Date 3 February 1944

TO: Inspection Division,
Wright Field, Dayton, Ohio.
Attn: Major W. A. Oswalt

AC-1706
(33-038)

SUBJECT: Assignment of AAF Inspector to Union Switch & Signal Company, Swissvale, Pennsylvania.

1. Contract W 33-038-AC-1706 was placed by letter 23 November 1943. As yet a formal contract has not been issued but the Procurement Division is exerting every effort to accomplish a formal contract.

2. Due to both the urgency and the secrecy of the program it is realized that complete information has not been made available to all Branches concerned; also at the time the contract was placed very little information was available.

3. Delivery of Azon, Bomb Tail Assemblies was scheduled as:

Jan.	Feb.	Mar.	Apr.	May	June
600	1200	1800	2200	2400	2400

This was an optomist schedule and a more realistic schedule in view of difficulties that have been encountered would be:

Jan.	Feb.	Mar.	Apr.	May	June	July
0	1000	1800	2200	2400	2400	800

Deliveries on the production order will probably begin about 15 February 1944. NDRC had an order for 200 each for service testing and the delivery of this order is just coming to completion.

4. The contract was placed using Contractor drawings as worked out by NDRC. During the NDRC order many changes in design were made but the Union Switch & Signal Company completed revised drawings about two weeks ago and these were sent to Washington for approval. The revised Contractor drawings should be adequate to accomplish inspection.

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Signature

[redacted]

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NTER-OFFICE MEMORANDU

ARMY AIR FORCES
MATERIEL CENTER
Office of The Commanding General

[redacted]

Wright Field, Dayton, Ohio
Date 3 February 1944

TO: Inspection Division,
Wright Field, Dayton, Ohio.
Attn: Major W. A. Oswalt

SUBJECT: Assignment of AAF Inspector to Union Switch & Signal Company, Swissvale, Pennsylvania.

5. Both the Production Division and the Procurement Division have been working against practically impossible deadlines and at all times information has been inadequate. However, the Chief of the Army Air Forces, as per letter 16 November 1943, desires that nothing should hinder the Guided Missiles Program.

6. It is requested that an Army Air Force Inspector be assigned to subject Company in order to assure the success of the Azon Program.

H. O. Cattleberry Capt AC
for W. M. MORGAN,
Colonel, Air Corps,
Chief, Production
Engineering Section.

[redacted]

Signature .....

C/C Const. Missiles
70.210 Misc. 25 (2/5 mp)
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Azon

4 Feb 44

AC/AS, O. C. & R.

1

SPW:mmv 5375

Air Communications Officer

1. In order to expedite the employment of the Azon type of guided missile, 1000 pound GP bomb, controllable in azimuth only, it is recommended that a program be set up which will make possible the employment of at least one hundred (100) Azon bombs against special targets in the European Theater of Operation. As these targets are of primary interest and their destruction mandatory, every effort should be made to provide the 8th Air Force with the Azon type of guided missile. In order to implement this program, the following immediate action is recommended.

a. The supervision of the initial training and plans for tactical employment should be assigned to the Army Air Forces Board, Orlando, Florida.

b. Establish the dead line date to depart the continental U. S. as not later than 1 March 1944.

c. Instruct the Air Forces Board to plan the training of the replacement crews so that there will be at least 100 Azon bombs available for actual employment.

d. Inform the AC/AS Training of the plans so that adequate training facilities may be incorporated at an early date for production articles.

e. Assign six (6) replacement B-17-G type airplanes scheduled for the 8th Air Force to Orlando by 7 February 1944 so that the necessary controls, radio transmitters and associated equipment can be installed and ready for use by 15 February 1944. Installation of this equipment will require the services of four (4) men per airplane with supervisory personnel being furnished by Aircraft Radio Laboratory, Wright Field. The time required to make this installation will be one (1) week.

f. The replacement crew members to accompany the six (6) B-17-G airplanes mentioned in (e) above should be as follows:

Pilot
Co-Pilot
Navigator
Bombardier
Radio Operator
Engineer

All other crew members to be sent to the Theater by other means. The off loaded crew members to be replaced by personnel listed in h below so that the technicians can accompany aircraft to the Theater.

g. For instruction on the Azon trainer, Col. S. R. Stewart, Special Weapons Branch, Equipment Lab., Wright Field, will make Capt. Chiba available for one day. A telephone call by the Air Forces Board to Col. Stewart as to the

[redacted]

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G/C Cont. Missile,
70.210 Misc.
25(3/5 pp) R&RS
DSB

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Azon cont'd

desired date is all that is necessary. The actual drops will be made at Eglin Field No. 1, where qualified personnel on Azon are available for the initial training required in this program.

h. The following technicians to accompany the aircraft to the theater and included in the orders as such:

One (1) civilian Technician from Union Switch and Signal Co. (Manufacturer of Azon)
One (1) officer Technician from Special Weapons Branch, Equipment Lab., Wright Field.
One (1) officer or civilian Technician from Aircraft Radio Laboratory, Wright Field.
Four (4) enlisted men qualified in Azon gyro and servo maintenance.
Four (4) enlisted men qualified in Azon radio link maintenance.

The above personnel to be prepared for overseas shipment which will necessitate passports for the civilians.

i. The weight of the 100 Azon assemblies, the tail section which contains all control mechanism, will weigh about 12,000 pounds and it should be directed that this initial number go via Air Transportation. The shipment of these assemblies should coincide with the departure of the subject airplanes and crews so that all will arrive in the theater concurrently.

j. An officer should be assigned to this program so that one person will have the responsibility and authority to control all items and deliver same to the 8th Air Force. This officer, also, would be the one to acquaint the Air Force Command with the capabilities and limitations of this guided missile. This office will furnish an officer for this assignment with the understanding that the temporary duty will not exceed sixty (60) days.

H. M. McCLELLAND
Brig Gen, USA

[redacted]

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(AFR 11-30)

Orig. Cont. Missiles
70.210 Misc 26(1/4pp)
R+R 8, D&B
M+8

SECRET 89

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HEADQUARTERS
607th SINGLE ENGINE GUNNERY TRAINING SQUADRON
FIRST SINGLE ENGINE GUNNERY TRAINING GROUP
EGLIN FIELD, FLORIDA

7 February 1944

SUBJECT: Tactical use of Azon.

TO : Air Communications Officer, Special Projects Section, Headquarters, Army Air Forces, Washington, 25, D. C.

1. Most of the points in this report are developed and projected academically by combining a careful study of the available information on Azon with the general knowledge and back ground of theater of experience. An attempt is made to indicate how necessary it is to begin at the earliest possible date a program of training and experimentation which can furnish information more concrete and reliable than an academic guess.

2. A furthur limitation to Azon's tactical effectiveness besides those discussed in the preliminary report has appeared.

I. Range error.

a. There is an inherent range error in Azon as in any other bomb. Ordinary bombing depends upon a pattern or string of bombs to compensate for this error. However, in using Azon there is no such compensation. It either hits or misses, there is only one chance. This range error is sufficient at medium altitudes to be almost prohibitive against Azon's use on strictly pin point targets. Against such an objective as a coastal gun position, Azon's near - perfect azimuth is of no value at all, if the range of the bomb is off by even a small amount.

b. Let us analyze this range error. In the Azon there are several factors which affect the bomb's drop besides those which affect the course of an ordinary 1000 lb. bomb. One of these factors is the time when control is first applied, another is the amount or length of time of control.

The following table compares the fall of a conventional 1000 lb. bomb to that of the 1000 lb. Azon under varying conditions of control.

	ALTITUDE	GROUNDSPEED	TIME OF FALL (Sec.)	RANGE (Feet)
Conventional 1000 lb. bomb	15,000	250	31.41	10,837
Azon - no control	15,000	250	31.85	10,573
Azon full control during entire drop	15,000	250	34.07	9,966
Azon "Average" control applied after 20 seconds	15,000	250	32.77	10,541

NOTE: Azon figures from calculations by M.I.T.

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This table reveals several interesting things, but the fact of primary interest to this discussion is that control does have a very noticeable effect on the range of the bomb and therefore on the range error. While there are no figures available of Azons dropped at other altitudes or other speeds, it is safe to assume that they follow the same general trends as the conventional 1000 lb. bomb at the same altitudes and speeds. We know that a simple change in bombing altitude will change our range error accordingly. For example, at 10,000 feet our average error is only 5/6 that of 15,000 ft., while at 20,000 feet it is 1 1/6 the error at 15,000 ft. Since the lowest altitude where an air craft is safe from light and medium flak is app. 9,500, it is easy to conclude that Azon's most effective altitude for bombing pin point targets would be somewhere between 10 and 12 thousand feet. In spite of the fact there is no data for drops above 15,000 ft, indications are that the accuracy of azimuth control will not suffer noticeably, up to at least 20,000 feet. For this reason, Azon could still be effective against a longitudinal target from this altitude, but not against a pin point target, since the range error increases so rapidly with the increase in altitude. To review our original thesis. Range error inherent in Azon would render it relatively ineffective against pin point targets.

II. Remedies.

a. More than any other factor, intelligent use of the bomb will neutralize this disadvantage. In the case at hand this obviously points to Azons employment against longitudinal, or strip targets. The campaign in Italy, to mention one specific theatre presents dozens of such targets: Strategic roads and intersections; bridges, both steel and concrete, both railroad and highway; railroads and marshalling yards; large enemy ships. Any other campaign where local communications, especially land communications, are of such vital importance would offer similar targets.

b. Selection of proper altitude. This has already been discussed above. The proper altitude seems to be the lowest one which will still allow the attacking air craft security against light and medium flak. This altitude would be above 9,500 and probably somewhere between 10,000 to 12,000 feet.

c. Development of some suitable device to control a string of Azons dropped in train.

d. A Razon unit which can suitably compensate for this range variation seems to be one complete answer.

III. Training.

a. The necessity for a program to determine by actual experiment the tactics best suited to the use of Azon becomes increasingly apparent. Such a program would include the following salient points:

1. Formation.

a. Since a concentration of bombs on the target is desirable both for destructive effect and for security of air craft making the run, an attempt should be made to determine the maximum number of air craft which can drop Azon's simultaneously on the same bomb run and still allow accurate control of each bomb without interference between units.

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(AFR 11-20)

b. Study the possibilties of suitable evasive action to protect the attacking air craft. Determine what action can be taken without disturbing the formation and without interfering with proper control of bomb.

c. Decide what formation gives most accurate bombing results.

2. Altitude.

Determine by actual experiment the effect of altitude on Azon drops:
1. Range error - best altitude.
2. Effect on control of bomb - determine maximum and minimum altitudes at which adequate control can still be obtained.

3. Investigate Azon's night bombing possibilities.

a. This might have promising possibilities, since darkness furnishes a lone bomber with a degree of protection impossible to day bombers.

4. Investigate use of Azon as part of combined operation with other conventional bombardment serving as diversion.

5. Investigate bomb's application to lgith, fast air craft of Mosquitoe type, which can fly in small formations or without formation to attack special targets, and which rely chiefly upon their speed and manueverability for protection against enemy action.

6. Investigate the results obtained by using different types of air craft: B-25, B-26, B-17, B-24, P-38 etc.

7. Study the effect of Azon on different types of targets.

IV Recommendations.

a. Ballistics and bomb tables on Azon.
1. Of first importance, even before any training program can be conducted properly it is imperative that ballistics and bomb tables for the Azon be furnished by the Proving Ground at Aberdeen.

b. It is my opinion that Azon is definitely a medium bombardment or light bombardment weapon. Too many advantages of a B-17 or B-24 would be wasted, for example their ability to fly at high altitudes, their superior bomb carrying capacity, their long range. At present, indications point to the most effective altitude of Azon being somewhere between 10 and 12 thousand feet. This is the very altitude range at which the majority of medium bombers are already operating today. And if experiments prove that the bomber can perform it's job with one or two Azon's as effectively as it formerly did with three or four times that weight of ordinary bombs, there is left a margin of pay load which the field commander might use in a variety of ways. Azon furnishes pleasant possibilities of extending the range and versatility of some types of medium and light bombardment air craft whose striking power in the past has been limited by insufficient range.

c. That the necessary elements for Azon training and experimentation be set up.

V Conclusions.

Everything seems to point to one salient fact: That the effectiveness of Azon will be dependent almost entirely upon it's handling.

Orig. Cont. Missiles
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R&RS, P&B

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In my opinion, a candid recognition of Azon's limitations and a means to minimize them should govern it's use. One of these limitations appears to be it's range error; others can only be brought to light by experiments conducted on a suitable scale to simulate combat conditions of formation, target and evasive action. With a view to the present lack of exact information on the tactical possibilities of Azon and the lack of proper training of combat crews in it's use, I believe that any large scale attempt to use Azon against pin point target would prove disappointing. However, should the proper machinery for training and experimentation be instituted without delay, these problems of inexperience and lack of knowledge can be solved in a few weeks.

Gordon C. Bigelow
1st Lt. Air Corps
46 AAF

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Mimeo - Cont. Missiles
70.210 Misc - 24(1/7M)
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Azon Dev
Pol

February 11, 1944.

Training and Experimentation program for tactical use of Azon.

Air Communications Officer,
Special Projects Section,
Headquarters, Army Air Forces,
Washington, 25, D.C.

1. The following program is recommended. It has already been pointed out in a previous report why, in the writer's opinion, Azon is more suited to medium than to other types of bombardment. But to review these reasons briefly: 1. It has been found that a certain unavoidable range error is reduced to a minimum by dropping Azon from the lowest safe altitude. This was found to be between 10 and 12 thousand feet. 2. Medium bombers are already operating at this very altitude range. Also, their bomb-carrying capacity, their speed, their accustomed targets, all coincide with those conditions which would make for the most effective use of Azon. 3. Too many advantages of heavy bombers would be wasted: their superior bomb-carrying capacity, their long range. Flying at their comparatively low speeds they would prove quite vulnerable at altitudes of 15,000 feet or below. This program, therefore, presumes that Azon will be applied to medium bombardment for its main use and that only special missions will be conducted by light and heavy type bombardment

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aircraft. An attempt has been made to combine two programs in one with a view to compressing the experiments into as short a time as possible. The same Azon units can thus serve the two-fold purpose of evolving effective tactics for the bomb and giving green combat crews experience in its use.

2. This program is set up to provide only the minimum requirements of training for one flight of six aircraft. But it provides the framework upon which a much expanded training program can be built.

3. Necessary elements.

a. As soon as practicable to have Azon ballistics and bomb tables furnished by the Aberdeen Proving Ground.

b. A minimum of six B-26 or B-25 type aircraft equipped with Azon installations.

c. Six complete combat crews to man the above aircraft.

1. It is essential that the crew chiefs of these aircraft accompany their planes through the installation point to the training point. They are necessary to keep mechanical troubles to a minimum and to expedite a quick ferry trip to the combat zone.

2. Since this is specialized equipment and since these crews will be used to train other units, an effort should be made to obtain crews which have already completed their advanced tactical training and are familiar with conventional techniques of bombing and evasive action.

d. One B-17 type aircraft

e. One light-bombardment type aircraft, preferably Mosquitoe with crew to man it.

[redacted]

f. A sufficient number of Azon units to permit trial of basic formation patterns, and to experiment with varying conditions of altitude, target, and evasive action. Estimated number--fifty (50).

g. An officer familiar with Azon technique to serve as instructor and to supervise the experiments.

h. The assistance of civilian technicians who are intimately familiar with Azon mechanisms to assist instruction and to cope with mechanical problems in Azon units.

i. Suggestion: If at all possible that the training location be changed from the Gulf Coast to some area such as the Southwest where weather will not prove such a handicap to proceedings. That is, if any extensive training program is contemplated. Visibility and ceiling conditions must be optimum for Azon work.

4. Training program for six medium bombardment crews.

a. This program presupposes that the Azon units in aircraft are to be tuned each to a separate frequency, and that three separate flare colors are available, to allow a different assigned color to each unit of a three-ship element.

b. Indoctrinization.

1. Acquainting complete combat crews with history, development, purpose, and possibilities of Azon.

2. Demonstration of unit--its mechanism and operation.

3. Familiarize entire crew with ship installation necessary to convert bomber to Azon-carrying unit.

4. Demonstrate proper loading technique.

5. Show movies of experimental Azon drops.

6. Discussion and explanation of technique of controlling bomb during drop. (Mr. Wykoff, Mr. Mollan, and Capt. Chiba.)

5. Practice bombing--First drop. Two aircraft only--each loaded with three Azons. Both airplanes to take off and bomb same target. Altitude, between 10 and 12 thousand feet for all drops with medium bombardment. Normal I.A.S. Two bombardiers drop. The other four bombardiers to be carried as observers, two to each aircraft. Rotate bombardiers till each has dropped and steered one bomb.

a. During first drops by new bombardiers, select target such as road junction, so as to give bombardiers a road or other long, straight line to use as a referent. In later drops, select target with no "lead-in" referents.

6. Second drop. Each plane to carry its own crew, all six aircraft to participate. Formation, single line astern. One bomb, drop at will.

7. Third drop. Altitude and I.A.S. same. Formation, three two-ship elements in line astern. Lead ship of element to solve for rate and deflection. Wingmen to drop on leader. Steer bombs individually. Element leader begins evasive action immediately after release. (See Appendix A)

8. Fourth Drop. Formation, two three-ship elements. Element leader only solves for rate and deflection. Wingmen toggle off bombs on leader. Evasive action.

9. Fifth drop. Formation, one six-ship flight. Same bombing technique. Evasive action.

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5. Additional experimentation for medium bombardment.

a. During the early stages of the program a single aircraft should try various types of evasive action to determine which will not interfere with proper control of bomb. Successful types will be used in formation flights.

6. Experiments conducted by heavy bomber.

a. Determine the highest altitudes where 100% control of Azon is still possible and where accuracy of bombing is still within reasonable limits. Three bombs each should be dropped from the following altitudes: 20,000 ft., 25,000 ft., and 30,000 ft., if 25,000 ft. drop proves reasonably successful. Besides ascertaining if bomb has good azimuth control during drop, average range errors should also be recorded.

b. Night bombing. Two bombs dropped on target illuminated by parachute flares. Altitude, 10,000 ft. Also, two experimental drops should be made on target illuminated by flares or burning gasoline on the ground. An attempt should be made to simulate a burning city or other target already set afire by previous bombing.

7. Experiments with light bomber.

a. Ascertain the minimum altitude from which Azon can be dropped and effective control still applied. (This altitude might prove disappointingly high, since the bomb requires a certain time of drop in which to pick up speed sufficient for the controls to be effective.) After minimum altitude is determined, experiment with tactics best suited to light bombardment. E. G. Hedge-hop approach, followed by zoom to altitude, release of bomb, evasive

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action and escape.

8. Once the necessary elements for this program are assembled, the training and experimentation itself, barring accidents and red tape, should not require more than a week for completion.

GORDON E. BIGELOW
1st. Lt. Air Corps
HQAAF

APPENDIX A

I. Types of evasive action to be used in Azon experimentation.

1. Assume gentle climb, not to exceed 500 ft. per min. Climb 15 secs. Level out and continue on same heading for 15 secs. Make easy break to left or right, bank not to exceed 20°.

2. Lose altitude in gentle dive, not to exceed 500 ft. per min. Dive 15 secs. Level off, maintaining same heading. Hold course for 15 to 20 secs. Break gently left or right.

3. Immediately after bomb release, turn 45° to right in bank not to exceed 20°. After completing 45° turn, gently swing left back to original heading. Hold course for 15 secs. Break left or right.

4. Identical to #3 except make first 45° turn to left, then turn right back to original heading.

5. Immediately after bomb release, break 45° to left or right, losing altitude gently. Turn no more than 45° and maintain such heading 15 secs. Resume normal evasive action.

II. In all these maneuvers, single aircraft should govern its action as if it were flying as lead ship of formation. Make all movements gradually.

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SUBJECT: AZON

TO: AC/AS, M. M. & D., Research Liaison Section, Attn: Col. Brown Date 12 Feb 44

FROM: Air Communications Officer

COMMENT NO. 1
Gen. McClelland/mav 6324

1. The guided missile "Azon" has finally completed successful tests, and a program for early introduction into a combat theatre has been approved and is underway. The first Azons to be used are of a pre-production order and it is considered essential that the Commanding Officer of the detachment which is to take Azon into combat have the technical assistance of one of the NDRC engineers who has been intimately connected with the development. It is requested that NDRC be asked to make available, Mr. A. J. Wollan, who has had broad experience in the development of Azon or someone with equivalent qualifications. It is desired to assign Mr. Wollan as technical aide to the detachment which will use Azon.

/s/ H. M. McClelland
H. M. McCLELLAND
Brig Gen, USA
Air Communications Officer

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c/c Contr. Missiles
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Change in Assignment - Project 925428.

AC/AS. OCS. Attention: Brig Gen H. A. Craig

17 Feb 44

Air Communications Officer

1

Gen. McClelland/rmv 8324

1. Reference is made to WCF dated 4 Feb 44, which outlines a special project for the employment of Azon guided missiles, which has since been given a Project No. 925428 by OCS.

2. Experience with Azon against the special targets at Eglin Field indicates that this missile is not a suitable weapon for that kind of targets. Azon is suitable only for a long target in which error in range is not particularly important. Such targets are long bridges, docks and marshalling yards. In discussing the operational use of Azon with General Gardner and General Eubanks, it was agreed that it should not be used against targets on the French coast, but should be used in Northern Italy. Accordingly, it is recommended that the original orders covering this project be amended so that destination will be 15th Air Force instead of the 8th Air Force as originally planned.

3. Experience in the use of Azon at Eglin Field has demonstrated that the amount of control given the missile during flight effects the range in an unknown relation. Colonel Montgomery of the Air Force Board believes that considerable useful information on the relationship between range and the amount of control can be developed during the training phase of this project. However it is believed that to accomplish this, the date of departure originally planned for 1 March, should now be changed to 15 March.

4. All other points covered by the original outline remain unchanged.

/s/ H. M. McCLELLAND
Brig Gen, USA

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Attach

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WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES (AFDMA-2F)
WASHINGTON

1 February 1944

SUBJECT: Information on Azon, GB-4, and GB-8.

S E C R E T

By Authority of
The Commanding General
Army Air Forces
7 Feb 1944 JMCD
Date Initials

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Special Weapons Branch

1. In confirmation of the conversations of 29 January and 31 January, 1944, with Major C. O. French, the following information is requested:

a. Equipment for airplanes carrying Guided Missiles:

(1) What additional items other than the controlling Radio are required to enable a medium or heavy bomber to use the Azon bomb?

(2) What provisions have been made to procure the additional items in 1a(1)?

(3) What additional equipment other than radio and television is required for any standard B-17F or B-17G airplane to enable this airplane to use either the GB-4 or GB-8 Glide Bombs?

(4) What provisions have been made to procure the additional equipment in 1a(3)?

b. G.F.E. for Azon Bomb:

(1) What additional equipment has to be furnished to the Union Switch and Signal Company and/or furnished with each Azon bomb for operational use?

(2) What is the procurement and delivery status of each

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item in 1b(1)?

c. Flares for Azon:

(1) What maximum speed should these flares be designed for?

(2) What time of burning is required?

(3) At what altitude must the flares ignite?

d. Flares for Glide Bombs:

(1) What maximum speed should these flares be designed for?

(2) How many sizes are required and what times of burning are necessary for these sizes?

(3) How many flares are required for each GB-4 and what is the size?

(4) How many flares are required for each GB-8 and what is the size?

(5) At what altitude must the flares ignite?

e. Bomb Dollies for Guided Missiles:

(1) What modifications have to be made to the standard Dollies for any necessary special handling of the Azon?

(2) What modifications have to be made to the standard Dollies for handling the Glide Bombs?

(3) What other special equipment is required for either the handling or the procedure of attaching Azon and Glide Bombs?

2. It is understood that the production of the N.D.R.C. Azon contract will be completed by the Union Switch and Signal Company on approximately 10 January and that production on the Materiel Command Azon order will start at that time. The following information is requested on the inspection for this order:

a. What degree of inspection by the Materiel Command is necessary?

b. What inspection has been arranged by the Materiel Command?

3. It is further requested on the Azon bomb that the 1000 lb. bomb diameter tolerances be checked for the area contacted b the Azon tail flange. If the tolerance range for the bomb is too great, the Azon tail cannot be

[redacted]

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fastened on when the diameter of the bomb is too large or it will be too loose when the diameter is too small. Recommendations are requested on whether several size flanges, or other means of adjustment, are necessary to take care of the anticipated variations in bomb size.

4. It is requested that all checking on the questions in paragraphs 1, 2, and 3, be coordinated with Captain W. C. Castleberry, Aeronautical Equipment Branch, Production Engineering Section. Captain Castleberry is now securing information on several of these questions.

By command of General ARNOLD:

R. C. WILSON
Colonel, Air Corps,
Chief, Development Engr. Br., Materiel Div.,
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

[redacted]

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6

Information on Azon, GB-4 and GB-6.

1st Ind.

CAS:nle:pl:-1

HQ., Materiel Command, Wright Field, Dayton, Ohio.

To: Commanding General, Army Air Forces, Washington 25, D. C. Attention: Development Engineering Branch, Materiel Division, Asst. S/S, AMC.

1. Reference is made to basic communication requesting information concerning the requirements and procurement status of allied equipment for Guided Missiles.

2. Equipment for airplanes carrying Guided Missiles:

a. External bomb rack modification kits to enable B-17F or B-17G airplanes to carry GB-4 or GB-6 glide bombs can not be standardized until design requirements are definitely determined. Design requirements for the GB-4 bomb will be known on completion of tests now in progress at Eglin Field, Florida. Design requirements for the GB-6 will be known on completion of tests to be conducted as soon as control units are manufactured. The GB-6 test program is being delayed due to the using of materials originally procured for GB-6 control units in the GB-4 control units being manufactured with higher priority.

b. Procurement of modification kits has not been initiated. Number of kits to be procured and delivery dates are not yet scheduled.

c. No procurement of a modification kit for airplanes carrying the Azon bomb has yet been initiated. This kit would consist of electrical wiring, type B-5A switches and a Jones plug. With the exception of the Jones plug, the remainder of the kit would consist of standard Air Corps items and no procurement problems for these items are anticipated.

3. Additional equipment to be furnished to the Union Switch and Signal Company as Government furnished equipment consists of the radio receiver-selector set and the steel bomb fin sleeves. A quantity of fin sleeves sufficient to equip the entire quantity of Azon bombs under the present procurement (10,600), has been shipped to the Union Switch and Signal Company.

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(APR 11-30)

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AAFMC-190-WF-4-20-42-2 MH

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1st Ind. to C.G., AAF, Washington 25, D. C.
Att'n: Development Engin. Br., Mat. Div.
Asst. C/AS, MMD.
"Information on Azon, GB-4 and GB-8."

The control radio, a Signal Corps procurement item is expected to be available in quantity to meet the production requirements of the Azon bomb. Flares, fuses, and the bomb itself are all necessary components for operational use and are to be furnished by Ordnance at the theater of operations. It is anticipated that all three components will be available in sufficient quantity to permit operational use.

4. Flares for Azon:

a. Azon flares should be capable of maintaining a normal burning rate and brilliance at a speed of 700 miles per hour.

b. A minimum burning time of 45 seconds is allowable.

c. The flares should be capable of ignition at an altitude of 25,000 feet.

d. The required characteristics of the Azon flare were transmitted in a letter dated 14 December 1945, to your office, marked for the attention of the Air Ordnance Officer, AC/AS, MMD.

5. Flares for Glide Bombs:

a. These flares should be designed for a maximum speed of 300 miles per hour and capable of ignition at 20,000 feet.

b. The type of flare under consideration by the Ordnance Department at the present time is a modification of Flare, Candle, type M-26 and is known as Flare, Guide, I-3. In the next GB-8 tests to be made as soon as control units are available, the number of flares required per bomb will be determined and the method of mounting and arming will be standardized.

c. The GB-4 glide bomb uses no flares.

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(AFR 11-30)

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1st Ind. to C.G., AAF, Washington 25, D. C.
Attn: Development Engin. Br., Mat. Div.
Asst. C/AS, WCD.
"Information on Azon, GB-4 and GB-8."

6. GB-4 and GB-8 bombs are handled with the standard M-6 Truck, Bomb Service and standard M-22 Truck, Bomb Lift. No special handling equipment is required. The Azon bomb may be handled and loaded in a manner similar to any standard 1,000 pound bomb.

7. With respect to the production contract of the Azon bomb, the degree of inspection required by the Materiel Command has not yet been determined. Action has been initiated for a representative of the Inspection Division to visit the Union Switch and Signal Company to determine the degree to which the production model of the Azon bomb corresponds to the revised prints which were recently made available.

8. Since the variation in the diameter of the 1,000 pound bomb is excessive to such an extent that the Azon tail assembly cannot be fastened on to the bomb in certain cases, it is the suggestion of this office that no particular adjustment be made on the tail flanges but rather that the oversized or undersized bombs be rejected and delegated to some other use. This suggestion has been forwarded to the Ordnance Department. An investigation to determine the percentage of bombs to be rejected for use with the Azon tail due to excessive diameter tolerances is being accomplished. If the percentage of rejects from any particular lot appears to be small, it is suggested that this practice be adopted as standard.

For the Commanding General:

F. C. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

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UX-225

7

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON

26 February 1944

SUBJECT: Possible Adaptation of 1000 lb Azon Bomb.

S E C R E T
By Authority of
The Commanding General
Army Air Forces
26 Feb 44 RCW
Date Initials

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Technical Executive

1. The potential tactical uses of high-angle controlled bombs indicate a distinct advantage for a bomb that will weigh at least 2000 lbs and have controllability in both Azimuth and range. It is hoped that the Razon 1000 and 2000 lb bombs will meet this need when development is completed and production gets under way.

2. The Azon 1000 lb bomb is under production at the present time. It is requested, therefore, that the following adaptation of the 1000 lb Azon bomb be studied with the thought that, if it is successful, a usable tactical weapon can be secured far before the Razon bomb will be available:

a. Adjust the gyro stabilizers in one Azon bomb so that the bomb will maintain such a flight position that the radio control will give an up and down deflection rather than a right and left.

b. Fasten this bomb to a regular Azon bomb.

c. The resultant structure could be controlled for either range or azimuth -- provided the structure does not spin and the controls are adequate to guide the combined weight.

d. The combined bombs might be carried on the interior or exterior racks - depending on the method of combination.

e. Representatives of the N.A.C.A. Laboratory at Langley Field, who have been involved in the Azon wind tunnel tests, have given an informal opinion that the controls would be adequate and that a combined study with the Materiel Command on this possible adaption might prove of value.

f. The effect of the two 1000 lb bombs would be higher in fragmentation density and somewhat less in blast than one 2000 lb bomb.

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Subj: Possible Adaptation of 1000 lb Azon Bomb. (Cont'd)

3. As a suggestion for this type of adaptation, the gyros might be turned 90° in the one bomb so as to give range control. In the other bomb the gyros could be left as they are. There is also the possibility of taking the gyros out of one of the bombs to simplify the overall device.

4. It is realized that suitable range sighting devices have not been completed for guided missiles. It is believed, however, that with a device of the type described in paragraph 2, that the Azimuth could be controlled by the airplane carrying the bomb and that an airplane flying an approximately perpendicular path would have a better range perspective and could control the range more accurately. The frequencies used for the range and azimuth control of the combined bombs could be different. An approximately simultaneous drop by each airplane might be controlled by two bombardiers in each airplane.

5. It is requested that the Material Command report on either:

a. The prospective action on this study.

b. The reasons why the adaptation would not prove feasible.

By command of General ARNOLD:

/s/ R. C. Wilson
R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Div.,
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

[redacted]

C O P Y

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XXXXXX Command

(Dict. 26 Feb. 1944)
Ref: Capt. W. C. Castleberry;
bd-70-5-D - Ext. 28228

26 February 1944

Chief, Resources Control Section
Wright Field, Dayton, Ohio
Att: Lt. Colonel R. T. Boyce

"Razon" AZ-1, RO-225

1. Contract 33-038-ac-1706 was placed with the Union Switch and Signal Company, Swissvale, Pennsylvania, for 10,000 each Razon AZ-1 on 23 November 1943. This procurement is covered by TI-1350, Add. No. 1, dated 28 October 1943.

2. The latest delivery schedule is set as:

15-28 February	1 -15 March	15-30 March	1 and on April
50 per day	50 per day	[illegible] per day	100 per day or more

It is believed that this company can meet the schedule as set providing raw materials are available.

3. Wright Field, Maintenance and Distribution, Washington, D.C., has requested, by telephone, that the possibility of providing "Razon" AZ-2 be considered. The Union Switch and Signal Company was contacted and the following information was given to us by telephone:

a. Assuming 5,300 each Razon AZ-2 were placed on order to be delivered after the completion of the present AZ-1 order then deliveries would be 50 to 75 each AZ-2 per day beginning 1 September 1944.

b. Assuming 5,300 each Razon AZ-2 were placed on order to be delivered concurrently with the present AZ-1 order, then deliveries would be approximately 5 each per day beginning in July 1944 and increasing to 50-75 each AZ-2 per day, 1 September 1944. However, to run both AZ-1 and AZ-2 concurrently will require additional machinery as follows:

3 each - No. 4 Warner and Swasey Universal Turret Lathes.

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Ref:Capt.W.O.Castleberry:
be-7.-5-0 - ext. 2 2228

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26 February 1944

Chief, Resources Control Section
Wright Field, Dayton, Ohio
Att: Lt. Colonel K. T. Royce

"Azon" AZ-1, AX-825

2 each - No. 96 Universal Coil Winding Machines
2 each - No. 0.6. Brown and Sharpe Automatic Screw Machines
1 each - Toledo No. 56 (or larger) punch press
2 each - De Vilbis Spray Booths
1 each - Federal 50 KVA Transformer Capacity Spot Welder
1 each - Federal 125 KVA Transformer Capacity Spot Welder

The Union Switch and Signal Company is willing to provide the above list of equipment at their own expense with the exception of the last two items which they do not feel they will need after the completion of Army Air Force contracts.

4. The Inspection Division was requested to assign an Inspector to the Union Switch and Signal Company and Mr. J. S. Crosby arrived the second week in February 1944.

5. The Package and Container Branch, Production Engineering Section, was requested to specify a suitable shipping container that would protect the finished articles from corrosion and damage in handling. This was accomplished 14 February 1944. This container is suitable for overseas shipment in accordance with AN-P-13, Method II and A.A.F. 100-14A.

6. Material problems are increasing on subject contract. Mr. W. Cadwallader, Vice President and General Manager, has asked for advice as to the best method in handling shortages. In general the procedure to be followed has been pointed out; however, since this company has indicated that they are not familiar with Army Air Force procedure it is believed that Resources Control Section should familiarize them with the method of handling material problems.

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XXXXXX Command

Ref: Capt. W. O. Castleberry:t
70-5-U - Ext. 28223

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26 February

Chief, Resources Control Section
Wright Field, Dayton, Ohio
Att: Lt. Colonel K. P. Royce

"Azon" XX-1, XX-225

7. Due to the urgency of the guided missiles program, as per letter dated 16 November 1943, from Chief of Army Air Forces, it is requested that special attention be given to material problems on this contract.

W. O. Castleberry Capt. AC.
for W. W. MORAN
Colonel, Air Corps
Chief, Production
Engineering Section

cc: Colonel J. K. Stewart
Major W. E. Mohler, A.C.

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AAFMC-100-WF-12-17-43-500M

c/o Cont. Missiles
70.210 Misc. 27 (2/2 pt)
R & R S, DEB

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From: AAF Boards Orlando, Fla.

TO: CG, AAF
CG, Materiel Command, Wright Field, Ohio

29 February 1944

For Chief Equip. Lab., Dayton, Ohio and Col. S.P.Wright, AFMCD Wash DC, sgd Heimick.

Work to date on Azon project with 6 B17's indicate present equipt not practicable for Air Corps use. Numerous failures and instances of defective design, materials or workmanship have caused approximately 30% rejection of units during preparation. Complete or partial failure in drop tests have numbered five out of seven indicating need for great reduction in check and test routine before large numbers of units can be prepared in limited time under field conditions. Improvements which have been suggested should be incorporated in Azon units and service tested in this country. Recommend production schedule be revised to allow incorporation of all suggested improvements now in hands of aircraft radio laboratory and Dr. Grendahl. The present equipment is definitely unsatisfactory under service conditions.

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HEADQUARTERS OF THE ARMY AIR FORCES
WAR DEPARTMENT
WASHINGTON, D. C.

SECRET
By Authority of
The Commanding General
Army Air Forces
3/1/44 Date
Initials

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

BMG by MAR

MAR 1 1944

MEMORANDUM FOR GENERAL ARNOLD:

SUBJECT: Radio Controlled Bomb (AZON Azimuth only)

1. Reference is made to Cable No. AFH 275 dated 29 February 1944 pertaining to faults of the "AZON" radio controlled bomb.

2. The Air Communications Officer has contacted Colonel Harry G. Montgomery, Jr. of the Army Air Forces Board who stated that the message was not an Army Air Forces Board decision, but merely the opinions of Lieutenant Colonel Paul F. Helmick, the Project Officer. Colonel Montgomery further stated that insufficient data has been obtained to date, and that the true picture can be presented only after more drops have been made.

3. Action taken on the cable is as follows:

a. Arrangements are being made with Dr. Grondahl of N.D.R.C. to send Dr. Ogoff and Mr. O'Hagan to Orlando to investigate the situation immediately.

b. Major Rand, Azon technical representative of the Air Communications Office, is departing for Orlando this date.

4. Examples of some failures, which are believed traceable to inexperienced personnel, are as follows:

a. Two (2) caused by reversed electrical connections.

b. Two (2) probably caused by premature uncaging of gyroscope.

5. In summation, it appears that the cable received by this Headquarters is slightly premature. However, as a precaution, the civilian technicians are being sent to obtain definite answers and recommendations. Until more complete and accurate data is available, steps will be taken to monitor the AZON Program closely for the Fifteenth Air Force, who is scheduled to receive six (6) B-17 aircraft

471.6 Bombs

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To Cen File 3/1/44

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equipped with the necessary transmitter and antenna assembly equipment.

6. LATE FLASH. After this memorandum was completed additional information came in per telephone conversation with Orlando. Four planes carried Azons, four bombs hit target, three bombs operated satisfactorily from a radio mechanical standpoint, but were lost due to flare failure. Flares now being used are experimental and not properly humidity sealed. Production item which will go overseas will have complete water proofed and perfected flares.

7. The difficulty is no fault of the airplane itself.

H. A. Craig
Brigadier General, U. S. Army
Asst. Chief of Air Staff
Operations, Commitments & Requirements

[redacted]

14

CONFIDENTIAL

90-C

Lt.Col. K.P.Royce
Tel. 2-1126

KPR:sa

8 March 1944

Contract W33-038-AC-1706
Azon, AZ-1, Project W-225

Union Switch & Signal Company
Swissdale, Pennsylvania.

Attention: Mr. W. H. Cadwallader, Vice President & General Manager

1. It is understood that when Major Band of the Air Communications Office visited the contractor recently, he was given an approximate schedule of deliveries as follows: 500 complete units in March, 1,000 in April and 3,000 per month thereafter.

2. The Air Staff in Washington has stated that the Azon, and similar devices, are all extremely high priority, and that the Azon has the highest priority of such devices.

3. It is felt that the schedule for March and April is not consistent with the importance of the project, and the contractor is earnestly requested to make every effort to increase the production in those two months.

4. If attainment of a higher schedule in March and April is being impeded by difficulty in getting any materials or components, these shortages should be reported immediately to the Area Office for action. The contractor is authorized to do this informally, and the Area Office is authorized, in cases which cannot be relieved locally, to communicate directly with Capt. [illegible] A. Thom, of General Hopkins' Staff in Washington, who can be reached on Republic 6700, Extension 78952 or 76940.

5. In view of the foregoing information, the contractor is requested to submit, as soon as possible, a revised schedule, to the attention of Lt. Colonel K. P. Royce, Department 90-C. It is pointed out that, although a revised schedule is requested, a realistic schedule

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[redacted]

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CONFIDENTIAL

To: Union Switch & Signal Co.
Subj: Contract W35-038-AC-1706
Date: 5 March 1944

is wanted and if, in spite of all possible efforts on the part of the contractor, and all expediting efforts by A.A.F. personnel, no improvement is considered possible, the schedule submitted should be consistent with the known facts.

For the Commanding General:

for E P Rogers Col AC
W. R. HEROD
Colonel, Air Corps
Acting Chief, Resources
Control Section

cc: East. Dist. Supv'r
Att'n: Lt. Col. W. J. Majek
Pittsburgh Sub-Area Office
Att'n: Mr. Geo. H. Kiefer
Mr. Crosby, Resident Inspector
Union Switch & Signal Co.
Major V. M. Stace, M&D
Armament Unit, RCS

OTHERS | CIV. PERS. | TECH. DATA | A. S. C. | L. P. S. | PROD. CONT. | PROD. ENG. | PROD. DIV. | INSP. | CONTRACT | EXP. ENG. | BUD. OFF. | C. O. | ADM. EXC. | TECH. EXC. | COM. GEN.

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C/O Cont Minutes
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SECRET 100

Hq. AAF AFDMA-1
Col. R.Q. Kelsey/ah

17 March 1944

CG
US Strategic Air Forces
London, England

Number F 979

To Spaatz for Doolittle from Kelsey signed Arnold

Suggest checking on possible value of azimuth controllable bomb project being prepared for Italian theater and China. Possible to divert with immediate action. Project is on test basis but indicates good possibilities on long targets where evasive action is not needed. Will investigate further.

Originator: CGAAF

Information: OPD

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16

STANDARD FORM No. 14 A
APPROVED BY THE PRESIDENT
MARCH 16, 1928

FROM: WAR DEPARTMENT

BUREAU

To production Division for Compliance and Report Technical Executive

TELEGRAM

OFFICIAL BUSINESS—GOVERNMENT RATES

ACTION COPY

RFA78 WA163 RF V WARF NR 162

FROM NC SIG WAR WASHINGTON DC 232@1@2

TO CG MATERIEL COMMAND WRIGHT FIELD OHIO [redacted]

mx-9225 PRIORITY

AZONS

PACKED FOR WATER SHIPMENT SHOULD BE SENT AS SOON AS POSSIBLE IN LOTS OF ONE HUNDRED OR MORE TO KARACHI INDIA QQQQQ AXON RPT AXON ONE HUNDRED IN NUMBER PACKED FOR AIR SHIPMENT SHOUGD BE SHIPPED TO ARRIVE IN ORLANDO FLORIDA BEFORE APRIL TWENTIETH PAREN WAR ONE THREE XERO SIX SEVEN FOR PRODUCTION ENGINEERING ATTENTION COLONEL ROYCE FROM MCCLELLAND SIGNED ARNOLD PAREN FOUR HUNDRED ADDITIONAL AXONS RPT AXONS

AZONS AZONS

Analy RCS-C-6035 25

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(AFR 11-30)

90-C 268

PC-Engineer 11

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Address reply to:

Commanding General
Air Materiel Command
Engineering Division
Reference: EWD:ale:5h1A-15679
Wright Field, Dayton, Ohio

17

27 MAR 1944

19703/3572

Possible Adaptation of 1000 lb
Azon Bomb.

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Development Engineering Branch,
Materiel Division, Asst. C/AS, MM & D.

1. Reference is made to a letter from your Office dated 26 February 1944, subject as above, with 1st Indorsement from this Office dated 10 March 1944, regarding action to be taken on the subject proposal.

2. A study of the proposal presented the problem of determining the most practical combination of the two 1000 lb Azon bombs. It was determined that a grouping of one bomb below the other was the most practical combination. In such a grouping, the stability and control problems involved were studied. The top bomb, bomb No. 1, was considered to be a standard 1000 lb Azon and the bottom bomb, bomb No. 2, was considered to be rotated ninety degrees so as to respond to range and pitch control.

3. A combination as described above presents the following problems:

a. Separate radio frequencies for left, right, and up, down signals would be required.

b. The control surfaces of bomb No. 2 which were originally intended for ailerons have now been rotated into the azimuth axis. These surfaces would have to be disconnected and locked from the servo in order that changes in azimuth by radio control can be accomplished by means of the rudder surfaces of bomb No. 1. If this were not done, azimuth control surfaces of bomb No. 2 would oppose any change of azimuth due to radio control of the rudder surfaces of bomb No. 1.

Copy of reference letter in paragraph 1, above, attached to 1st Indorsement to C.G., AAF, Washington 25, D. C. Att'n: Develop. Engrg. Br., Mat. Div., AC/AS, MMD, subject as above, dated 3-10-44.

[redacted]

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AAFMC-190-WF-5-20-42-2 Mil.

CENTRAL FILES

C.G., AAF, Washington 25, D. C.
Att'n: Develop. Engrg. Branch,
Asst. C/AS, MM & D.
"Possible Adaptation of 1000 lb
Azon Bomb."

c. During a visit by a Materiel Command representative to the N.A.C.A. Laboratory, Langley Field, Virginia, on 9-10 March 1944, the subject proposal was presented them for consideration. It was the opinion of personnel at the N.A.C.A. Laboratory, that due to the location of the center of gravity, which in the combination suggested above would be between the two bombs, the bomb could not be stabilized in roll. Due to a shift in the center of pressure upon any change in azimuth, the resultant lift of the bomb combination would be outside of the axis of symmetry. This would produce a rolling moment which could not be overcome by the small aileron surfaces and the bomb would roll over on its side.

d. The effectiveness of the control surfaces was questionable. According to personnel of the N.A.C.A. Laboratory, it would not be feasible to make wind tunnel tests of this combination to determine their effectiveness. The high speed at which this bomb would fall would produce an airflow velocity over the control surfaces in excess of the sonic speed. It has been found from numerous wind tunnel investigations that present aerodynamic theory is unreliable at sonic or super-sonic speeds.

e. It is anticipated that the ballistics of this bomb combination would require extensive test drops before sufficient data could be obtained.

f. In the proposal from your Office, it was suggested that the range of this combination could be controlled by an airplane flying a ninety degree course to the airplane carrying the bomb. This technique was to be used in the absence of a range sighting device. It has been found by past experience, that coordination of effort between two crews in separate airplanes has been very unsatisfactory in any attempt at controlling radio controlled missiles. It is, therefore, the opinion of this Office that such a technique would not prove satisfactory in this instance.

g. In combination, the control surfaces would overlap 7.7 inches. This would require modification of the tail assemblies

[redacted]

C.G., AAF, Washington 25, D. C.
Att'n: Develop. Engrg. Branch,
Asst. C/AS, MM & D.
"Possible Adaptation of 1000 lb
Azon Bomb."

by cutting away from the two interfering surfaces an amount of 7.7 inches, or by introducing a spacer block between the two bombs. If a spacer block were used, the over-all depth of the combination would be approximately 53 inches.

4. It is the opinion of this Office that the 2000 lb Razon bomb unit which has already been produced in experimental quantities, has a greater possibility of becoming a tactical weapon than the subject proposal. The diversion of personnel to the development of the subject proposal would seriously retard the testing of the 2000 lb Razon bomb.

5. In view of the problems involved in the development of the proposed adaption of the 1000 lb Azon bomb, it is the recommendation of this Office that no further action be taken and that the subject proposal be discontinued as a project.

For the Commanding General:

W. H. WINGATE, Capt., A.C.
for F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

28 MAR 194

[redacted]

2-23-44-3M

CONFIDENTIAL

ac-1706

ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

MP:87-12
WRIGHT FIELD, DAYTON, OHIO
28 March 1944

Subject: Amendment No. 2 to Letter Contract Special Form dated 24 November 1943 (W 33-038 ac-1706)

To: Union Switch & Signal Co., Swissvale, Pa.

AFP: 378558

1. The subject Letter Contract provided that in the event the formal document for the supplies referred to therein was not placed with you prior to 1 February 1944 (or any subsequent date at any time mutually agreed upon), subject Letter Contract would terminate.

2. It is now considered that it will facilitate the prosecution of the War to extend the expiration date (heretofore extended to 1 April 1944) to 1 June 1944. Such date is hereby extended accordingly.

3. If the foregoing is acceptable to you, will you kindly so indicate on the original, the carbon-backed copy and one (1) additional copy of this letter and return same to the Contracting Officer forthwith, thereby constituting this letter an Amendment to subject Letter Contract.

4. This Amendment was negotiated under the authority of the First War Powers Act, 1941, and Executive Order No. 9001, 27 December 1941.

J. R. WORK,
Major, Air Corps,
Contracting Officer.

ACCEPTED: April 3, 1944

UNION SWITCH AND SIGNAL COMPANY
(Name of Contractor)

SWISSVALE, PA.
(Business Address)

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(AFR 11-30)

BY: W. H. Cadwallader
(Name) (Official Title)
W. H. Cadwallader)
Vice President and General Manager. [redacted]

B-8210

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SECRET

Maj Norvell/Maj 375
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Date 29 MAR 44 Initials

Introduction of AZON to Theatres

Bureau of Aeronautics, Navy Department, Washington, D.C.
(Attention: Captain Temple)

1. The Army Air Forces have completed plans for active employment of AZON type radio controlled bombs in combat theatres.

a. Accordingly, arrangements have been made for a squadron of six (6) B-17 airplanes, with technical and operating personnel, to depart at once for the Mediterranean Area.

b. An additional squadron of ten (10) B-24 airplanes and personnel is now being set up for departure to the China-Burma-India Theatre about 1 May 1944. This unit will be undergoing operational training at Orlando, Florida, from about 8 April to 25 April 1944. Navy personnel may desire to witness drops of AZON during this period.

2. The above information is submitted in accordance with Army-Navy agreement regarding employment of guided missiles.

For the Commanding General, Army Air Forces:

STUART P. WRIGHT
Colonel, Air Corps
Chief, Special Projects Section
Office of the Air Communications Officer

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[redacted]

OFFICE SYMBOL	1 AFACO/M	2	3	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER	SPWright					
INTERNAL OFFICE COORDINATION						

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION:

C.T.

HEADQUARTERS, ARMY AIR FORCES (AFDMA-2F)
WASHINGTON

1 April 1944

SUBJECT: Possible Adaptation of 1000 lb Azon Bomb

20642

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Engineering Division

SECRET
By [illegible] General
Army Air Forces
3 April 1944 m.c.R.
Date Initials

1. In reference to the Materiel Command letter of 27 March 1944 on the above subject, no further action will be required on the request of 26 February 1944 from this office, subject "Possible Adaptation of 1000 lb Azon Bomb."

By command of General ARNOLD:

for M. O. Deuelev, Col. A.C.
H. A. LEGG
Colonel, Air Corps
Actg. Chief, Devel. Engr. Br., Materiel Div.
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

21

CONFIDENTIAL

ATTENTION:

HEADQUARTERS, ARMY AIR FORCES (AFIMA-3F)
WASHINGTON

6 April 1944

SUBJECT: Further Procurement of Azon Tails for 1000 lb. Bombs

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Technical Executive

1. In confirmation of the teletype of 5 April 1944, prompt procurement is directed of 10,000 additional Azon tails for 1000 lb. bombs, plus standard spares for these tails.

2. This additional procurement will increase the quantity on order from 10,600 to 20,600.

3. This additional procurement will include all of the items, services, and S.P.E. for which the Materiel Command is responsible in the present procurement of 10,600.

4. The percentages of standard spares are to continue as follows:

a. 10% spare gyros

b. 3% spare servos

c. 18% spare battery sets

d. 10% spare Ordnance kits (including the flare).

5. This additional procurement is requested at this time in order to insure that the planned production rate of 3000 per month will be maintained after the completion of the present order.

6. The present Union Switch and Signal Company order for 10,600 should be completed by early August 1944, and it will be necessary to expedite this further procurement in order that immediate further orders can be placed for necessary materials and components.

7. The following information is requested on this further procurement

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Subj: Further Procurement of Azon Tails for 1000 lb. Bombs. (cont'd)

of Azon tails and accompanying G.F.E.:

a. The date on which letters of intent or contracts are issued that will permit the ordering of materials and components.

b. Whether or not the production rate of 3000 per month on the present order can be continued without delay.

By command of General ARNOLD:

for R. C. Lindler, Col. S.C.
R. A. LEGG
Colonel, Air Corps
Actg. Chief, Devel. Engr. Br., Materiel Di
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

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(AFR 11-30)

[redacted]

23

(AFDMA-2F)

8 April 1944

SUBJECT: Study on Increased Production Azon Tail for 1000 lb. Bomb.

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Technical Executive

1. If theater operations prove that the Azon tail is a useful weapon, it is probable that the rate of requirement will be decidedly increased.

2. Since any such increase would come very abruptly and the increased quantity would be wanted immediately, it is requested that the Materiel Command expedite the following study at the present time.

a. Determine the total production that should be secured from the Union Switch and Signal Company if their present facilities were operated on a full time basis.

b. Determine several other potential manufacturers for the Azon that would require a minimum increase in facilities to start production, and secure the following information from each of these manufacturers:

(1) The length of time necessary to start production of Azon tails.

(2) The rate at which Azon tails could be produced.

3. It is requested that information on 2a be submitted not later than 15 April 1944 and that information on 2b be submitted not later than 1 May 1944.

By Command of General ARNOLD:

R.C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Div.,
Office, Asst. Chief of Air Staff,
Materiel, Maintenance and Distribution.

VAS/lb

AFDMA-2

CORRECTED COPY

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Wright Field, Dayton, Ohio

11 April, 1944

CTI-1350, ADDENDUM NO. 3

High Angle Controllable Bomb in Azimuth

Production Division

1. Problem Presented:

a. The Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution has directed that immediate action be taken to procure an additional 10,000 Azon tails for 1000 lb. bombs, plus standard spares for these tails.

2. Factual Data:

a. CTI-1350, Addendum No. 1 directed procurement of 10,600 control and flare assemblies for the high angle controllable bombs (Azon tails) and spares for this quantity was procured by Addendum No. 2. This additional procurement will increase the quantity on order from 10,600 to 20,600.

b. This additional procurement is to include all of the items, services and G.F.E. for which the Materiel Command is responsible in the present procurement of 10,600 Azon tails.

c. The percentages of standard spares are to continue as follows:

1. 10% spare gyros
2. 3% spare servos
3. 15% spare battery sets
4. 10% spare ordnance kits (including the flare)

d. The present Union Switch and Signal Company order for 10,600 should be completed by early August 1944, and it will be necessary to expedite this further procurement in order that immediate further orders can be placed for necessary materials and components.

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AFMC-190-WF-18-17-48-600M

CENTRAL FILES

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EMW;mjo;HGP

Wright Field, Dayton, Ohio

11 April, 1944

CTI-1350, ADDENDUM NO. 3

High Angle Controllable Bomb in Azimuth

Production Division

3. Authority:

a. Commanding General, Army Air Forces by letter dated 6 April, 1944, subject: Further Procurement of Azon Tails for 1000 lb Bombs and teletype AFRDE-2F-1788 dated 6 April, 1944 from the Chief, Development Engineering Branch, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution.

4. Action Desired:

a. That the Production Division take immediate action to procure an additional 10,000 Azon tails for 1,000 lb. bombs, plus standard spares for these tails. This additional procurement is directed in order to insure that the planned production rate of 3,000 per month will be maintained after the completion of the present order.

b. That the Production Division advise the Development Engineering Branch, Office, Assistant Chief of Air Staff, Materiel, Maintenance and Distribution, through the Technical Executive office, the date on which letters of intent or contracts are issued that will permit the ordering of materials and components and whether or not the production rate of 3,000 per month on the present order can be continued without delay.

By Command of Major General EARNSHAW:

T. A. SIMS
Colonel, Air Corps
Deputy Chief of Staff

cc: Engineering Division
Aircraft Radio Laboratory
Air Service Command (3)

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AFMC-190-WF-12-17-48-500M

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11 April 1944

Technical Aide for Tenth Air Force
Azon Project

War Department Liaison Officer with NDRC,
Headquarters, Army Service Forces,
Room 4E-637 Pentagon Building,
Washington, D. C.

1. The second project for Azon, which is going to the Tenth Air Force, has been set up. In view of the primitive conditions in this Theatre, and in view of the fact that Azon has still not been used in a theatre, it is considered essential that the Commanding Officer of this detachment, who is to take Azon into combat with the Tenth Air Force, have the technical assistance of one of the NDRC engineers who has been intimately connected with the development.

2. It is requested that NDRC be asked to make available Mr. Thomas J. O'Donnell, who has had broad experience in the development of Azon, or someone with equivalent qualifications. It is desired to assign Mr. O'Donnell as a technical aide to the detachment which will use Azon.

For the Commanding General:

B. M. CHIDLAW,
Brig. General, U. S. A.
AAF Liaison Officer with the
Natl. Defense Research Committee

WCB

HQ. AAF
12 APR 1944
Please return to RECORD SECTION

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AFDMA-2G

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Resources Control

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P R O R I T Y

FROM NO SIG WASHINGTON DC 1118012

TO COMMANDING GENERAL MATERIEL COMMAND WRIGHT FIELD DAYTON OHIO

GR 292

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4-11-44

SW

ATTN RESOURCES CONTROL SECTION LT COL K P ROYCE

NUMBER SIX RELEASE ON AZON IS SHIPMENT OF ONE HUNDRED WITH STANDARD PXX SPARES TO FIFTEENTH AIR FORCE BY ~~WATHEXXX~~ WATER PD PAREN FROM ~~AFAXXX~~ AFDMA DASH TWO F SIGNED ARNOLD PAREN

ALL ITEMS OF THIS SHIPMENT ARE TO BE MARKED FOR AIR DASH ORD DASH OHAM REPEAT AIR DASH ORD DASH OHAM PD IT IS UNDERSTOOD BY THIS OFFICE THAT ALL PARTS OF AZON RELEASES ONE TWO THREE AND FIVE AND ONE HUNDRED UNITS OF RELEASE FOUR ARE NOW SHIPPED PD RELEASE SIX WILL BE SHIPPED IMMEDIATELY BEFORE ANY FURTHER SHIPMENTS ARE MADE ON RELEASE FOUR PD NUMBER SIX RELEASE WAS REQUESTED FROM EAKER SIGNED DEVERS HQ MEDITERRANEAN ARMY AIR FORCES CMA CASERTA ITALY ON CABLE EN SIX THREE NINE TWO CMA EIGHTEEN MARCH ONE NINE FOUR FOUR CITE MAAF ONE SEVEN EIGHT ZERO PD REQUEST THIS OFFICE BE INFORMED OF AIR SERVICE COMMAND PROJECT NUMBER ASSIGNED TO RELEASE SIX TOGETHER WITH SHIP AND CONVOY NUMBERS CMA DATE SHIPMENT WILL LEAVE THE UNITED STATES AND ANY OTHER PERTINENT SHIPPING DATA PD NUMBER SEVEN RELEASE ON AZON IS SHIPMENT OF FOUR HUNDRED WITH STANDARD SPARES TO FIFTEENTH AIR FORCE BY WATER PD ALL ITEMS OF THIS SHIPMENT

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Carbon
Guid Missiles
471.6-I
CF, AAF-5141/9pp)

JFV/ljv/72674

(AFACT-4)
12 April 1944

Guided Missiles Training Program

Commanding General, First Air Force
Mitchel Field, New York

1. It is directed that a program for training Guided Missiles teams be initiated within the First Air Force.

2. This training will consist of:

a. Assembling specialists at a central point and their reassignment to additional schools, if necessary.

b. Team training of Special Weapons teams.

c. Transition training of such Heavy Bombardment Squadrons as are designated to employ guided missiles.

d. Preparation and training of a parent training organization consisting of one Special Weapons Training Unit and a Special Weapons Training Squadron organized according to the Manning Table included in this letter as Inclosure #1. These organizations will provide training on the Azon, GB-4, GB-8, and subsequent types as they are released for operational use. Various types of controlled missiles, which have been developed for use by the Army Air Forces, have been tested by the Army Air Forces Board. A brief discussion of these is given in the inclosed Army Air Forces Board Report (Inclosure #2).

3. It is desired that the training facilities be so organized as to have one Guided Missile team trained by 31 May 1944, if possible. Subsequent teams will be trained according to the schedule set up in Inclosure #3.

4. The time required to train a team on each type of missile and also to transition a squadron has not yet been determined; consequently, the training of the first team will prove valuable in determining action necessary in training future units.

(AFR 11-30)

OFFICE SYMBOL	1 AFACT-4	2 AFACT-6	3	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER						
INTERNAL OFFICE COORDINATION			[redacted]			

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CF, AAF-545/090

IMMEDIATE ACTION
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(AFACT-4) Ltr to CG, First AF 12 April 1944

5. Transmitted herewith, as Inclosure #4 and #5 is a summary of action taken and pending to facilitate this training.

By command of General ARNOLD:

5 Incls.

#1 - Manning Table
#2 - AAF Board Report
#3 - Schedule of Units to be Trained
#4 - Summary of Action Taken
#5 - Guided Missiles Trainers

ROBERT W. HARPER
Major General, U. S. Army
Assistant Chief of Air Staff,
Training

Incl #2 not retained in AW file

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(AFR 11-30)

OFFICE SYMBOL	1 AFACT-4	2 AFACT-6	3 AFACT-8	4 AFRDB	5	6
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INTERNAL OFFICE COORDINATION						

IMMEDIATE ACTION

CF AAF-51 (Rep)

1. Permanent Party (Special Weapons Training Unit)

a. Special Weapons Training School, T/O & E 1-112

Designation	SSN	OFF	WO	EM	Remarks
Radar Officer Air	0141	1			
Communications O	0200	1			
Bomb Pilot Four Eng	10249	2			
Navigator-Bombardier	1036	2			
Personnel Eq Off	1042	1			
Adjutant or AG	2110	1			
Administrative O	2120	1			
Operations O Air Forces	21614	1			
Op & Trng Staff O	21624	1			
Flight Surgeon	3162	1			
Dental Officer	3170	1			
Avn Ord Officer	4532	1			
Arm & Cml O	4822	1			
Aircraft Eng O	4823	1	1		
Special Services O	5000	1			
Chaplain	5310	1			
Statistical Control O	6402	2			
Weather Officer	8219	1			
Aerial Photo O	8502	1			
Aerial Photo Interp O	8503	1			
Mil Intell O	9300	2			
Mail Clerk	056			2	
Cook	060			3	
Draftsman	070			2	
Teletype Operator	237			1	
Classification Specialist	275			1	
Automotive Equip Op	345			4	
Clerk Typist	405			10	
Administrative NCO	502			15	
Ammunition NCO	505			1	
Armorer	511			1	
Basic	521			5	
Armament Chief	663			1	
Message Ctr Clerk	667			1	
Medical NCO	673			1	
Airplane Line Chief	752			1	
AAF Radio Opr	755			1	
Cryptogr Code Cmplr	807			3	
Dental Tchn	855			1	
Surgical Techn	861			1	
Radio Inspector	898			1	
Photo Lab Techn	945			1	
Totals		25	1	57	

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Incl #1

CF, AAF-51 (4/9pp)

b. Special Weapons Training Squadron, T/O & E 1-117 + Col 34-1/2

Designation	SSN	OFF	WO	EM	Remarks
Communications O	0200	1			
Bomb Pilot Four Eng	1024	24			
Bomb Pilot Four Eng	10249	1			
Navigator	1034	13			
Bombardier	1035	13			
Personnel Equip O	1042	1			
Adjutant or AG	2110	1			
Adm Officer	2120	1			
Opns O Air Forces	21614	2			
Flight Surgeon	3162	1			
Mess Sup Transp O	4113	1			
Avn Ord Officer	4532	1			
Arm & Cml O	4822	1			
Aircraft Eng O	4823	1			
Bombsight Maint O	4825	1			
Mil Intell O	9300	2			
Security O Cryptanc	9610	1			
Col 34-1/2 - Officers (SC)		6			Includes 1 Major, 3 Capts, & 2 1st Lts.
Autom Mechanic	014			2	
Carpenter Cons	050			1	
Cook	060			14	
Draftsman	070			1	
Teletype Opr	237			6	
Lineman Tp & Tg	238			1	
Teletype Mech	239			1	
Welder Comb	256			2	
Classification Specl	275			1	
Autom Equip Opr	345			12	
Clerk Typist	405			22	
Medical Techn	409			2	
Adm NCO	502			3	
Ammunition NCO	505			3	
Basic	521			12	
Communication Chief	542			1	
Ap Sheet Metal Wkr	555			6	
First Sgt	585			1	
Ap Armorer Gunr	612			24	
Parachute Rigger Repmn	620			2	
Intell NCO	631			1	
Tp Switchboard Opr	650			3	
Med NCO	673			2	
Power Twr Gunst Sp	678			7	
Bombsight Mech	683			5	
Ap Elec Specl	685			6	
Ap Instr Specl	686			4	

CF, AAF-51 (S/9pp)

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Designation	SSN	OFF	WO	EM	Remarks
Ap Propeller Specl	687			3	
Army Ap Eng Mech	747			48	
Army Ap Mech Gunr	748			24	
Ap Crew Chief	750			15	
Ap Line Chief	752			3	
AAF Radio Mech	754			9	
AAF Radio Opr	755			5	
AAF Radio Opr Mech Gunr	757			24	
Cryptogr Code Cmplr	807			5	
Decontamatg Eq Opr	809			2	
Motor Transp NCO	813			2	
Supply NCO	821			1	
Mess Sgt	824			1	
AAF Tech Sup NCO	826			1	
Surgical Tech	861			2	
Radar Mech IFF	862			4	
Mun Work Avn	901			19	
Ap Armorer	911			33	
Refueling Unit Opr	932			12	
Camera Techn	941			1	
Photo Lab Techn	945			3	
Television Mech (SC)				12	
Servo-air-frame Mech (AC)				24	
Totals		72	0	398	
Total Permanent Party		97	1	455	
2. Special Weapons Teams (Guided Missiles)					
Special Weapons Officer		1			
Armorer, Spec Weapons				2	
Gyro-servo Mech (SW) / Airpl Mech, SW				11	
Powered Weapons Mech				6	
Radio Link Mech / Television Mech / Radar Mech / Thermocontrol Mech / Photoelectric Mech				6	
Totals		1	0	25	
Total for 55 teams		55	0	1375	

CP, AAF-51-16/9pp)

INCLOSURE NO.____ - GUIDED MISSILE TRAINING DIRECTIVE

1. Tentative production schedule for guided missile teams without regard to squadron transition training:

Date	Number	Type of Missile Stressed
30 May 1944	1	Azon, Fexix
30 June 1944	2	Azon, Felix
30 July 1944	4	Azon, Felix
30 August 1944	6	Azon, Felix, GB-4
30 September 1944	6	Azon, GB-4
30 October 1944	6	Undetermined
30 November 1944	6	Undetermined
30 December 1944	6	Undetermined

2. Tentative flow of squadrons for transition dependent on designation and availability of same.

Incl #3

CF, AAF-51-(9/7AP)

INCLOSURE NO.___TO GUIDED MISSILES TRAINING DIRECTIVE

The following action has been taken by Headquarters Army Air Forces to initiate and facilitate the Guided Missiles Training Program:

1. Increase in Troop Basis of the First Air Force by 97 officers, 1 warrant officer, and 455 enlisted men in accordance with a request from the Commanding General, First Air Force for the handling of this program.

2. Action has been taken to activate a Special Weapons Training Unit using the 11th and 12th Radar Calibration Detachments as cadre. These two detachments will be disbanded immediately and their equipment retained for use by the Special Weapons Training Unit in accordance with the provisions of paragraph 3 of War Department Circular #24, dated 18 January 1944. Any remnants of Radar Calibration training remaining, will be completed as early as practicable, either by the 11th and 12th Radar Calibration Detachments or by the Special Weapons Training Unit.

3. Arrangements are being made with the Commanding General, Fourth Air Force for the use of the Tonopah Army Air Field, Tonopah, Nevada, for special field exercises. Large quantities of the Azon, GB-4, and GB-8 missiles are in storage at Tonopah and limited facilities are available for actual practice drops.

4. Training aids are being developed; these will be made available as soon as practicable.

5. The Army Air Forces Board has had the training responsibility of the four initial squadrons. These units have been trained on an experimental basis, however, much valuable information may be obtained by investigating the difficulties experienced in this program. Agencies involved in this early training are the Army Air Forces Tactical Center; Eglin Field; Special Weapons Division, Wright Field; Army Air Base, Tonopah, Nevada; and the Army Air Base, Muroc Lake, California.

6. The availability and flow of trained specialists is being taken under advisement. Sources of these specialists will be the Training Command, Aircraft Radio Laboratory, Special Weapons Division at Wright Field, and the U. S. Army Detachment, Clinton, Ontario, Canada. All possible sources are being surveyed with a view to obtaining sufficient talent to man the training unit and the initial detachments with critical specialists.

Incl #4

CF, AAF-5118/9mp)

INCLOSURE NO._____GUIDED MISSILES TRAINERS

1. The only Trainer available, at present, for Azon is one which makes use of the Celestial Navigation Trainer but without the dome. In this trainer, an aerial photographic map of the terrain is placed below the bombardier's compartment and is moved to simulate the forward movement of the plane. A dot of light is placed on this surface to represent the bomb and the bombardier directs this by means of Azon controls.

2. Six of these complete trainers are available at the Equipment Laboratory. When set up they are housed in a wooden building with concrete floors and, consequently, represent a great expenditure as well as necessitating a considerable time for erection. This time is estimated at approximately one month. When located at such fields where navigational training is also given, these considerations are negligible. The modification of the celestial navigation trainer for Azon training was accomplished by the Synthetic Trainer Branch of the Equipment Laboratory at Wright Field under the direction of Major Melvin. Due to their belief that an Azon trainer was urgently needed, this was developed instead of a trainer that would be smaller and complete in itself.

3. The value of such a trainer is doubtful. Colonel Stewart, who is in charge of the Special Weapons Unit at Wright Field, does not deem such a trainer necessary. Whether or not it could pay for itself by reducing the number of necessary practice drops, must also be considered.

4. A trainer for GB-4 has also been developed by Major Melvin's group. This trainer makes use of a moving picture projector and screen; the projector being tilted by the instructor's controls and the target centered by the student's controls. The picture shown continuously brings the target nearer and, thus, simulates the approach of the bomb to the target. The student thus gets a clear idea of such pictures he will later see on the television screen, as well as practice in centering the target; ~~[illegible]~~ and in guiding the bomb in flight. Sixteen of these trainers are available at Wright Field.

5. Major Pamykata, GB-4 Project Officer at Tonopah, Nevada, does not feel that the trainer simulates accurately enough the actual control which the bombardier gives the bomb. There was some talk at Wright Field about making some changes in the trainer but such work had not been started.

6. Another trainer or briefing machine is being developed which makes use of a still photograph projected from a machine. This machine runs up an inclined track enlarging the projection and, thus, simulates the frop of the bomb. By means of controls, which rock the projector, the student can receive practice in controlling the bomb.

Incl #5

CF, AAF-5, (9/9AP) 10

7. The only trainer existing on GB-8 is one developed by the Hammond Instrument Company and is at Tonopah, Nevada. In order to understand the use of this trainer, it must be remembered that the plan for dropping GB-8 calls for the plane to make a right turn of 35° after release and then making a counter-clockwise circle. The target is eclipsed by the bomb at all times.

8. The trainer consists of a blackboard upon which a target is drawn in eliptical shape and a pulley-wire arrangement upon which a marker is placed to represent a bomb. The movement of the bomb is controlled from a machine which has wheels for winding and unwinding the wire to give the effect of:

a. Direction of flight path

b. Bank

c. Angle of attack of wing

d. Lift

e. Inclination of flight path

9. The student stands in front of the board and applies such control as is necessary to bring the bomb over the target while the motors are varying the normal direction of the bomb. In order that the student may get the true picture of the angle found between eye and bomb in relation to target, three such targets are used. The student moves backward and after each 30 seconds uses a larger target so that the target always remains about the same size to him; whereas the amount of variation of the bomb from the target decreases as it continues its downward path.

10. The value of such a trainer is contingent upon the use of the circular path and eclipse method of control which seems to be still in the experimental stage.

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SECRET
BY AUTH: Brig. Gen. U.S.A.
DATE: 19 April 194
Initials:

Ref: R.L. Bell: ~~MG 90 0 0 3~~

17 April 1944

[redacted]

Study on Increased Production Azon Tail for 1000 lb. Bomb.

Ref: MMRD Letter dated 8 April 1944.

Commanding General
Army Air Forces
Washington 25, D.C.
Attn: Chief Development Engineering Branch
Materiel Division,
Office, Ass't Chief, Air Staff
MMRD
Colonel R.C. Wilson

1. The results of a study to determine total production that could be secured from Union Switch and Signal Co. in accordance with reference letter, Paragraph 2.a. are as follows:

Outline below shows three (3) phases of production on a twenty-four (24) hour, six (6) day week basis, and the determining factor for each:

a. Present production is at a maximum of 50 units daily. GFE Material furnished is sufficient with the exception of radios. It is understood that the Signal Corps is following the radio contractors closely and that deliveries are improving. It is believed that the 50 per day schedule will be met for the balance of this month and increased thereafter, as outlined in paragraph 2.

b. A maximum of 100 units daily will be possible starting 1 June 1944. This will be contingent upon receipt of the following equipment, i.e. two (2) turret lathes, two (2) sand blast cabinets, one (1) spot welder, and nailing machine, one (1) saw box, required for packing. This equipment has been promised for delivery by the first week in May. Union Switch and Signal estimate required time to increase production approximately three (3) weeks after receipt of above equipment. This increased production to 100 units daily would necessitate an increased production on radio sets and ordnance equipment.

c. A maximum of 150 units daily would be possible approximately three (3) weeks after receipt of the following equipment, i.e. three (3) lathes -turret, two (2) coil winding machines, two (2) automatic screw machines, two (2) spot welders. This equipment has not been ordered.

[redacted]

COM. GEN.
TECH. EXC.
ADM. EXC.
C.O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I.P.S.
A.S.C.
TECH. DATA
INVENTORS
OTHERS

C-4-194

AAFMC-190-WF-12-17-43-500M

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production of radio sets and Ordnance equipment would have to be increased to 150 units daily.

2. Ordnance equipment appears to be available to meet any of the above requirements, but radio sets do not appear to be available in excess of production schedule as follows:

1250 to 1500 in April
2000 to 2500 in May
[illegible] in June
3000 per month thereafter. With additional procurement, [illegible] delivery schedules could be increased, after a [illegible] months, to a much higher figure.

3. Information requested in paragraph 2.b. of reference letter will be forwarded no later than 1 May 1944.

For the Commander-in-Chief:

cc: Col. Royce
Col. Moriarity.

COM. GEN.
TECH. EXC.
ADM. EXC.
C.O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I.P.S.
A.S.C.
TECH. DATA
CIV. PERS.
OTHERS

[redacted]

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Copy No. 17

SECRET

15 April 1944

DETAIL OF A.A.F. GUIDED MISSILES PROGRAM

1. UNITS IN PRODUCTION (200 OR MORE ON ORDER) INCLUDING AZON 1000 LB. GB-4, GB-8, GB-1, GT-1, GB-7, FELIX

a. Azon 1000 lb. High Angle Bomb (MX-225, A.C.-36):

(1) Description: The Azon tail replaces standard tail on 1000 lb. bomb and the Azon can be carried in the bomb bay on standard 1000 lb. bomb shackles. Six can be carried in a B-17, eight in a B-24, two (with possibly three) in a B-25, and four in a B-26. Gyro stabilized against rotation. Remote radio control for azimuth only, by bombardier. A brilliant flare in the end of the Azon tail permits observation during the complete fall. Flares come red, white and green. Two more colors being requested. Radio frequency adjustment permits up to six simultaneous drops controlled by six different bombardiers.

(2) Characteristics: Can be controlled 2000 to 3000 ft. right or left when dropped from 15,000 ft. Great accuracy in azimuth. The last 108 bombs dropped on the N.D.R.C. experimental order were used in operational practice by inexperienced bombardiers. The Army Air Force Board reports: "108 bombs dropped. 58 functioned properly. 88% of successful drops within 50' deflection. Average circular errors converted to 12,000 ft. is 234 ft." Most of the functional faults have been corrected on the production order and it is expected that at least 80% of the production articles will function properly. Accuracy in range was expected to be worse than standard bombs due to effect of azimuth control, but has been as good or better in practice drops - probably because the bombardier can concentrate more on range and because the Azon tail is precision built and rugged and less subject to damage than a standard tail.

(3) Availability: (a) 10,600 on production order with an additional procurement request for 10,000 issued. Of these, 600 are for the Navy, and the British are about to order experimental quantities of at least 50. (b) 200 experimental were received on a N.D.R.C. order. Approximately 500 were built on the production order in March, at least 1000 should be built in April, 2000 to 2500 in May, and 3000 per month thereafter. (c) The tail production could go to 3000 per month shortly but radio shortages are the bottleneck. Studies are being started on increased production rates for both the Azon tail and the radio.

(4) Training: (a) Six B-17 airplanes were equipped for Azon in March. The crews were trained at Orlando with 108 total drops, and left for Italy on approximately 1 April 1944. 100 Azons have been shipped by air to Italy. (b) Ten B-24 airplanes are now being equipped and the crews trained at Orlando for operation with the Tenth Air Force. They will drop 100 of the production Azon during training. They should depart in late April. (c) Training of further heavy bombardment squadrons is planned, starting May, 1944. Guided Missiles teams are also being trained. These teams consist of one officer and

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25 enlisted men, trained in factory schools on the special guided missiles equipment for which they are to be responsible. Any team can set up and maintain the equipment involved in using Azon, Felix, GB-4 and GB-6. Training rate of these crews will be one in May, two in June, four in July, and eight per month thereafter until 55 have been trained.

(5) COMMENTS: Suitable for long narrow targets such as roads, railroads, landing strips, ships, bridges, docks, etc. Equipping of airplanes and training of bombardier are quite simple. Airplane modification instructions are available for B-17, B-24 and B-26. Instructions will be prepared for B-25. Extended bombing run (30 seconds plus) after release of bomb is an additional hazard. A number of runs have been made with a shorter than normal run prior to release, but no firm operating practice has been established yet. Visibility must be good enough to see the target. Several drops have been made in trains and more dispersion was secured than desired. Experiments with train drops are planned for early May, and it is believed that further practice and development will decidedly decrease the over-dispersion.

b. GB-4 2000 lb. Television Glide Bomb (MX108-4):

(1) Description: Gyro stabilized Pomykata glider with 12 ft. wing spread and approximately 12 ft. overall length including bomb. Has remote radio control of range and azimuth with a Block III (AN/AXT-2) Television transmitter for determination of position. Placed in a "bathtub" shaped container below the bomb. Pomykata vehicle is "cleaner" better streamlined and more expensive than Aeronca vehicle. B-17 carries two on external bomb racks and B-25 carries one.

(2) Characteristics: Glide ratio is over 8 to 1. Speed at this glide path is approximately 220-240 mph. This speed can be increased by diving. Preset tests indicate vision for 7-10 miles on television but identification of target is difficult unless target or surroundings have easily identifiable characteristics. Control up to 20 miles under good conditions is planned (this is the estimated limit of the television reception and the radio control). Television antenna is directional and with a fixed antenna, the airplane turns 180° after dropping. Hope to use the gyro stabilized directional antenna, which has been developed. This will permit airplane to maneuver in any direction after drops. Accuracy should be good when all equipment operates and if the bombardier "finds" the target in time with the television. If bomb lands in front of target it will slide for long distances, due to low angle of approach. No figures are available on the amount the GB-4s cut the speed of a B-17, but it should be somewhat less than the GB-1 or GB-8 (which is approximately 10 miles per hour). The speed and maneuverability reduction on a B-25 is considered negligible. No tests have been tried from a B-24 (could only carry one) or a B-26.

(3) Availability: 2000 are on the production order. Developmental models are now being tested and experimented with at Tonopah, Nevada. The present delivery status follows:

On the experimental order for 200, approximately 8 complete GB-4s are available for training (without high altitude heater element). All of the 200 airframes have been delivered and at least 150 are left. 150 of the RT control boxes

are still undelivered and are included in the following production schedule:

	Klassen Airframe	RT Hammond Control Box incl. AN/CRW-6 Radio Receiver
Delivered and still available 15 April 1944	App. 158	App. 8
April Deliveries	200	0
May "	300	100 (starting app. 8 May)
June "	300	250-300
Deliveries per month until completion	300	350-400

Only approximately 300 television equipments are available from the Aircraft Radio Laboratory for these deliveries and no further equipments will be available until August 1944 unless further allocations are secured promptly from the Navy (Navy equipment must be modified for A.A.F. use). Aircraft Radio Laboratory estimates this modification will require approximately three months on the finished article. Less time should be needed if it is made on the production line.

(4) Training: See Azon Training 1a(4)(c).

(5) Comments: This weapon should be effective now against easily identifiable targets such as bridges, docks, tunnels, dams, large boats, buildings, etc. Also the most promising development for point targets, but further experimentation on identification of camouflaged and hard-to-identify targets is necessary. Experimental development is now complete and tests of first production articles will start approximately 1 May 1944. Further development of identification and operational procedures will continue then. Limitations are:

(a) Present radio and television are susceptible to jamming.

(b) Television cannot "see" through low visibility or smoke screens.

(c) Use of this weapon requires careful training.

(d) The weapon itself requires careful servicing and adjustment by trained personnel prior to use.

c. GB-8 2000 lb. Glide Bomb, Visually directed:

(1) Description: Aeronca glider structure, with 12 ft. wing spread and approximately 12 ft. overall length. Simpler, cheaper, and sturdier than GB-4. Control equipment has same basic components, but has different size containers for these components. Will probably use five bright flares to enable bombardier to follow its flight.

(2) Characteristics: Glide ratio from 5-1 to 6-1. Speed at this glide path is approximately 250 mph. This speed can be increased by diving.

Guided Missiles
C-36
8(5/15/44)
L. DEB

Accuracy of 10 mills or better is hoped for. Will not be as accurate as the GB-4 due to the greater seeming distance of the observer from the target, and the difficulty of observing the altitude of the bomb in order to control the range. No studies are available on the reduction of speed in a carrying B-17 but this reduction is estimated at 10 mph. The speed and maneuverability reduction on a B-25 is considered negligible.

(3) Availability: 2000 on production order. The present delivery status follows:

On the experimental order, no complete GB-8s are now available. 25 airframes and 90 control units are still undelivered and are included in the following production schedule:

	Aeronca Airframes	Hammond RSV Control Box incl. AN/GRW-3 Radio Receiver
April	130	100
Rate per month until completion	500	300-400

The basic operating components of the RSV units are the same as the RT (for the GB-4) but they cannot be profitably changed to the RT units until the tools for the RT are complete (app. 8 May 1944).

(4) Training: See Azon Training 1a(4)(v).

(5) Comments: (a) Suitable now for line targets where range is not too important. Could be used on these targets instead of Azon when following points are important: 2000 lb. bomb (instead of present Azon 1000 lb.) that can be dropped much further away from target than Azon, and skips along surface of ground after landing due to low angle of approach. No extensive practice has been made against line types of targets. (b) Practice has been directed against point targets. Degree of possible accuracy against point targets cannot be determined until operating procedures are further developed. Experiments are now being made on a procedure of flying the airplane in a curved path, and after the bomb is dropped, the bombardier keeps the bomb lined up between his eye and the target. This procedure results in a spiral path for the bomb. (c) Aeronca has just developed a streamlined shell to go under the airframe boom and accomodate present GB-4 controls, plus a "bathtub" to go underneath the bomb and hold the present GB-4 television transmitter (Mark III). Experiments will be made on this modification. If the device is successful, it means that a high production of airframes and controls can be secured comparatively quickly for television type glide bombs. (d) See GB-8 for further promising use of a modified GB-8 vehicle.

d. GB-1 2000 lb. Preset Glide Bomb (XCK-108):

(1) Description: Aeronca glider structure having 12 ft. wing spread with approximately 12 ft. overall length, including bomb. Preset with no control after leaving airplane. Gyro stabilized in azimuth. B-17 can

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c/o Court Minutes
No. 210 Misc.
34 (3/6/44)
K&R S 52B

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AFACO/M-3

25 Apr 1944

MEMORANDUM FOR: Maj. Wm. L. Norvell

SUBJECT: Azon Project No. 2

1. Ten (10) B-24's arrived at the Orlando Army Air Base on 5 Apr. The crews, minus rear gunners, arrived by 7 Apr. The ships all had antennae and transmitters installed by 12 Apr., and training was immediately begun. It was discovered that further modification of the B-24J aircraft was necessary in order to provide bombardiers with better vision, so modification was started on three aircraft at a time. A hole 6" in diameter was cut in the forward right corner of the flooring in the bombardier's compartment, and a plexi-glass window was inserted.

2. The first 40 Azons to be dropped had the usual trouble. Out of these 40, 19 were failures. 3 failures were caused by airplane rack trouble, 6 were caused by malfunction of transmitter, or control box, due to faulty wiring; 1 was caused by flare failure, 8 were caused by undetermined failure in the bomb mechanism, and 1 was due to gyro failure. It was discovered during those first 40 drops that the tuning procedure was not adequate, since a check with the signal generator revealed the receivers had been tuned slightly to one side. A new tuning procedure was instituted. This procedure consisted of tuning in the airplane transmitter on a Hallicrafter S-27 receiver. This incoming signal was hetrodyned against an 804-C signal generator which then was marked. The receiving sets in the Azon were then tuned with the signal generator at a minimum output to make sure the Azon receiver would be exactly tuned.

3. On the next 60 Azons no radio failure was observed. However, there were 9 flare failures and 1 gyro failure. The bombardiers, after the first 40 drops, became quite expert, so that 41 of the last 60 Azons dropped hit their mark with no discernible error. As a matter of fact, 16 of these 41 hits in azimuth were estimated to also have a zero range error. From the experience with Azon Project No. 2, development work is indicated to improve delay train in flare. Most failures of flares were due to premature or greatly delayed ignition time. One flare went off in the bomb bay. All the others either did not light, were very light, or exploded in air. Further development is also indicated for antenna installation in the B-24 aircraft. The present antenna installation is located just behind the tail skid. A rough landing breaks off the antenna.

4. The General Instrument radio proved eminently satisfactory, but it is felt that great care should be taken in equalizing the output of the two studio channels which, in some cases, had a 2 to 1 difference with a given RF input. 25 Emerson radios were received for drop tests; 6 of these were used. The balance were out of adjustment or defective; they were not taken apart to determine which was the case. Their malfunction consisted of being either insensitive or noisy. The term "noisy" means that when a servo motor was hooked to the receiver, and left or right rudder given, then neutral, a situation was created -- probably due to noise from the servo motor which caused the release in the set to operate. This caused the rudder to fluctuate violently from one position to another even after signal had been turned off. The

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C/O Cont. Minutes
No. 470 Misc.
3rd (3/0 M) R+RS
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SECRET 105

batteries of the Azon were ok, but it is essential that Azon technicians be equipped with 30 cc. hypodermic type syringe since this reduces the time of filling of batteries 80 or 90 per cent.

5. It was determined that the 15,000-ft., 6 mills additional trail should be added to compensate for a longer time of fall for the Azon.

6. A steep dive, as an evasive measure, was found to have no effect on bombardier's accuracy.

7. The last 60 drops were carried out at all altitudes, varying from 15,000 feet down to as low as 4000. The Azon was very accurate at all altitudes.

8. The following T/O for a Heavy Bombardment Squadron is considered adequate:

4 technicians are able to load and test 18 Azons per day, which will allow 36 Azons, or enough Azons for 9 aircraft completing a mission every other day. This, of course, will be true only if no major repair or maintenance is expected of it.

9. A Squadron T/E should include:

1-Signal generator such as generator 804-B, plus an audio oscillator covering 475 and 3000 cycle range.

1-Battery charger

1-Gyro test stand as developed by Union Switch & Signal Co.

1-Final test panel, plus flare arm tester as developed by Union Switch

4-12 watt storage batteries

1-Signal Corps tube tester No. 1-56-J

1- 0-10 millimeter of the portable type

2- Volt ohmeters, multi-tested type

1- 0-5 amp ameter

1- 0-30 volt voltmeter, portable, 1% accuracy

2- 4 ohm 100-watt resistors for battery check

1- Hallicrafter receiver, model S-27, plus speaker

10. In addition to this test equipment, each man should be equipped with a tool kit, which will include a light and a heavy soldering iron, diagonal cutter, wrench sets (medium and extra small sizes), ratchet type screw driver sets, Allen and Spintite screw driver sets, a 9/16 open end wrench, a 6", 8", and 10" wrench, and a special spanner wrench for tightening bomb collar. Information concerning spanner wrench can be obtained from Gulf Research.

[redacted] HENRY J. RAND
Major, Air Corps

C/O Cont Missiles
70.210 Misc.
34.(4/6 M) Rocks
DEB

SECRET 106

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RECORD OF DROPS - AZON PROJECT NO.2

No.	Range Error	Azimuth Error	OK	Flare Failure	Gyro Failure	Other Bomb Failure	Trantr & Cont. Box Failure	Cloud-No Spot
1						x		
2			x					x
3			x					x
4							x	
5							x	
6	125	0	x					
7							x	
8							x	
9							x	
10							x	
11			x					
12			x					
13			x					x
14	100	50	x					
15	175	250	x					
16						x		
17	250	50	x					
18						x		
19						x		
20			x					
21	40	75	x					
22	350	120				x		
23						x		
24		0	x					
25						x		
26	50	0	x					
27					x			
28	50	100	x					
29						x		
30	0	0	x					
31	0	70	x					
32	200	0	x					
33	150	0	x					
34	200	25		x				
35	150	0	x					
36	50	50	x					
37	50	0	x					
38	Aircraft Rack Failure							
39	"	"	"					
40	"	"	"					
41	0	0	x					
42	175	75	x					
43	200	50	x					
44	0	30	x					
45	40	0	x					
46	40	20	x					
50	600	0	x					

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[redacted]

0886

C/o Cont. Minutes
70.210 Mine.
54. (5/6 Imp) R&R S
A2B

[redacted]

No.	Range Error	Azimuth Error	OK	Flare Failure	Gyro Failure	Other Bomb Failure	Trantr. & Cont. Box Failure	Cloud-No Spot
51	0	0	x					
52	75	20	x					
53	1000	0	x					
54	100	0	x					
55	100	60	x					
56	0	0	x					
57	0	0	x					
58	0	60	x					x
59	Bombardier		x					
60	500	0	x					
61	150	0	x					x
62	Bombardier							
63		0	x					
64	250	0	x					
65	0	0	x					
66		200				x		
67	0	0		late				
68	Bombardier		x					
69	0	0	x					
70	0	0	x					
71	20	0	x	x				
72	0	0	x					
73	100	0	x					
74	50	0	x					
75	0	20	x					
76	20	0	(Ignited in ship)					
77	75	0	x					
78	0	0	x					
79	0	100	x					
80	100	50	x					
81	0	0	x					
82	0	0	x					
83	100	0	x					
84	0	0	x					
85	50	0	x					
86	0	150			x			
87	100	0		x				
88	50	0	x					
89	10	0		fell off				
90	50	0	x					
91	100	0	x					
92	0	50		fell off				
93	0	50	x					
94	0	0	x					
95	50	0	x					
96	50	0		x				

[redacted]

No.	Range Error	Azimuth Error	OK	Flare Failure	Gyro Failure	Other Bomb Failure	Tremtr & Cont. Box Failure	Cloud-No Spot
97	150	0	x					
98	200	40	x	x				
99	0	0	x					
100	0	0	x					
101	0	0	x					
102	200	0	x					
103	150	0	x					

LIST OF FAILURES - 1st 40 Azons:

Rack	Transmitter	Flare	Other	Gyro	Total
3	6	1	8	1	19

LIST OF FAILURES - LAST 60 AZONS:

Rack	Transmitter	Flare	Other	Gyro	Total
			9	1	10

(However, 5 of the flare failur s did not hinder accuracy)

Total estimated 0 azimuth - 41
Total estimated 0 azimuth 0 range - 16

[redacted]

33

SECRET

Flare Failures in Drops of 1000 lb. Azon

Air Ordnance Officer

26 April 1944

AC/AS,MRD, Material Division

Major V.A.Stace/mm/6440

1. A meeting was held on the above subject on 25 April 1944 with Major Rand, Special Projects Section, Air Communications Officer, Captain Lacasses and Mr. Settle, Office of the Air Ordnance Officer, and Mr. Fagan, Office of the Chief of Ordnance.

2. Major Rand reported that in the last several weeks, 100 Azon bombs have been dropped at Orlando during the operational training of ten B-24 crews for the use of Azon. Very little flare trouble was encountered with the first 50, but the difficulties increased in the last 50, and a total of ten flare failures were encountered in the 100 drops. The detail of these failures follows:

a. One flare started burning immediately after the bomb left the shack and the plug to the airplane ignition system pulled out.

b. One flare did not ignite until just before the bomb hit the ground.

c. Three flares came off the bomb during the descent.

d. Five flares never ignited.

3. Several of the bombs whose flares did not ignite were controlled as long as they could be seen. This indicates that the failure was in the flare itself.

4. Mr. W. J. O'Donnell, Gulf Research representatives with this project, stated on 22 April 1944 that he felt at least a part of the flare failure might be due to incomplete moisture proofing and recommended a moisture-proof type packing. Major Rand did not believe that all of the flare failures were due to moisture, but stated that the weather in Florida had been extremely humid.

5. The flare difficulties for Lt. Colonel Helmick's 108 drops and the 100 drops described by Major Rand became worse after the flares used had been exposed to high moisture conditions.

6. Mr. Fagan agreed that Ordnance would take the following steps:

a. Expedite drop tests of 100 flares, attached to bombs, from at least 15,000 feet.

b. Expose batches of these flares to several lengths and types of moisture conditions before dropping.

c. Issue immediate orders to put all future flares produced in moisture-proof containers and recall all unused flares from Union Switch and Signal Company for replacement by moisture-proof packed flares when they become available. This moisture-proof packing will continue until decisions can be reached concerning the necessity for such a packing.

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(AFR 11-30)

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34

SECRET

Flare Failures in Drops of 1000 lb. Azon

Air Ordnance Officer

26 April 1944

AC/AS, MM&D, Materiel Division

1 (Cont'd)
Major V.A.Stace/mm/6440

d. Examine the possible effect on flare failures of the Tung-Sol Relay Type X-26, used in connection with the safety system to prevent flare ignition in the bomb bay if the plug should be accidentally pulled.

e. Make any necessary corrections to the flares or flare ignition squibs as soon as possible.

7. It is requested that the Air Ordnance Officer take the necessary action in connection with this program to insure that the correction of the Azon flare difficulties is expedited to the fullest extent.

R. C. WILSON
Colonel, Air Corps
Chief, Development Engineering Br.

Son Copy. Cont. Miscellaneous
2.2 - Reports R+RS, DSB 1(1-n)
S

HGM/EWH/kg-C

27 April 1944

Azon Bombing Records.
(Army Air Forces Board Project No. (T-1) 13).

Tactics Division

TO : Commanding General, Army Air Forces, Washington 25, D. C.
Assistant Chief of Staff, O. C. & R., Bombardment Branch, Attn: Major V. A. Stace.

1. Enclosed herewith find one copy of the record of Azon bombs dropped by the B-24's operating on Phase 2 of Army Air Forces Board Project (T-1) 13. The scoring was by estimation only, and while it definitely presents an optimistic view, it is believed by all concerned that they are reasonably accurate. Those bombs listed as perfect in range and deflection are believed to be well within a 100' circle.

2. For further information, you are referred to the Army Air Forces Board Project (T-1) 13, the final report on which project will be available through the Army Air Forces Board Control Office, O. C. & R., approximately the 1st of June.

3. Phase 3 of this project, involving a careful study of training releases and bombing of maneuvering targets, is as yet incomplete. This phase of the test is being run by experienced combat crews and will be the basis of the final evaluation of this type bomb by the Army Air Forces Board.

For the Executive Director:

H. G. MONTGOMERY, JR.,
Colonel, Air Corps,
Chief, Tactics Division.

1 Incl -
Incl 1 - Cy abv record

[redacted]

66

Date	Target	Ship No.	Bombardier	Bomb No.	Operation [redacted]	Deflection R-Right L-Left	Range S-Short O-Over	Remarks
4-14	CR-Ocala	264	Holbrook	X	X	Not Spotted	(Clouds)	No. Rt. Control
4-14	CR-Ocala	264	Lacy	2	OK	Not Spotted	(Clouds)	
4-14	CR-Ocala	264	Lacy	3	OK	Not Spotted	(Clouds)	
4-14	Ocala	291	Holbrook	4	X	300-L	100-O	No Rt. Control.
4-14	Ocala	291	Butler	5	X	200-R	75-S	No. Left Control
4-14	Ocala	291	Butler	6	OK	0	125-S	
4-16	CR-Ocala	287	Schelzi	7	OK	Not Spotted		Flare Went Out
4-16	CR-Ocala	287	Schelzi	8	X	Not Spotted		Control Box Wiring Faulty
4-16	CR-Ocala	287	Schelzi	9	X	Not Spotted		" " " "
4-16	CR-Ocala	287	Busby	10	X	Not Spotted		" " " "
4-16	Ocala	273	Sonnenfield	11	OK	Not Spotted		Double Release.
4-16	Ocala	273	Sonnenfield	12	OK	Not Spotted		
4-16	Ocala	273	Sonnenfield	13	OK	Not Spotted.		
4-16	Ocala	273	Sonnenfield	14	OK	O-L	100-O	
4-16	Demo Range	291	Halverson	15	OK	250R	175-S	1st Bomb.
4-16	Demo Range	291	Halverson	16	X	350-L	250-S	
4-16	Demo Range	283	Busby	17	OK	0	250-S	
4-16	Demo Range	283	Busby	18	X	1500L	200-S	Controls Reversed.
4-16	Demo Range	283	Busby	19	X	250L	0	Controls Reversed.

[redacted]

Date	Target	Ship No.	Bombardier	No.	[redacted]	[redacted] Right Left	S - Short O - Over	Remarks.
4-17	OCALA Demo Range	291	Butler	20	X	400R	100-O	Hack Response
4-19	Demo Range	[illegible]	Lacy	21	OK	75L	40-O	
4-17	Demo Range	[illegible]	Lacy	22	OK	120L	350-S	Synchronization off
4-18	Demo Range	291	Butler	23	X	400R	75-O	No left control
4-19	Demo Range	283	Washington	24	OK	0	0	
4-19	Demo Range	283	Washington	25	X	not plotted	0	Spinner
4-19	Demo Range	288	Legl Page	26	OK	0	50-O	
4-19	Demo Range	288	Legl Page	27	X	not plotted		Spinner
4-19	Demo Range	277	Harris	28	OK	100-L	50-S	
4-19	Demo Range	277	Harris	29	X	500-R	70-S	No Control
4-19	Demo Range	277	Bullard	30	OK	0	0	Very Good Control
4-19	Demo Range	277	Bullard	31	OK	70-L	0	Very Good Control
4-19	Demo Range	285	Halverson	32	OK	0	200-S	Good Control
4-19	Demo Range	281	Lesh-Page	33	OK	0	150-O	Good Control
4-19	Demo Range	281	Lesh-Page	34	X	65R	430-S	Faulty A-2 Release
4-19	Demo Range	281	Lesh-Page	35	OK	0	150-S	Perfect Control
4-19	Demo Range	275	Harris	36	OK	50L	50-O	Control Very Good
4-19	Demo Range	275	Harris	37	OK	0	50-S	Control Very Good

[redacted]

Date	Target	Ship No.	Bombardier	Bomb No. [redacted]	Operation	Deflection R - Right L - Left	Range S - Short O - Over.	Remarks.
4-20	Demo Range	297	Butler	38				DRopped Safe
4-20	Demo Range	297	Butler	39				Dropped Safe
4-20	Demo Range	291	Butler	40				Flare Failure
4-19	Demo Range	288	Washington	41	OK	0	0	Perfect Control
4-19	Demo Range	288	Washington	42	OK	50R	150-0	
4-20	Demo Range	288	Washington	43	OK	0	200-0	
4-20	Jap Village	283	Busby	44	OK	30-L	0	
4-20	Jap Village	283	Busby	45	OK	0	40-S	
4-20	Jap Village	283	Busby	46	OK	20-R	40-0	
			No Record	(47)				
			" "	(48)				
			" "	(49)				
4-20	Jap Village	285	Halvorson	50	OK	0	6008	Good Control
4-20	Jap Village	285	Halvorson	51	OK	0	0	Good Control
4-20	Jap Village	285	Halvorson	52	OK	20L	75-0	Good Control
4-20	Jap Village	275	Hargis	53	OK	0	1000-S	Incorrect disk speed from lead ship
4-20	Jap Village	275	Hargis	54	OK	0	100-0	Very Good Control
4-20	Jap Village	275	Hargis	55	OK	60L	100-S	Good Control
4-20	Jap Village	281	Legh Page	56	OK	0	0	Perfect Control

[redacted]

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Date	Target	Ship No.	Bombardier	Bomb No.	Operation [redacted]	Deflection R - Right L - Left	Range S - Short O - Over	Remarks.
4-20	Jap Village	281	Legh Page	57	OK	0	0	Perfect Control
4-20	Jap Village	281	Legh Page	58	OK	60L	0	Cloud Interference.
4-21	Jap Village	275	Hargis	59	X	600L	100-0	No Control
4-21	Jap Village	275	Hargis	60	OK	0	500-0	False Level
4-21	Jap Village	275	Hargis	61	OK	0	150S	Control very good
4-21	Jap Village	285	Halvorson	62	OK	600L	0	Good Control
4-21	Jap Village	285	Halvorson	63	OK	0	Not plotted	Good Control
4-21	Jap Village	285	Halvorson	64	OK	0	250S	Good Control
4-21	Jap Village	291	Butler	65	OK	0	0	Very Good Control
4-21	Jap Village	291	Butler	66	X	200R	0	No Left Control
4-21	Jap Village	291	Butler	67	OK	0	0	Flare Delayed
4-21	Jap Village	277	Bullard	68	X	400L	0	Weak Control
4-21	Jap Village	277	Bullard	69	OK	0	0	
4-21	Jap Village	277	Bullard	70	OK	0	0	Very Good Control
4-21	Jap Village	281	Legh Page	71	OK	0	20	Flare Failure
4-21	Jap Village	281	Legh Page	72	OK	0	0	No Attempt at Control
4-21	Jap Village	281	Legh Page	73	OK	0	100S	Perfect Control
4-21	Jap Village	283	Busby	74	OK	0	50-0	
4-21	Jap Village	283	Busby	75	OK	20R	0	Flare exploded
4-21	Jap Village	283	Busby	76	OK	0	20-0	Flare ignited in Bomb Bay

[redacted]

Date	Target	Ship No.	Bombardier	Bomb No.	Operation	Deflection R - Right L - Left	Range S - Short O - Over	Remarks.
4-21	Jap Village	273	Sonnenfield	77	OK	0	75-O	
4-21	Jap Village	273	Sonnenfield	78	OK	0	0	Perfect Control
4-21	Jap Village	273	Sonnenfield	79	OK	100L	0	Control Slow
4-21	Jap Village	264	Lacy	80	OK	20R	80-O	Flare not Armed
4-21	Jap Village	264	Lacy	81	OK	0	0	Perfect Control
4-21	Jap Village	264	Lacy	82	OK	0	0	Perfect Control
4-22	Jap Village	277	Bullard	83	OK	0	150-S	Perfect Control
4-22	Jap Village	277	Bullard	84	OK	0	0	Perfect Control
4-22	Jap Village	277	Bullard	85	OK	0	50-O	Perfect Control
4-22	Jap Village	277	Bullard	86	X	150R	0	No Control
4-22	Jap Village	287	Schelzi	87	OK	0	100-O	Flare Failed.
4-22	Jap Village	287	Schelzi	88	OK	0	50-O	Perfect Control
4-22	Jap Village	287	Schelzi	89	OK	0	10-O	Perfect Control
4-22	Jap Village	273	Sonnenfield	90	OK	0	50-S	Perfect Control
4-22	Jap Village	273	Sonnenfield	91	OK	0	100-O	Perfect Control
4-22	Jap Village	273	Sonnenfield	92	OK	50R	0	Flare came off
4-22	Jap Village	264	Lacy	93	OK	50R	0	Control Weak.
4-22	Jap Village	264	Lacy	94	OK	0	0	Perfect Control
4-22	Jap Village	264	(AFR0PL30)	95	OK	0	60-S	Perfect Control

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Date	Target	Ship No.	Bombardier	[redacted]	Operation	Deflection R - Right L - Left	Range S - Short O - Over	Remarks.
4-22	Jap Village	283	Washington	96	X	0	50-O	Flare Failure
4-22	Jap Village	283	Washington	97	OK	0	150-S	
4-22	Jap Village	283	Washington	98	OK	40R	200-S	Flare Failure
4-23	Jap Village	285	Washington	99	OK	0	0	Perfect Control
4-23	Jap Village	285	Washington	100	OK	0	0	Perfect Control
4-23	Jap Village	287	Schelzi	101	OK	0	0	Perfect Control
4-23	Jap Village	287	Schelzi	102	OK	0	200-O	Perfect Control
4-23	Jap Village	287	Schelzi	103	OK	0	150-O	Perfect Control

53 at 0 — 34 at 0
11 at 0-50 — 15 at 0-50
6 at 51-100 — 16 at 51-100

Not Plotted

7

[redacted]

Date	Target	Ship No.	Bombardier	[redacted]	Operation	Deflection R - Right L - Left	Range S - Short O - Over	Remarks.
4-22	Jap Village	283	Washington	96	X	0	50-O	Flare Failure
4-22	Jap Village	283	Washington	97	OK	0	150-S	
4-22	Jap Village	283	Washington	98	OK	40R	200-S	Flare Failure
4-23	Jap Village	285	Washington	99	OK	0	0	Perfect Control
4-23	Jap Village	285	Washington	100	OK	0	0	Perfect Control
4-23	Jap Village	287	Schelzi	101	OK	0	0	Perfect Control
4-23	Jap Village	287	Schelzi	102	OK	0	200-O	Perfect Control
4-23	Jap Village	287	Schelzi	103	OK	0	150-O	Perfect Control
						53 at 0 11 at 0-50 6 at 51-100	32 at 0 15 at 0-50 16 at 51-100	

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WAR DEPARTMENT - ARMY AIR FORCES
Office, Asst. Chi[illegible] Air Staff, Materiel, Mainten[illegible], and Distribution

Inter-Desk Memorandum

TO: LT COL F H RICHARDSON

Date 28 April 1944

SUBJECT: AZON

1. Mr. Richmond, NDRC., discussed the use of Azon in the European theatre with General McClelland and Major Norvell today. General McClelland is very cordial to the idea of utilizing Azon in that theatre.

2. The two squadrons being trained at Orlando are to go with the 10th Air Force in the China Burma theatre. It is expected that this unit will be in action in about one month, although reports from this theatre may be delayed, due to the usual bad weather in this theatre in May.

3. At the present time, the production rate is 3,000 per month, which will be maintained for the next four months. The first 100 of the one-ton Azons will be delivered in approximately one month, and production on the one-ton Azons will probably be started within the next thirty days.

4. Major Norvell feels that if Azon is to be used in the European theatre, the training facilities might well be set up in the British Isles and he is anxious to go there in connection with this project. It is understood that General McClelland would be agreeable to this arrangement.

5. General McClelland is agreeable to the informal transmittal of results of latest tests at Orlando to General Doolittle. General McClelland stated that he had no formal report to transmit himself.

6. The latest movies received in General McClelland's office from Orlando proved to be training movies rather than movies of the latest series of drops. The drop pictures have only been received from the Army Air Forces Board.

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Form
W. E. BROWN, LT. CO. A.C.

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M.M.S.#111

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Lt. Col. K. P. Hoyceisa
90-C-30 Tel. 3-4534

29 April 1944

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TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF
EXP. ENG.
CONTRACT
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PROD. DIV.
PROD. ENG.
PROD. CONT.
J. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS

Study on Increased Production Axon Tail for 1000 lb. Bomb.

Commanding General
Army Air Forces
Washington 25, D. C.

Attn: Asst. Chief/Air, MAC
Material Division, Development Engineering Branch
Colonel A. C. Wilson.

Ref: A - This letter dated 8 Apr. 44, subject as above

B - Materiel Command letter dated 17 Apr. 44, subject as above.

1. In accordance with paragraph 2. b. of reference letter A, a study of additional sources for the manufacture of the Axon XM-1 Tail Structures has been made.

2. Five companies are recommended, although information to date is not complete on two of the five.

3. The Aeronca Aircraft Company, Middletown, Ohio, has sent representatives to this office on several occasions on this subject, who have inspected the prints as well as the sample Axon tail and are convinced that they would be in a position to manufacture same. They have about 75,000 sq. ft. of floor space available; also, sufficient employees to produce the item at the rate of 2500 to 3100 per month. This company has been a large producer of light airplanes; also, is now manufacturing a pilot less, radio controlled, and has additional work on the [illegible] They claim that they can start their tool makers on this work immediately and could get into production within a very short time.

4. The Harden City Plating Co., Chicago, Illinois, has also had its representative check the drawings and sample and they also have the capacity and employees to do this work. They have had experience in

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CENTRAL FILES

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CONFIDENTIAL

To: Asst. Chief/ AS, MMD - Col. W. C. Wilson
Subj: Study on Increased Production Azon Tail for 1000 lb. Bomb
Date: 29 April 1944.

electrical installations and can manufacture their own solenoids. They are of the opinion that they could get started on the manufacture of this item within 30 to 60 days and could produce 2500 or more per month at peak.

5. Ridgefield Manufacturing Co., Ridgefield, New Jersey. This company's representative has also inspected the drawings and sample of this Azon tail and this company has the facilities and capacity for this work. It was one of the prime contractors of the CG-4A gliders, which work is now running out and the representative believes that they could get on the work immediately and could turn out 2500 per month, or more.

6. Crocker-Wheeler Electrical Mfg. Co., Empire, New Jersey. This company's representative has also checked the drawings and stated that his company would be in a position to manufacture this item. The company has been manufacturing trainer turrets but has been cut back to some extent leaving additional open capacity. The representative felt that they could get started immediately, but gave no information as to the number of units which could be produced per day.

7. Another potential source is the National Electric Mfg. Co., Berrien Springs, Michigan, which company has had electrical installation experience and has also sheet metal facilities for this type of work. Its representative has not yet had an opportunity to check the drawings and sample and, therefore, is not in position to state when they could start production, or advise the number of units that could be produced per day.

8. Exhibit A, attached, is a report covering a study of the major subcontracted items which would be required by any new prime contractor.

9. As soon as further information on the sources listed in paragraphs 6. and 7. is available, it will be transmitted.

For the Commanding General:

J. H. WYNN,
Captain, Air Corps
Asst. Tech. Executive.

5 MAY 1944

cc: Lt. L. L. Slee, RCS
Capt. W. O. Castleberry, PES

Attach. Exhibit "A"

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EXHIBIT "A"
PRINCIPAL SUBCONTRACTED ITEMS - AZ-1 AZON TAIL STRUCTURE

SIGNAL CORPS AND ORDNANCE DEPT. ITEMS

To date, the bottleneck in AZ-1 production has been radio sets. There has been no difficulty in obtaining Ordnance kits, and it is believed that they can be supplied in any required quantity. Availability of both radio sets and Ordnance kits should be checked.

SERVO MOTOR

This motor is now being furnished to the contractor by the White-Rodgers Electric Co., St. Louis, Missouri. Mr. R. F. Mercer, Resident Representative in Dayton, has checked with his company and was given the information that the company has capacity for any additional requirements for servo motors for the Azon tail.

SOL NOTES

These solenoids are now being manufactured by the prime contractor; however, a number of sources for solenoids are available and some of the prospective sources of manufacture of the Azon tail have advised that they can manufacture their own solenoids.

6 VOLT BATTERIES

These batteries are now being furnished by the Willard Storage Battery Company, Cleveland, Ohio. Mr. L. N. Sutherland, Assistant Sales Manager, advises that the company is now producing the MT-6 battery at the rate of 2000 batteries per week and that, if necessary, this production can be increased to meet any requirements.

GYROS

The present source for the gyro is the L. H. Schwein Engineering Company, Los Angeles, California. In order to supply the gyros necessary for the Union Switch & Signal Company's maximum production of 4500 AZ-1 Tail Structures per month, plus spares, they would have to produce approximately 10,000 units per month. They state that they could get up to this production within sixty days provided that a AAA Priority could be obtained for certain critical materials. These materials are as follows: 2 Alnico Magnets per gyro, 8 Ball Bearings per gyro, 1 Relay per gyro and 1 Uncaging Magnet per gyro. They would also need to add 112 unskilled female employees.

The company is adding another small building to its assembly space, making

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four buildings for production. The additional building will require some assembly benches which the company will build itself, but there will also be required some additional testing equipment including 2 Dynetric Balances and 4 Strobotachs. The company already has duplicates of all existing machinery, fixtures, dies and jigs.

A new source for gyros is also under consideration. This source, the Harvill Corporation, Los Angeles, California, has submitted a gyro for test in the Equipment Laboratory. Informal reports from the Laboratory are to the effect that Harvill could now be recommended as an approved source, subject to final approval of the production sample. A representative of the Harvill Corporation states that the company could produce approximately 10,000 of these gyros per month, working two shifts.

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Eng. Govt. Weapons
Rep. Reports RoRS
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HEADQUARTERS
301ST BOMBARDMENT GROUP (H) AAF
APO 520 US ARMY

30 April 1944.

SUBJECT: Azon Operations in Italian Theater.

TO : Office, Chief of Air Communications, War Department, Washington, D. C.

1. Operations with Azon in this theater have to date been greatly hampered by extremely bad weather, or by cloud conditions which precluded its use. To date, only four Azon missions have been attempted. The first, on 17 April, resulted in a non-effective sortie due to weather over the target. The second, on 24 April, the third on 29 April, and the fourth on 30 April were carried to completion and the results obtained are outlined in Appendix I.

2. To date, no attempts have been made to include Azon in the massed Air Force attacks, but it is handled rather as an independent squadron. This has been necessary in order to evaluate the weapon's effectiveness, and to obtain some knowledge of the tactics necessarily dictated by the nature of the device. Targets in all cases to date have been railroads and railroad bridges which are considered of importance to the enemy's supply echelons. This type of target was indicated by the undersigned as the target to which Azon was best adapted, and Air Force has consistently directed attacks against such targets. In attacks so far completed, the general plan has been to fly down a section of railway line approximately fifty miles in length, dropping successively at vital points such as bridges, using one bomb per ship per target.

3. Accuracy has declined to an alarming extent from that obtained in tests and training in Florida. This decline may to some extent be attributed to enemy fire and the necessity for shorter bomb runs, but it begins to appear that accurately dropping the bomb and then controlling it is too much for the bombardier, especially when targets come up in rapid succission. This condition, if correct, would indicate the desirability of an extra crew member to control the bomb. The use of the radio man, navigator or other regular crew member for this purpose is not considered advisable in view of the attacks by enemy fighters which have been encountered and the necessity for having all defensive armament manned at all times. When experienced bombardiers are available, it is planned in the future to have one bombardier drop the bombs and the Azon-trained bombardier control it.

4. As more information and experience is obtained, it is planned to drop sticks of three to six Azons at short intervalometer settings, and to control them so as to accurately place the pattern by observing (for control purposes) the center bomb only. What dispersions in the pattern will result from such tactics cannot be known at this time. However, this knowledge is considered of importance in that, as range errors decrease and compensation for those errors becomes more accurately known, the device will naturally come to be considered as a point-bombing weapon. This view is of course being avoided at present, but the assignment of bridges as targets rather than just a stretch of railroad is thought to be indicative of the trend. Also the fact that range errors apparently are becoming less seems to lend credence to this premise.

Incl. 1

CC# 376 [redacted]

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Eng. Capt. Wimsley
1, & 2 Reports, R&RS
LB 4 (4/5 M)

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(Azon Operations in Italian Theater, 30 Apr 1944 cont'd)

5. Functional failures with Azon have been encountered in a number of instances, in a larger percentage than was encountered during the tests in Florida.

a. As was pointed out in a previous report, one source of constant trouble is batteries; the leakage of current after installation in the unit may account for the great loss in voltage observed in many cases where the takeoff has been delayed a day or two. This is thought to be due to an electrical short circuit from the battery terminals to ground through a film of acid on top of the battery. This could be eliminated by covering all battery terminals with wax or other insulating compound. At present, candle wax is melted over terminals when time will permit.

b. The uncaging mechanism of the gyro has in many cases been found faulty in that it is too susceptible to jarring and becoming uncaged. This, where noticed, has generally been repairable, but even where this is done it is thought several failures ("spinners") have been due to gyros becoming uncaged during take-off on the very rough field. Once installed, there is no means of telling whether or not the gyro is still caged. It is recommended that efforts be made to eliminate the possiblity of accidental uncaging.

c. Where the bombs failed to respond to signals (but apparently did not spin), it is reasonable to suspect radio receiver failure. From observation and numerous careful tests, the principal radio defects which might cause or contribute to this type of failure are drift off frequency and consequent large decrease in sensitivity. Also, the inherent sensitivity of the radios tested to date has varied over quite a large range. Tests should be conducted in a laboratory to determine what the proper sensitivity should be in order to insure positive control and yet not be susceptible to extraneous impulses such as caused by stabilizing solenoids and servo-motor. A great number of radios have been found inoperative due to defective 9002 and 9003 tubes, indicating faulty inspection.

d. Dud bombs have occurred when fuzing was at 1/10 second, although ~~thereafter~~ extreme care in selection of the fuzes was observed. All fuzes thereafter were set a instantaneous, and no failures have been noted. However, this is not ideal on most targets, and it is strongly recommended that a tail fuze be developed for Azon bombs. An attempt along this line is being made here.

6. Despite mechanical failures and personnel deficiencies, a sufficient number of successful drops have been made, it is felt, to demonstrate the value of Azon on certain targets. This may be reasonably assumed when consideration is given to the relatively small number of sorties and number of bombs dropped in comparison to the hits made. In the past, the same targets have been attacked

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Cont. Missiles
Opn Reports R+RS
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(Azon Operations in Italian Theater, 30 Apr 1944 cont'd)

by relatively large formations and a large weight of bombs dropped to achieve comparable results. What is meant by this may be observed in strike photos showing great number of craters around the target, with only one or two direct hits on railway or bridges. However, it is desired to point out that no statements or evaluation of Azon have been made by Air Force to date, and that the above statement is merely the opinion of the Project Officer. When at least five effective missions have been completed, it is the intention of the Project Officer to ask that an evaluation be made of the weapon and, on the basis of lessons learned on those missions, a study made of tactics most applicable to the weapon. At present, the actual method of attacking the assigned target is left to the Project Officer and operations personnel of the Bomb Group.

7. If the various suggestions and recommendations noted above are considered advisable by your office, it is requested that they be passed on to Materiel Command and N.D.R.C. for such action as you may direct.

Paul F. Helmick
PAUL F. HELMICK,
Lt Col, Air Corps,
Project Officer, Azon.

Enclosures:
Log and pictures for missions 2, 3, and 4.
Log for mission 1.

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(AFR 11-30)
[redacted]

90.212 Reports, R+RS
DEB 3 (3/6 mo)

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AZON LOG

MISSION NO. I

DATE: 17 April 1944

TARGETS: Railroad line, Rimini to Ancona (Italy)

AIMING POINTS: Railroad bridges.

NO. OF BOMBERS (AZON): 3

FIGHTER COVER: 16 P-38's

OPPOSITION: FLAK - Medium at several points.

E/A - 20 to 35 EIA, attacking for 35 minutes.

REMARKS: Fighter cover lost due to bad weather, and bomber formation attacked by FW-190's and ME-110-F's. One B-17 seriously damaged and one minor casualty. Five E/A shot down.

RESULTS: No bombs dropped due to weather conditions

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[redacted]

AZON LOG

MISSION NO: 2

DATE: 24 April 1944

TARGETS: Same as Mission No. 1

AIMING POINTS: Same
Altitude 15,000'

NO. OF BOMBERS (AZON): 5

FIGHTER COVER: 18 P-38's

OPPOSITION: FLAK - Medium at Rimini and Fano.
E/A - None sighted.

REMARKS: Three flare failures in total of nineteen (19) Azons dropped. All bombardiers claimed lack of control, especially during later portion of bombs fall. Two bombs were accidentally dropped North of Rimini and fell in the sea.
Radios and batteries being investigated for possible cause of partial failures.

RESULTS: No hits on bridges. RR line probably cut at Rimini, Pesaro, and North of Senegallia. One hit (incidental) was made in factory or warehouse area at Cesano River bridge.

Note: Bombing was done in formation:

+
+ +
+ + ← Second element stepped down.

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C O P Y

AZON LOG

MISSION NO. 3

DATE: 29 April 1944

TARGETS: Same as #1 and #2

AIMING POINTS: Same
Altitude 18,000

NO. OF BOMBERS (AZON): 8
FLAK-
OPPOSITION: Medium
E/A - No attacks

FIGHTER COVER: 24 P-47's

REMARKS: Several cases of failure to control and four flare failures noted. Extremely poor releases by bombardiers in this attack. Total of 24 Azons dropped.
Formation drop as in Mission No. 2
Altitude 15,000'

RESULTS: Apparent hit by one of three bombs dropped in train at Senegallia on R R bridge. One hit on highway at Pesaro, one on RR line South of Rimini.

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(AER 11-30)

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– Copy, Cont. Missiles
212 Reports, R&RS.
B 3 (6/6 pp)

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C O P Y

AZON LOG

MISSION NO. 4 DATE: 30 April 1944

TARGETS: R R Line, Fano to Esino River

AIMING POINTS: R R bridges at Fano, Cesano River, and Esino River

NO. OF BOMBERS (AZON): 5 FIGHTER COVER: None (fighter cover lost)

OPPOSITION: FLAK - Slight

E/A - None

REMARKS: Attack made in column, stacked down, each ship to drop two bombs at each target. Experienced (group) bombardiers made drops, Azon bombardier controlled. Very poor run ins made by many.

Total of 30 bombs dropped. No spinners, no flare failures, only one (1) doubtful control.

Range seems improving. Standard trail settings used, with 6.5 to 7 rpm added to standard Disc Speed. Altitude 16,000 ft., with 100' differential between ships.

RESULTS: Fano Bridge: One direct hit where repair work was in progress to close break made 29 April, Mission No. 3. One hit on highway (not photographed). Other hits scattered.

Cesano River Bridge: Very poor run-in, but at least one hit on highway, possibly one hit on RR bridge, with several near misses.

Esino River Bridge: Attack ineffective. Possibly two hits on highways, others badly scattered.

[redacted]

C O P Y

Address reply to ENVELOPE to:

Commanding General
A F Materiel Command
Engineering Division
Reference: JHE:hle:54
Wright Field, Dayton, Ohio

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CONFIDENTIAL

Requirement for Special Tail Fuse for
High Angle Bomb, Project MX-225.

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Air Ordnance Officer,
Asst. C/AS, MM & D.

1. A new requirement exists for a special tail fuse for high angle bombs under Project MX-225, in particular, the high angle bombs designated as the Azon type AZ-1, using a 1000 lb. general purpose AN-M-65 bomb and AZ-2, using a 2000 lb. general purpose AN-M-66 bomb. These bombs are under the final stages of development by the National Defense Research Committee through the Union Switch and Signal Company in Pittsburgh, Pennsylvania.

2. For the present model of the Azon bomb type AZ-1, authority to omit the tail fuse was contained in a letter from the Development Engineering Branch, Materiel Division, Asst. C/AS, MM & D, dated 8 September 1943, subject, "High Angle Controllable Bomb in Azimuth, GTI-1350 (Project AC-36)." Omission of the tail fuse was necessary in the earlier stages of the Azon bomb development, but the above cited correspondence directed the early incorporation of a tail fuse in the bomb and any similar bombs developed in the future.

3. It is requested that the Ordnance Department initiate a project for the development of a tail fuse which can be used with the Azon bomb, type AZ-1 and type AZ-2. This fuse should meet the following requirements:

a. The fuse should be designed to use the M14 primer-detonator or a primer-detonator incorporating the same delays as the M14.

b. The fuse should, if mechanically armed, have an arming delay approximately equivalent to that of the fuse, bomb, tail, AN-M102A2.

FOR [redacted] USE ONLY

MX-225

AAFMC-190-WF-5-20-42-2 MH.

CENTRAL FILES

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
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PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PER.
OTHERS

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CONFIDENTIAL

C.G., AAF, Washington 25, D. C.
Att'n: Air Ordnance Officer, Asst. G/S, WD & D.
"Requirement for Special Tail Fuse for
High Angle Bomb, Project AX-225."

4. It is understood that there are several methods of arming this fuse as follows:

a. Mechanical--This would involve the use of an anemometer type arming vane similar to that shown on the inclosed drawing No. G.O.51930-Sh.A.

b. Electrical--This involves the arming of the fuse upon receipt of an electrical impulse after the bomb has been dropped.

c. Combination mechanical electrical--It is understood that this method has been considered by personnel of W. A. C. It involves the use of an electric motor to unwind an arming screw.

5. Additional drawings showing dimensions of the fin assemblies for the type AX-1 and type AX-2 bomb will be forwarded at an early date.

6. It is requested that twenty-five fuses meeting the above requirements be produced at the earliest date and that this Office be notified when they are available, at which time shipping instructions will be furnished.

7. It is further requested that these requirements be coordinated with Lt. Colonel F. B. Richardson of the Materiel Division, Materiel, Maintenance and Distribution, coordinator of Special Weapons Projects.

8. This letter has been coordinated through Ordnance Section, Wright Field.

For the Commanding General:

Cy Colonel Hubbard
aut. Cpa OCOR 3255

F. C. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

1 Incl.
Drawing No. G.O.51930-Sh.A.

Drawing not available for Central File
[redacted] copy in Special Weapons file.

Copy to:
Ordnance Section, Wright Field, AX-225
Att'n: Lt. Colonel McInnes.

- 2 -

15 MAY 1944

dress reply to

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mmanding General
F Materiel Command
gineering Division
ference: Bomblesh
right Field, Dayton, Ohio

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A. S. C.
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CIV. PERS.
OTHERS

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Azon Bomb, Type AZ-1.

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Radio & Radar Section, Development Engineering Branch, Mat. Div., AC/AS, MM & D.

1. The Azon bomb, type AZ-1, is now out of the experimental stage of development and is in a production status. However, this Office is of the opinion that further development of this item is necessary. As with any item of equipment just out of the experimental stage, refinement of the Azon would be desirable--not major changes in design, but refinement, in that its use in combat will be more general. Additional colors for flares would be desirable, a tail fuse should be incorporated in the design, and the inherent large dispersion when dropped in train should be reduced. Such refinements as these can be incorporated in the Azon type AZ-1 at this time without affecting production schedules.

2. It is requested that 75 each of the subject items be allocated to this Office for additional study, development and test.

3. It is further requested that this allotment be divided into three shipments of 25 each and shipped on or about 15 May, 1 June and 15 June 1944, to the Tonopah Army Air Field, Tonopah, Nevada, marked for the attention of the Special Weapons Test Unit.

4. It is further requested that Division 5.2 of N.D.R.C., be asked to participate in this development on the same basis in which they have operated in the past; this is, they will undertake the development of certain refinements in which they are interested by virtue of their experience with the original development of this item, and the Materiel Command will closely cooperate in the development and test of the product.

Vbs for the Commanding General:

C. H. WINDSOR, Capt., A. C.
For F. C. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

9 MAY 1944

[redacted]

AAFMC-190-WF-5-20-42-2 Mil.

CENTRAL FILES

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SECRET

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THE ARMY AIR FORCES BOARD
Orlando, Florida

8 May 1944

ARMY AIR FORCES BOARD PROJECT NO. (T-1) 13

Preliminary Report

Test On Azon Type High Altitude Bomb

1. OBJECT: This test was authorized by letter from Headquarters, Army Air Forces, Assistant CA/S., O.C.-& R., dated 11 November 1943. The object of the test is to determine:

a. The effectiveness of the bomb as modified by control equipment.

b. The limits of accuracy in deflection which can be obtained by this type of guided missile, and the maximum error which can be corrected.

c. The technique of control and limitations which such technique imposes on flight of the aircraft, especially with regard to evasive action after bomb release.

d. The size and type of formation which can most effectively employ the missiles, and suitable tactics for its employment.

e. If the installation and operation are such that special units shall be required for employment of this weapon, and if so, what characteristics shall distinguish such special units.

f. The effectiveness of this weapon in comparison with standard bombs on these criteria:

(1) Effectiveness against various targets.

(2) Economy, production and maintenance.

(3) Cost of employment.

2. FACTUAL ELEMENTS OF THE PROJECT:

a. The "Azon" bomb (name derived from azimuth only) is a remotely controlled bomb which can be guided after being dropped to correct errors in deflection. The control unit is situated in the tail fin of the AN M 65 bomb and conforms to the same dimensions as the standard fin. The interior components of the radio control device consist of a gyro, a radio receiver, a servo motor and a battery. The gyro stabilizes the bomb so the rudders are in a vertical plane. The radio receiver converts the signal from the controlling transmitter into an

C
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electrical impulse which actuates the servo motor and controls the rudders. The battery supplies power for the radio, gyro and servo motor. A flare is attached to the rear of the fin, which flare ignites by an electric arming device after the bomb leaves the plane. This flare burns until impact of the bomb, enabling the bombardier to follow his bomb and apply necessary control.

b. Difficulties encountered during the tests consisted mainly of properly evaluating the equipment when it was used mainly for training rather than evaluation tests. This report is based on the information obtained while training two detachments of airplanes for duty in the Mediterranean and Indian theaters. A final report will be submitted at the completion of phase three, exploiting the possibilities of this type weapon against a maneuvering target.

3. CONCLUSIONS: It is concluded that

a. A military requirement exists for the Azon Bomb.

b. The control is positive, adequate and satisfactory.

c. The deflection error should not exceed one hundred (100) feet on any successful bomb and the range error will be normal, provided an additional six (6) mils trail is put into the bombsight for this type bomb.

d. Control should not be applied until two-thirds of the time of fall has elapsed.

e. Evasive action against anti-aircraft fire by planes dropping these bombs is limited until impact of the bombs. The maximum change in altitude is limited by the size of the formation, but the technique of control restricts the planes to a close approximation of the continuation of the bombing run.

f. The size of the formation employing Azon bombs is at present limited to the number of separate channels of control. There is no reason why the Azon planes should not be mixed with planes carrying standard bombs, thus imposing no restrictions on the size or type of formation. This employment would, however, expose the ordinary bombers to anti-aircraft fire for an additional period of time in order to maintain the integrity of the formation.

g. The equipment is so simple that a standard unit can perform this type of operation with the addition of four enlisted specialists per eighteen bombs expended per day.

h. This type bomb is peculiarly adapted to the attack of linear targets but improved accuracy will result against any target requiring 1,000 pound bomb. The Sequel to this report will contain factual data concerning the attack of maneuvering targets. Contrary to initial ideas of employment of this bomb, it has been found that a

line leading to the target is not necessary.

i. The cost of this bomb as compared to the standard bomb is about four times as great. The production model is now available and operates successfully. The accuracy of the Azon bomb as compared with the ordinary bomb warrants the additional cost.

4. RECOMMENDATIONS: It is recommended that:

a. This type bomb be adopted as standard equipment, with present production facilities being maintained at full capacity. Final production and standardization requirements will be submitted later in final report.

b. Theater Commanders be supplied a copy of this report.

c. The technique described in Inclosure "A" be adopted as standard.

d. The Ordnance Department be instructed to initiate a more reliable flare for this bomb.

5. DISCUSSION:

a. The Air Forces Board was assigned the task of evaluating the Azon bomb during the execution of an operational training program involving two detachments of heavy bombers. The first detachment consisting of six (6) B-17G's and crews, together with eight (8) enlisted specialists for preparing the bombs, dropped a total of one hundred eight (108) bombs. Of these bombs, fifty-eight (58) operated successfully. The low percentage is due to the fact that this detachment was using the remainder of an experimental lot of bombs. The production model did not become available until the latter part of the training and it still needed improvement.

b. Of the fifty-eight (58) successful bombs, eighty-eight percent (88%) had a deflection error of fifty (50) feet or less. The average CE was two hundred sixty-one (261) feet at fifteen thousand (15,000) feet converted to twelve thousand (12,000) feet = 261' x .84 = 219 feet. The average range error was eighty-eight (88) feet short, or approximately six (6) mils from 15,000'. The corrected circular error of the first contingent becomes 248' from 15,000' when the bombing is corrected for the six (6) mils additional trail found necessary. This C.E. converted to 12,000 feet gives 248 x .84 = 208 feet.

c. The second detachment consisted of ten (10) B-24-J's with crews and eight (8) additional enlisted specialists. The B-24J is not well adapted to this type of bombing because of limited visibility in the bombardier's compartment. Accordingly, a small window was installed in the bottom of the compartment and the new installation was quite successful.

5050-3

d. Perhaps due to the increased available knowledge on this type of equipment, the second detachment received better results than the first. Technically, they produced seventy-seven (77) successful bombs out of one hundred three (103) or seventy-five (75%) percent. They claimed nineteen (19) dead-center bombs out of seventy-seven (77) and the average deflection error was 24 feet. The circular error from fifteen thousand (15,000) was one hundred seventy-five (175) feet. Converted to 12,000, it is 175 x .84 = one hundred forty-seven (147) feet. This picture is undoubtedly optimistic as the bombs were scored by estimation. However, the estimates were spot checked by moving pictures and are not unreasonable.

e. This bomb was found to require better weather than ordinary bombs. A cloud coming between the point of release and the point of impact will eliminate the advantage of control.

f. The Azon bomb was found to fall about six (6) mils short of the standard one thousand (1,000) pound bomb. This figure was established on the basis of the bombs dropped by the first detachment and confirmed by the second detachment. Apparently, it is satisfactory, although it is an empirical figure. It is suggested that a study be initiated by the Ordnance Department Proving Ground to determine a more scientific correction for dropping this type of bomb.

g. The weight of the Azon installation is approximately seventy-five (75) pounds. The components are:

One RC 186 transmitter	9" x 16" x 17"	wt. 32 lbs.
One Dynamotor	8" x 7" x 9½"	wt. 16 lbs. 4 oz.
One Control Box	7" x 5-3/4" x 5"	wt. 2 lbs. 2 oz.
Wiring And Antenna (estimate)		wt. 25 lbs.
Total		75 lbs.

h. The final report and evaluation of this equipment will be available about June 1944. It will contain more detailed information on this equipment and its tactical employment.

6. INCLOSURES:

a. Inclosure No. 1 - Cy. of directive - letter from Hq. AAF, Assistant CA/S., O.C. & R., dated 11 November, 1943.

b. Inclosure No. 2 - Cy. "Radio Preparation Procedure"; "Checking Units After Loading in Plane"; and "Procedure, Azon Bombs (In Flight)".

10

SECRET

1679

PREPARED BY:

Edward F. Hoover, Jr., Lt. Colonel, Air Corps, Tactics Division, AAF Board.

CONCURRED IN BY:

H. G. Montgomery, Jr., Colonel, Air Corps, Chief, Tactics Division, AAF Board.

CONCURRED IN BY:

G. M. McGregor, Colonel, Air Corps, Executive, AAF Board.

APPROVED:

For the Army Air Forces Board:

E. L. EUBANK
Brigadier General, U. S. Army
President

OFFICIAL:

Gustav A. Neuberg
GUSTAV A. NEUBERG
Major, AGD
Recorder

Distribution "SB"

AAF Board Project No. (T-1) 13

5050-5 [redacted]

Mines
Cont. Missiles
70.210 Mine.
35 (7/9 mp)
R&RS, D&B

115

SECRET

RADIO PREPARATION PROCEDURE

A. Tuning Procedure for Azon Radio.

I. The output of the 804-B signal generator is connected to the antenna of the bomb tail with the radio and gyro inside and operating with 24 volts applied to the kick-out plug. (This means the radio will have 19 volts input and correspondingly the sensitivity will be low).

II. The set is adjusted to the desired frequency color by first setting the 804-B correctly, (pick up signal from plane transmitter on receiver and zero beat the 804-B signal generator to this setting of the receiver) and then tuning the receiver to this frequency. In tuning the Azon receivers the receiver should never be allowed to become saturated (A.V.C. effect) tuning should be accomplished at a point just before relay closure.

III. The above procedure is repeated as many times as necessary. The units are then ready to be attached to the bombs.

B. Tuning Procedure for Azon Receiver with no Auxiliary Equipment.

I. The complete unit with Radio, Gyro, and Battery inside is set upright on the flare with the power extension cord plugged into the unit and plane (one of the Azon feeder plugs in the plane) with the shielded wire next to the unit. The auxiliary power plant for the plane shall be in operation and set at 28 volts. Warm up and control transmitter switches must be turned on and the control transmitter operated at low power. The auxiliary power plant shall be placed behind the left wheel of the plane. The bomb tail shall beplaced directly in front of the plane at the extreme distance of the power extension cord.

II. With the Bombardier giving a continuous left signal, the radio is tuned to the ship's frequency. (In some instances the bomb tail may have to be moved closer to the plane). After tuning is accomplished, a left and right check is made for correct operation. The unit is now ready for loading.

Inclosure No. 2, Item (1)

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Mines
Cont. Missile
70.210 Misc.
55 (8/9 pp)
RHS, DEB

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SECRET

CHECKING UNITS AFTER
LOADING IN PLANE

1. Turn on Main Line switch, battery switches, Azon 'warm-up' switch, and filament switch on control transmitter. If no engines (and generators) are operating, and no auxiliary power plant is operating, leave control transmitter switch on "High power". If generators are charging ship's batteries or auxiliary power plant is running, place control transmitter on "Low power" position.

2. Plug in Azon kick-out plug on one bomb. After sufficient warm-up time (30 sec. to one minute) bombardier will turn on carrier switch and give right, center, and left signals of at least five seconds duration each. Radio man or other crew member will observe action of Azon rudders for proper functioning.

3. Unplug first bomb, plug in second, and repeat above procedure for each bomb loaded in the ship. When check is completed, plug in all kick-out plugs.

4. See that arming wire is inserted through kick-out plug and extends not farther than four inches, and is secured by a Fahnstock clip.

5. See that bombs are properly fused, set for proper delay, if any, and that arming wire is installed and secured with Fahnstock clip.

6. When all units are thoroughly checked, bombardier will see that all switches are turned off, and report to the Project Officer or assistants.

NOTE: ALL ARMING WIRES SHOULD PASS THROUGH THE BOMB LUGS, AND SHOULD NOT HAVE ANY GREAT AMOUNT OF SLACK.

INCLOSURE NO. 2, Item (2)

5050-3

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SECRET

PROCEDURE, AZON BOMBS
(IN FLIGHT)

1. Bombardier will turn on Azon "Warm-up" switch immediately after take-off. This will cause the batteries in each unit to be charged by the ship's generators.

2. Bombardier will go to bomb-bay and plug in the flare plug on each unit, remove, kick-out plug pin (after inspecting arming wire), and remove safety cotter pin on nose fuze. When these steps are accomplished on each bomb, it is ready to be dropped.

3. On nearing the target, Bombardier will have the Radio man turn on control transmitter filament supply.

4. When the bomb-bay doors are opened, the Bombardier will turn on the "FLARE ARM" switch and the carrier switch on his control-stick box.

5. After all bombs are dropped, all the above switches should be turned off.

6. Control should not normally be applied until two-thirds (2/3) of the time of fall has elapsed.

Inclosure No. 2, Item (3)

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[redacted]

Address reply to

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Commanding General
AAF Materiel Command
Engineering Division
Reference JWS:hle:bh
Wright Field, Dayton, Ohio

[redacted]

[illegible] MAY 1944

Collaboration with the U.S.N.D.C.
Guided Missiles Program.

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Development Engineering Branch,
Materiel Division, Asst. C/AS, M.T.D.

1. Attached is a list of guided missiles under development by U.S.N.D.C. to which this Office has tentatively assigned type designations. The type designation "VB" will stand for Vertical Bomb compared to "GB" for Glide Bomb, thus retaining a consistency in nomenclature for all controllable bombs. Upon the acceptance of this nomenclature by the Specification Branch, this Office will in the future refer to the appropriate guided missile by the designation listed, VB-1, VB-2, etc.

2. However, the extent to which this Office is to participate in the development of these items is not clearly defined. To date, this Office has attempted to aid and expedite the development of these items in every way possible, but with the exception of VB-1 which is covered by MX-1556, it has done so without an explicit directive as to how far it should go in this matter.

3. Therefore, it is requested that authority be granted to this Office to collaborate with U.S.N.D.C. in the Guided Missiles Program. It is further requested that this authority state specifically which items are to be included and to what extent this Office is to participate.

4. It is further requested that this matter be given immediate attention in order that this Office can officially establish its correct responsibility in this development.

For the Commanding General:

FOR OFFICIAL USE ONLY
(AFR 11-30)

W. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

1 Incl.
List of Guided Missiles. [redacted]

16 MAY 1944

MX-225
CENTRAL FILES

AAFMC-190-WF-5-20-42-2 MH.

3296

73

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS

VB-1 1000 pound Vertical-Bomb, Visually Controllable in Azimuth Only. Consists of a standard 1000 pound general purpose bomb to which is attached, in place of the standard fin, a special tail fin containing stabilizing equipment, a servo mechanism, and a radio link. (Formerly known as the Azon type AZ-1).

VB-2 2000 pound Vertical-Bomb, Visually Controllable in Azimuth Only. Consists of a standard 2000 pound general purpose bomb to which is attached, in place of the standard fin, a special tail fin containing stabilizing equipment, a servo mechanism, and a radio link. (Formerly known as the Azon type AZ-2).

VB-3 1000 pound Vertical-Bomb, Visually Controllable in Both Range and Azimuth. Consists of a standard 1000 pound general purpose bomb to which is attached, in place of the standard fin, a special tail fin containing stabilizing equipment, a servo mechanism and a radio link. (Formerly known as the Razon).

VB-4 2000 pound Vertical-Bomb, Visually Controllable in Both Range and Azimuth. Consists of a standard 2000 pound general purpose bomb to which is attached, in place of the standard fin, a special tail fin containing stabilizing equipment, servo mechanism, and a radio link.

VB-5 1000 pound Vertical-Bomb, Controllable, Light Sensitive Target Seeking. Consists of a special bomb shell designed to house a seeking device and servo mechanism.

VB-6 1000 pound Vertical-Bomb, Controllable, Heat Sensitive Target Seeking. Consists of a standard 1000 pound general purpose bomb to which is attached a nose containing the seeking device and a special tail fin assembly containing the servo mechanism. (Formerly known as the Felix).

VB-7 1000 pound Vertical-Bomb, Controllable, Radio-Television Controlled.

VB-8 2000 pound Vertical-Bomb, Controllable, Radio-Television Controlled.

[redacted]

VB-9 1100 pound Vertical-Bomb, Controllable, Radar-Homing. Consists of a special bomb shell having four symmetrically arranged wings of known section and a correspondingly finned tail, with the fins spaced midway between the wings in an X+ arrangement. The structure is designed to contain an 1100 pound armor-piercing bomb with space forward for the radar homing device and aft for power supply. (Formerly known as the RPC).

VB-10 1600 pound Vertical-Bomb, Controllable, Radar-Homing. Consists of a special bomb shell having four symmetrically arranged wings of known section and a correspondingly finned tail, with the fins spaced midway between the wings in an X+ arrangement. The structure is designed to contain a 1600 pound armor-piercing bomb with space forward for the radar-homing device and aft for power supply.

70.212 R.R.S. DEB.-2
BC 4-8

8

70.21

Maj Stace
SD 875

WAR DEPARTMENT

CLASSIFIED MESSAGE CENTER

INCOMING CLASSIFIED MESSAGE

S E C R E T

P R I O R I T Y

From: CG, 15th Air Force, Bari, Italy

To : War Department
CG, Strategic Air Forces in Europe
London, England
CG, Mediterranean Allied Air Forces
Caserta Italy

No : BP1611 15 May 1944

To Eaker and Spaatz from Twining IE 903 NT, CS 640 NT.

Report on successful Azon mission is subject. Four Azon aircraft B17 supported by the 301st Heavy Bomb Group, 15th Air Force, attacked Avisio Viaduct north of Trento on Brenner Pass Railroad May 13th. 21 1000 pound RDX Azon bombs dropped. Estimated 4 direct hits with Azon bombs. Supporting group dropped 1000 pound GP bombs releasing simultaneously with Azon bombs. Group apparently scored several direct hits on viaduct and numerous damaging near misses. Preliminary damage assessment indicates Brenner Pass effectively blocked to all rail traffic with repair extremely difficult. Azon Aircraft led group sighting for range and deflection, remainder of group sighted for range only. Resultant pattern on ground excellent indication good basic bombing and minimum Azon corrections necessary. This tactic can be expanded to have all aircraft in gound loaded with Azon bombs on one frequency controlled by Azon leader or deputy in case of failure of equipment. In this manner center of pattern could be controlled 2500 feet from 20000 feet. Bombing accomplished from 22000 feet with good ability to control noted. Target altitude under 1000 feet. First Combat Camera Unit made cinematic record, copy being rushed to McClelland. 3 Azon bombs all remaining this theater.

ACTION: CG AAF No Sig

INFORMATION: OPD, G-2, Log

CM-IN-11265 (15 May 44) 2000Z [redacted]

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(AFR 11-30)

74

11
CONFIDENTIAL

Development of Tail Fuse for 1000 lb. Azon

AC/AS, WM&D, Air Ordnance Officer
THRU: Air Communications Officer
AC/AS, WM&D, Materiel Division

17 May 1944.

1
AFDMA-2F/Maj.Stace/lb/6440

1. In a report of 30 April 1944, subject "Azon Operations in Italian Theater," the following comment was made:

a. "Dud bombs have occurred when fuzing was at 1/19 second, although extreme care in selection of the fuzes was observed. All fuzes thereafter were set at instantaneous, and no failures have been noted. However, this is not ideal on most targets, and it is strongly recommended that a tail fuse be developed for Azon bombs. An attempt along this line is being made here."

2. It is requested that the Air Ordnance Officer take prompt steps to initiate the development of a tail fuze for the 1000 lb. Azon bomb. This development is to be coordinated with the Special Weapons Branch, Materiel Command.

3. It is further requested that this office be informed as soon as this development is completed in order that procurement can be initiated immediately through the Materiel Command for tail fuzes for all future production of the 1000 lb. Azon tails.

R. C. WILSON
Colonel, Air Corps
Chief, Development Engr. Br.

C O P Y

[redacted]

Orig. Cont. Missiles
70.210 Misc - 36 (3 M)
ADDRESS REPLY AND ENVELOPE TO:
R+R S, D&B, M+S.
COMMANDING GENERAL
AAF MATERIEL COMMAND
PRODUCTION DIVISION
DEPARTMENT 90-C-30
WRIGHT FIELD, DAYTON, OHIO.

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CONFIDENTIAL

(3)

ARMY AIR FORCES
MATERIEL COMMAND

KPR:ps

20 May 1944

Subject: Study on Increased Production Azon Tail for 1000 lb. Bomb.

To: Commanding General
Army Air Forces
Washington 25, D. C.

Attn: AC/AS, MM&D
Materiel Division, Development Engineering Branch
Colonel R. C. Wilson

Ref: A - MM&D Letter dated 8 Apr. '44, subject as above.

B - Materiel Command letter dated 17 Apr. '44, subject as above.

C - Materiel Command letter dated 29 Apr. '44, subject as above.

1. Reference Paragraphs 6 and 7, Letter reference C, additional information is now available.

a. Crocker-Wheeler Manufacturing Company, Ampere, New Jersey has been a prime contractor for trainer turrets but this contract is now being completed and the company has available approximately 20,000 square feet of floor space and about 2,000 employees. The company's representative gave assurance that the company could manufacture the item and that it could reach a peak of 2,500 to 3,000 articles per month. Production can probably start about 60 days after receipt of a letter contract and the peak rate can be reached 30 to 60 days later.

b. National Electric Manufacturing Company, Berrien Springs, Michigan, has had considerable experience on electrical assembly work and has facilities for sheet metal work welding and other operations required for production on Azon Tail Structures. Mr. F. M. Burke, Jr., a partner in the company states that his company could manufacture approximately 2,500 articles per month. It is estimated that it would take approximately 60 days after receipt of letter contract to start production and that the peak rate would be reached about 60 days later.

2. Representatives of the Grant Aircraft Corporation, New York, N. Y., examined drawings and a sample article at Wright Field on 12 May 1944. After their return to New York, Mr. Benjamin Weiss, President of the company telephoned and stated that they could complete their tooling within 60 to 90 days and that 30 days after completion of the tooling they could be in production at the rate of 1,500 per month; within 60 days they could pro-

3556

AAFMC-944-WP-10/22/43 20M

6619

[redacted]

Orig. Cont. Missiles
10.210 Misc. 36 (2/3 M)
R&RS, DZB

CONFIDENTIAL

To: AC/AS, MM&D - Colonel R.C. Wilson
Subj: Study on Increased Production Azon Tail for 1000 lb. Bomb.
Date: 20 May 1944

duce at the rate of about 3,200 per month and within 90 days they could produce at the rate of 10,400 per month.

3. The Laister-Kauffman Aircraft Corporation, St. Louis, Missouri has been a prime contractor on the CG-4A Glider and has considerable open capacity due to curtailment of the CG-4A program. A letter from this company, over the signature of John W. Laister, president, states that the company could reach a maximum production of 7,500 articles per month. He also pointed out that St. Louis is in a Class IV Labor Area. No statement was made as to the time required for tooling and to get into production but it is believed that tooling would require 60 to 90 days and that peak production could be reached 60 to 90 days after that.

4. A representative of the Vendo Company, Kansas City, Missouri states that the company has about 50 percent open capacity and that it could manufacture at least 100 Azon Tails per day working on one eight hour shift. He also stated that the company had received its fourth; award of the Army and Navy "E". He did not state how long it would take to tool up and reach peak production, but it is believed that tooling could be accomplished in 60 to 90 days and that peak production could be reached 30 to 60 days thereafter.

5. G and A Aircraft Company, Willow Grove, Pennsylvania sent a representative who estimated that the company could produce at a peak rate of 100 per day. The company has been a prime contractor on the CG-4A Glider and on the AT-21 Airplane and has equipment for sheet metal working, welding and electrical installations. It also has an experienced engineering staff and it is believed that it would prove a very satisfactory source. No statement was made as to the length of time for tooling and getting into production, but it is believed that tooling would not require over 60 to 90 days and that peak production should be obtained 30 to 60 days later.

6. It is desired to correct an error in the Exhibit "A" to letter, reference C.

Under "Gyros", the statement was made that 10,000 units per month would be required for 4,500 AZ-1 Tail Structures per month, plus spares. This statement is incorrect, as the two gyros required for each tail structure are supplied as an assembly and approximately 5,000 of these assemblies would be required for 4,500 AZ-1 Tail Structures, plus spares. Thus the maximum capacity, of the L. M. Schwein Engineering Company would suffice for a monthly production of 9,000 AZ-1 Tail Structures.

7. A possible second source of supply is the Harvill Company of Los Angeles which has submitted a hand made sample. This sample is some-

[redacted]

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3556

Orig. Cont. Minutes
70.2/0 Misc 36.(3/3 pp)
R+R S, DEB

120

 [redacted]

To: AC/AS, MD&D - Colone R. C. Wilson
Subj: Study on Increased Production Azon Tail for 1000 lb. Bomb.
Date: 20 May 1944

what simpler than the Schwein design and has been given tentative approval by the Equipment Laboratory subject to some minor changes.

8. No details are available at the present time as to the possible peak production of these assemblies, but the Harvill representative stated that he believed that his company could get up to a peak production of at least 10,000 per month. He was unable to state how rapidly they could tool up, or how long it would take to build up to peak production. Since this would be a completely new product for the company it is thought that tooling would require at least 90 days and that it would take 4 to 6 months to reach a high peak rate of production.

For the Commanding General:

E. H. WYNN,
Captain, Air Corps
Asst. Tech. Executive

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(AFR 11-30)

[redacted]

3556

12

SECRET

COPY

SUBJECT: Airplane Modification Kits for Azon

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio
Attention: Technical Executive

22323

22 May 1944
MCO

1. Reference is made to a letter to Commanding General, Materiel Command, from this office, subject as above, dated 25 March 1944, and to CTI-1350, Addendum No. 4.

2. The 550 Azon Airplane Modification Kits, which were directed to be procured in the above reference, are to be divided as follows;

a. 100 suitable for Field or Modification Center installation.

b. 450 suitable for Modification Center installation only. The necessary items for these kits will not have to be assembled in kits, but are to be available for installation with the Signal Corps items.

3. This confirms verbal instructions to Captain E. H. Wynn of Materiel Command on 19 May 1944.

4. It is understood that a delay has resulted in the procurement of the Azon kits, due to the request that a single type of kit be suitable to modify any of the following airplanes: B-17, B-24, B-25, and B-26.

5. This recommendation was made after a discussion with Captain Kerner of the Special Weapons Brance, and with the understanding that the only basic difference between the installations in the various airplanes would be in the electrical connections to the bombs.

6. Attention is called, however, to Paragraph 4 of the directive of 25 March in which it was stated, "If it is impractical to prepare a combined Azon Modification Kit or a combined Modification Instruction Book, detailed information is requested in order that further requirements can be specified, broken down by airplane models."

[redacted]

SUBJECT: Airplane Modification Kits for Azon 22 May 1944

7. The successful use of Azon in operations and by the AAF Board has decidedly accelerated the installation program for the transmission equipment. It is directed therefore that the procurement program on the subject kits be expedited and that a prompt report be made on the status of the procurement. It is further directed that any questions that are delaying this procurement be forwarded immediately by teletype.

By command of General ARNOLD:

R. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br., Materiel Div.
Office, Asst. Chief of Air Staff
Materiel, Maintenance and Distribution

Court Miscellaneous
Ltr Hdqrs. Inf.
S, 326-9.

31

SECRET

S E C R E T

O P E R A T I O N A L P R I O R I T Y

FROM: CG, Strategic Air Forces in Europe, London, England.

TO: War Department.

Nr: U-62865 29 May 1944

To Arnold for McClelland signed Spaatz U-62865.

Azon equipped B-24's in 8th Air Force are now considered operational. 150 tail units and spares requested on air priority ETAPR-1-0608 May EAF are urgently required for operations.

Request that this shipment be expedited and that this Headquarters be notified of expected date that shipment will arrive in United Kingdom.

Further request information concerning 250 tail units, transmitters and spares requested in ourad U-62590 May 22nd for shipment by fast vessel.

No Sig.

62590 is CM-IN-18596 (25 May 44) CG AAF

ACTION: CG AAF

INFO: OPD
JEIA

CM-IN-22329 (29 May 44) 1759Z vh

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(AR 11-50)

[redacted]

78

0932

123

Carbon Copy
Cont. Missiles
70.210 Misc
381/6 M/
R+R S, D2B
M+S

File
70.210

[redacted] (AFMA-2F)

1 June 1944.

SUBJECT: Further Tests of Azon Bomb, Type AZ-1

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTN: Engineering Div.

1. Azon Release No. 14 has been sent to Capt. J. W. Brugger of the Air Service Command to release the seventy-five flares called for in the Materiel Command letter of 1 May 1944, subject "Azon Bomb, Type AZ-1."

2. In regard to the participation of Division 5.2 of N.D.R.C., Mr. Spencer has indicated the willingness of Division 5 to cooperate with the Materiel Command in the further refinement and testing of the Azon bomb.

3. Mr. Spencer stated on 27 May 1944 that the details of N.D.R.C. cooperation would be worked out with Colonel Stewart on 1 June 1944 during the visit of Colonel Stewart to Washington.

By command of General ARNOLD:

R. C. WILSON
Colonel, Air Corps
Chief, Dev... Engr. Br., Material Div.,
Office, Asst. Chief of Air Staff,
Material, Maintenance and Distribution.

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(AFR 11-30)

AFMA-2 VAS/lb

[redacted]

79

C-O-N-F-I-D-E-N-T-I-A-L 14

301st Bomb Group (H) AAF
APO 520, c/o Postmaster, New York.

pfh
2 June 1944

80

Subject: AZON, report of mission 2 June 1944.

To: Office, Air Communications Officer, Headquarters, Army Air Forces, Pentagon Building, Washington 25, D.C. Attention: Colonel S.R.Wright.

1. In compliance with orders of Headquarters 15th Air Force, six (6) AZON airplanes participated in the raid of 2 June 1944 on the marshalling yard at ORADEA, Rumania. The object was to disrupt traffic through the yards and to destroy rolling stock and supplies going to the Russian front.

2. The six AZON ships led the 301st Group into the target, each ship dropping four standard bombs followed by two (2) AZON bombs. All AZONS were tuned to the frequency of the lead ship, second element, and were controlled by the bombardier of that ship. This was an attempt to dtermine if one control ship per squadron could handle the pattern, and thus permit the use of a Group of AZON airplanes withtthe limited number of control frequencies available.

3. The bombing altitude was 22,400 feet. Considerable difficulty was experienced with the racks hanging up, causing faulty releases. Also, the lead bombardier overshot the main portion of the target with the last bombs dropped. Therefor, this mission is not considered to be of any great value in determining the worth of this plan, and the same is to be repeated as soon as possible.

4. Strike photos enclosed show the bombs dropped by the AZON squadron.

Paul F. Helmick,
Lt. Col., A.C.,
Project Officer, AZON.

Enclosures: a/ Two AZON log sheets for mission 2 June 1944
b/ Two strike photos for mission, ORADEA, RUMANIA.

[redacted]

80

[redacted]

MISSION NO: 8 DATE: 2 June 1944

TARGETS: Marshalling yard at ORADEA, RUMANIA.

AIMING POINTS: String drop.

NO. OF BOMBERS (AZON): Six (6) FIGHTER COVER: P-51, area cover.

OPPOSITION: FLAK - Heavy, moderate, accurate NE of target, with "flaming onions". Heavy, intense, accurate over Sarajevo on return.
E/A - None encountered.

REMARKS: Each of the six AZON ships carried two AZON bombs in the top racks, with four standard bombs in lower racks. AZON squadron led the Group, and dropped independently. All AZON bombs were on one frequency and controlled by the lead ship of the second element. This was in the nature of an experiment to determine the practicability of controlling or moving the "pattern", using many ships to drop AZON, but with a single control ship per squadron. This was desired by Air Force because of the limited number of control frequencies available, and the desire for larger formations of AZON. The application of this plan would apparently be for use against marshalling yards, factory areas, etc.

The lead bombardier overshot with the last bombs dropped, and several hung in the racks and had to be salvoed late.

RESULTS: Although a few hits were made, this is not thought to be a representative test. A second trial of this same plan has been directed by Air Force.

On this mission, all AZON bombs were reported to have responded properly and without too great dispersion. One flare blew up immediately upon release but did no damage, although it occurred within the bomb-bay.

Address reply to ENVELOPE to:

16

Commanding General
AAF Materiel Command
Engineering Division
Reference JHK:hle:54-09056
Wright Field, Dayton, Ohio

[redacted]

Spec
Weap
file
6-1-44

0463

Correction of Difficulties With Type VB-1
Vertical Controllable Bomb (Azon).

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Development Engineering Branch,
Materiel Division, Asst. C/AS, MM & D.

1. Reference is made to a letter from your Office dated 17 May 1944, subject, "Azon Operation in Italian Theater," and the inclosed report from Lt. Colonel Helmick dated 30 April 1944, in which defects in present Azon equipment were presented, namely: Defective batteries, premature uncaging of the gyro, defective flares, and lack of radio receiver sensitivity.

2. This Office has been made aware of some of these difficulties through other sources and has initiated action to correct the faults insofar as it was able to obtain explicit information. The following corrective measures have been taken:

a. Action has been initiated to insulate the battery cells from the battery case by lining the battery case with insulating paper. Further tests will be conducted to determine if battery operation can be improved by covering all the battery terminals with insulating compound as suggested in paragraph 5a of the above report.

b. Army Air Forces Specification No. C-27537, Gyroscope Control Directional for Type VB-1 Vertical Controllable Bomb, accomplished by this Office, contains stringent acceptance test requirements which should remedy the complaint given in paragraph 5b.

c. Action has been initiated to decrease the tendency for the frequency to drift and increase the sensitivity of the radio. The information contained in paragraph 5c is the first specific information available to this Office.

[redacted]

MX-225

81

0936

17

CONFIDENTIAL

C.G., AAF, Washington 25, D. C.
Att'n: Devel. Engin. Br., Mat. Div., AC/AS, MM & D.
"Correction of Difficulties with Type VB-1
Vertical Controllable Bomb (Azon)."
[illegible] JUN 1944

d. A suitable tail fuse for the type VB-1 Vertical Controllable Bomb is under development by Ordnance. The requirement for the tail fuse was submitted by this Office on 1 May 1944, in a letter to your Office, subject, "Requirement for Special Fuse for High Angle Bomb, Project MX-225," dated 1 May 1944.

e. Considerable work has been done to improve the flare. To remedy the fault of the flare bursting in flight, the tolerances on the slow burning delay train tube are held more closely, and additional moisture proofing has been incorporated. This Office is now conducting acceptance tests on ten Yellow T-16 flares submitted by Ordnance.

3. It should be noted that the above report from the Italian Theater covered approximately the first 130 production units. Manufacturing methods and inspection procedures have been considerably improved since the release of these units, and should result in improved performance.

4. It is requested that a copy of this letter be forwarded to Lt. Colonel Paul F. Helmick, O-21601, HQ.301st Bomb Group (H) AAF, A.P.O. 520, c/o Postmaster, New York, New York.

For the Commanding General:

H. Z. BOGERT,
Colonel, Air Corps,
Acting Chief,
Engineering Division.

1 Incl.
Report dtd 30 April 44.

[redacted]

Address reply & ENVELOPE to:

Commanding General
AAF Materiel Command
Engineering Division
Reference JHB:hle:54
Wright Field, Dayton, Ohio

18

CONFIDENTIAL

14 JUN 1944

Spec
Weap
file
6-6-44

Anti-Dispersion Device for VB-1 (Azon).

Commanding General,
Army Air Forces,
Washington 25, D. C.

Attention: Development Engineering Branch,
Materiel Division, Asst. C/AS, MM & D.

1. From test drops conducted at Orlando, Florida, during March and April, it was learned that the inherent dispersion of the VB-1 Vertical Controllable Bomb when dropped in train, is about three times that of a normal bomb cluster. This undue dispersion results from the fact that the VB-1 bomb is not permitted to spin in flight, a characteristic of this type of bomb. However, it was found in the course of development that sufficient control is available if the bomb is controlled only the last half of its flight. With this fact in mind, it is the opinion of this Office that the inherent dispersion of train drops can be decreased if the bomb is subjected to controlled spinning during the first half of its flight.

2. The modification necessary to insure controlled spinning is relatively minor, consisting only of an addition of a time switch and linkage within the gyro case, otherwise the present production model of the VB-1 remains the same. This modification is only an addition to the present item.

3. Seventy-five VB-1 tail assemblies have been allocated to this Office for further development tests on the VB-1 controllable bomb. It is expected that fifty of the seventy-five will be used on the anti-dispersion tests, but the same fifty can also be used to test flares and tail fuses simultaneously.

4. It is requested that your Office issue a directive stating explicitly your opinion as to the importance and urgency of the anti-dispersion development in order that the necessary funds can be authorized for purchases of the time switches and gyro modification necessary for this development.

[redacted]

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(AFR 11-30)

82

0938

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C.G., AAF, Washington 25, D. C.
Att'n: Develop. Engin. Br., Mat. Div., AC/AS, MM & D.
"Anti-Dispersion Device for VB-1 (Ason)."

14 JUN 1944

5. It is understood that the development of the subject device will in no way affect present production schedules or present guided missiles developments.

For the Commanding General:

H. Z. BOGERT,
Colonel, Air Corps,
Acting Chief,
Engineering Division.

[redacted]

[redacted]

[redacted]

WWS:djt:MS
Wright Field, Dayton, Ohio
17 June 1944

GTI-1502, ADDENDUM NO. 5

Procurement of Azon Tails for 1000 lb. Bombs

Production Division

1. Problem Presented:

a. Assistant Chief of Air Staff, Materiel, Maintenance and Distribution has directed an additional procurement for 1944 delivery of 30,000 Azon tails for 1,000 lb. bombs with accompanying standard spares.

2. Factual Data:

a. All of this additional procurement outlined above should be delivered in the year 1944 and monthly delivery rates should be established to meet this requirement. It is imperative that the present rate of production of approximately 3,000 per month be increased as soon as possible.

3. Authority:

a. Commanding General, Army Air Forces, by teletype WAL-31110 dated 15 June 1944, from, Chief, Materiel Division, Office of Assistant Chief of Air Staff, Materiel, Maintenance and Distribution.

4. Action Desired:

a. That the Production Division take the necessary action to make the procurement as outlined under Problem Presented. A report should be prepared and submitted to the Assistant Chief of Air Staff, Materiel, Maintenance and Distribution, through the Technical Executive Office, concerning the planned monthly Azon tail schedule for the balance of 1944, as soon as it is possible to determine this schedule.

By Command of Major General MYERS:

FOR OFFICIAL USE ONLY

(AFR 11-30)

[redacted]

T. A. HIMS
Colonel, Air Corps
Deputy Chief of Staff

cc: Engineering Division
Procurement Division
Air Service Command

CENTRAL FILES

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
TECH. DATA
CIV. PERS.
OTHERS
83

Carton Comp
Cont. Remarks
70-371 Supp. Inf.
R+R D, B2B-11 (1/2 pg)

34 76.211 Enl pgs

Release 20

413.44 AM/GBW [redacted] AFDRS-3/C

AFS/al 73524

30 June 1944

SUBJECT: Summary of Area Requirements for the United Kingdom

TO: Commanding General
Air Service Command
Patterson Field, Ohio

Attention: Capt J. V. Brugger, Armament Branch

1. The following releases have been authorized by this Headquarters for the Eighth, Ninth and Fifteenth Air Forces:

Release No.	Date of Release	15th Air Force	8th & 9th Air Forces
1	15 March	150 by air	
3	23 March		100 - These were delivered to Orlando and transported by the 10 B-24 airplanes that were diverted to U.K.
6	10 April	100 by water	
7	10 April	400 by water	
9	18 May		150 by air
11	25 May	50 by air	
17	29 May		320 by water
18	30 May		1000 by water
19	30 May	1000 by water	
	TOTAL -	1600	1500

These additional releases have been made:

2 & 10	200 Army Air Forces Board
4	400 India

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(AFR 11-30)

[redacted]

84

35

[redacted]

413.44 AR/SAN Ltr to Air Service Command 30 June 1944.

Release No.

5	2 - One each to ARL, Emerson, General Instrument Co.
8 & 16	36 AS/AE. Training
12	808 Navy
13	50 British
14	75 Materiel Command
15	1 Air Service Command
TOTAL -	1388

Total release of Azon tails to date is 4512, as of 1 June, 3220 has been produced, with an anticipated production of 3700 for the month of June. All shipments have included standard spares and flares.

3. Until further notice, it is requested that the following quantity of Azon tail units be shipped monthly:

1000 units to the Fifteenth Air Force
2000 units to the Eighth Air Force

Cable No. E-31349 dated 6 June 1944 from United Kingdom established shipping instructions.

By command of General ARNOLD:

GEORGE C. KALB
Col, Air Corps
Communications Equipment Officer
Office, Asst C/AS, R, R & D

cc: ASONEZ, ASCSSEOS
Head Air Ord. Off.
AFDAS-4
ESCMA Shipments Control Div.
Materiel Command Tech Exec.

[redacted]

Carbon Copy
Cont minutes
70.212 Misc -
41 (1/2 pg) R+RS
DCB, MRS

133

[redacted]

70.210
Inform
30 Jun

85

Production Schedule for Azon

Air Communications Officer, Special Projects Section
THRU: AC/AS, M&MD, Communications Equipment Officer
AC/AS, M&MD, Materiel Division

23 June 1944

AFMMA-2F/Maj. Stace/lb/6440

1

1. The following was included in a teletype of 30 June 1944 from the Materiel Command:

a. Action has been started to comply with the required increase in production of Azon (increase to raise the 1944 requirements from 20,600 to 50,600).

b. The required total can be produced according to the present outlook but radios and certain subassemblies will be very tight.

c. One new independent source is planned for 15,000 units for 1944 and the Union Switch and Signal Company will continue with the rate building up to 5,000 monthly for the balance of 1944.

d. The proposed schedule for the new source is 1,000 in September, 4,000 in October and 5,000 each in November and December.

e. Authorization is required now to contract for additional 30,000 for delivery in the first quarter of next year in order to give the new source a better production run. This would permit better production planning for production and should also result in a reduced cost.

2. The following monthly schedule summarizes the information from the Materiel Command on the proposed Azon schedule for 1944:

To 1 June 1944	UNION SWITCH & SIGNAL CO	OTHER SOURCE	TOTAL ALL SOURCES
	app. 3200		app. 3200
June	3000		3000
July	4500		4500
Aug.	5000		5000
Sept.	5000	1000	6000
Oct.	5000	4000	9000
Nov.	5000	5000	10000
Dec.	5000	5000	10000
TOTAL FOR 1944	35700	15000	50700

3. Information is requested on whether this schedule is satisfactory.

4. It is also requested that the rate of the radio receivers for the Azon be planned so that these receivers (including the 10% spares) will be available for delivery one (1) month before the schedule of the completed Azon tails.

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85

Carbon Copy
Cont. Missiles
70.210 Misc.
41 (A/2nd) R+RS
DSB

[redacted] 134

Production Schedule for Azon

Air Communications Officer, Special Projects Section
THRU: AC/AS, MMSD, Communications Equipment Officer
AC/AS, MMSD, Materiel Division

23 June 1944

1 (Cont'd)

AFMCL-SF/Maj.Stace/lb/6440

5. It is understood that an authorization has already been forwarded for 1945 procurement.

N. C. WILSON
Colonel, Air Corps
Chief, Devel. Engr. Br.

[redacted]

Carbon
Crch. Missiles
471.6 C
CF, AAF-56-

CONFIDENTIAL 24

(AFDMA-2F)

28 June 1944

Lt Col Richardson/hms/6440

SUBJECT: Anti-Dispersion Device X413.6

TO: Commanding General Materiel Command
Wright Field Dayton Ohio

Attention: Technical Executive

1. Reference to letter 14 June 1944 subject as above, Air Communications Officer, Project Officer for Guided Missiles, has stated that the tests necessary to develop the Anti-Dispersion Devices should be expedited and that the whole project should be conducted as an urgent development.

2. Reference to paragraph 4 of the letter, the opinion of this office is that this project ranks high in importance and that the necessary funds should be authorized immediately for purchase of time switches and gyro modification items.

By command of General ARNOLD:

R. C. WILSON
Colonel, Air Corps
Chief, Devel Engr Br Materiel Division
Office, Assistant Chief Air Staff
Material Maintenance and Distribution

P 33665

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OFFICE SYMBOL	1 AFDMA-2	2	3	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER	R Campbell					
INTERNAL OFFICE COORDINATION	MCO					

(AFR 11-30)

[redacted]

86

4

[redacted]

(AFDMA-2F)
Maj.Etnoe/mw/5440

11 July 1944

SUBJECT: Development of a Light-Seeker for the Azon Bomb.

TO: Commanding General
Materiel Command
Wright Field
Dayton, Ohio

Attention: Engineering Division
Special Weapons Branch

[redacted]
By Authority of
The Commanding General
Army Air Forces
7/11/44 MCD
Date Initials

1. In conversations with Lt. Colonel A. Hymen, Special Weapons Branch, during March, and with Mr. Robert Hummell, Special Weapons Branch on 29 June, the suggestion was made by the Radio and Radar Section, of this office, that the feasibility be checked of developing a comparatively simple light-seeker for an Azon type bomb that would give only a left and right control.

2. The basic use of such a device would be to drop one Azon, or other flare-equipped bomb, and have the rest of the Azon bombs in the bomb bay of that airplane and possibly following airplanes equipped with light-seekers instead of radio, in order that they would base in azimuth on the flare of the first bomb. The purpose of such a procedure would be to establish a linear pattern of bombs, controlled in azimuth by the leading bomb and direction of flight, and controlled in range by the time intervals of dropping and by the space intervals between the dropping airplanes.

3. It is understood that present light-seekers could probably be used in a simplified version for this device because it is only necessary to control right or left.

4. Information is requested on the conclusions that have been reached concerning the feasibility of developing such a device and the anticipated length of time before production could be secured if the device is considered feasible.

By command of General Arnold:

Copy to Lt. Col. Royce, W.F.
Copy to Tech Executive, W.F.

R. C. Nixon
Colonel, Air Corps
Chief, Devel. Engr. Branch
Office, Asst Chief of Air Staff
Material, Maintenance & Distribution

[redacted]

87

Army Cont Missiles
70.210 Misc
C42 (1/7M)
R+RS, 022
M+S

SECRET

SECRET 134

Auth: CG, ETOUSA
Initials: HHB
Date: 14-7-44
JCW/na

HEADQUARTERS
AIR SERVICE COMMAND
UNITED STATES STRATEGIC AIR FORCES IN EUROPE
A.P.O. 633
Director of Technical Services

In reply refer to: ATS/JCW/P144-1

AAF - 586

13 July 1944

Subject: Azon

To: Commanding General, Hq. Army Air Forces, Washington, D. C.
Attn: Lt. Col. Richardson, AC/AS, M.M. & D., Material Division

1. There is being transmitted under separate cover marked for your attention reports covering the 2nd, 3rd, 4th and 5th Azon Missions, and a report on the glide bomb, (GB-1) attack on Cologne.

2. Dr. L. O. Grondahl, (NDRC and Union Switch Signal) recently spent two weeks in this theater familiarizing himself with the operational use of Azon and looking into the subject of Guided Missiles generally. We believe that Dr. Grondahl's visit was a profitable one and that valuable information was gathered from the many contacts we were able to arrange for him. Dr. Grondahl's visit to two (2) operational units enabled him to prepare a brief report covering his impressions and no doubt you will receive a copy of this in due course.

3. The present position with Azon in the Eighth Air Force is that five (5) operational missions have been performed to date. The two principal reasons why more missions have not been flown are, (a), lack of suitable weather, and, (b), the use of a considerable portion of the Azon equipment and personnel on the higher priority Aphrodite project. It is considered that these five missions are not sufficiently representative to form a basis for conclusions regarding the tactical value of Azon. From a mechanical standpoint, however, Azon has proved to be functionally reliable and it is very evident that the operational personnel has considerable confidence in it.

4. There is, however, one item in need of attention and that is the flare. So far, flare failures have been in the order of 15%. The failures noted fall into two groups, (a), flare break-up, possibly due to detonation, (b), late functioning or failure to function. The present failure rate is considered too high andit is suggested that an investigation to determine the cause be initiated.

5. The suggestion that flares should be armored as protection against flak has been advanced on several occasions. The methods suggested is to either place a light steel tube around the present flare or to compress the flare material into a steel tube. It is believed that steel tubing approximately 3/16" thick will be adequate for deflecting low velocity flak fragments. Your comments on this will be appreciated.

(AFR 11-30)

[redacted]

88
194-7

Orig. Cont Missiles
W. £10 Misc
42 (2/7pp) R+RS
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134 SECRET

6. During a recent visit to Horsham, Mr. T.J. O'Donnell, the civilian technical representative of the Gulf Research and Developement Company, made some suggestions concerning possible improvement or refinement of Azon. The comments which are attached hereto as an inclosure are based on operational experience and will be of interest.

7. Recently an effort has been made to improve the effectiveness of Azon bomb hits by securing 1/10 second and 1/40 second delay nose fuzes as a substitute for the instantaneous nose fuze used thus far. However no missions have been flown since the delay fuzes became available. In this same connection we would appreciate receiving information concerning the possible use of a tail fuze with Azon. Unquestionably the necessity for using an instantaneous nose fuze has been a limiting factor with Azon, and the delay fuze will be of considerable benefit against the types of targets usually selected. Nevertheless, a further improvement could be made if the tail unit could be made to accommodate a tail fuze.

8. Several enquiries have been received concerning the availability of the 2000 lb. Azon. In view of the interest in this bomb we will appreciate receiving advice concerning the status of this development, and, if possible, when it is likely to be available for this theater.

9. At the present time we have in this theater only one film on Azon. This film, made more than a year ago, shows drops with Azons of various experimental types. What is needed now is a later film, showing drops with production types and also a film showing the preparation of Azon. Both films are important, but at this time, first priority should be given to the film as preparation, if both are not available.

10. Of equal importance with this film on Azon preparation is the requirement for a shop manual. It is our understanding that such a manual has been prepared, in which event early receipt of copies in this theater is most desirable.

11. On the basis of practical operational experience to date there has been prepared a list showing the items of test equipment, tools and spares which should be included in Azon field maintenance kits. For adequate field maintenance it is strongly recommended that all of the items listed be provided.

12. While Dr. Grondahl was here he mentioned that some experiments were in progress in the United States to determine the feasibility of pattern bombing with Azon. Interest in Azon for this purpose continues and factual data based on actual experiments will be helpful in these discussions.

13. The Ninth Air Force is in the process of setting up an Azon Operational Squadron using B-26 aircraft. It is expected that of the fifteen aircraft with which they are to be equipped initially, ten will be operational by 15 July and the remainder shortly thereafter.

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194-1

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14. It is of interest to note that the B-26 aircraft arrived in this theater without any test equipment whatsoever, and had it not been possible to obtain the loan of some items and improvise for others, this unit would have been seriously handicapped. In addition to this, the sixteen maintenance personnel sent from the United States received only the minimum theoretical training and had no field experience at all. To correct this situation we arranged for Mr. O'Donnel and one officer, Lt. Baltimore, to be detached from the Eighth Air Force and loaned to the Ninth Air Force to render all possible assistance. In order that similar situations may be avoided in the future it is suggested that arrangements be made for complete test equipment to accompany the aircraft, and that wherever possible maintenance personnel receive more extensive theoretical and field training.

15. Of interest to many in this theater are the results that have been obtained with Azon by the 15th Air Force in Italy. If there is any information relating to their experience with Azon or any tactics which have been found to yield better results, it is suggested that it be made available to the Azon units here.

16. The R.A.F. through the Ministry of Aircraft Production is continuing with preparations to experiment with Azon. Recent inquiries on this subject reveal that they have not yet received any tail units, but that some are expected by water shipment in the near future. In the meantime we have arranged for them to obtain the loan of three tail units from Army Air Forces stores for experimental purposes. Additionally, personnel from Boscombe Downs recently visited Horsham and thereby gained first hand information regarding operational procedure.

17. In the future reports on operational missions will be confined to a brief description of the mission, the targets and the results obtained. We hope to be able to continue sending strike photographs. As soon as sufficient missions have been accomplished a comparison of the pattern obtained with Azon and regular bombing will be prepared.

J.C.E. Williams.
J.C.E. WILLIAMS
Major, A. C.

J. Morgan, Maj.
Noted: H. G. [redacted]
Colonel, A. C.
Director of Technical Services

2 Incls:
Incl 1 - "Azon - Suggested Standard Squad. Maint. Kit"
" 2 - List of Comments On Azon - Mr. T.J. O'Donnell

[redacted]

Orig. Cont. Missiles
70.5.10 Misc.
42(4/8 M) Rok 8
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AZON

SUGGESTED STANDARD SQUADRON MAINTENANCE KIT

TOOLS, TEST EQUIPMENT AND SPARES.

1st Priority
1 - 804.C Signal Generator or equivalent.
or 1 - Hallicrafter receiver model S-27 plus speaker.
1 - Command receiver (covering range 40-100 mg. cycles).
1 - Audio oscillator (Range 30-5000 cycles).
1 - Milliameter, (0-10 mils) portable type.
2 - Volt-ohmeters (Sig. Corps) Multi-tester type.
1 - Ammeter (0-10 amps).
1 - Transformer 2 kw. for 230-115 volt for U.K. with 1 doz. each U.S. wall sockets and plugs.
1 - Battery charger, 6 amp.
3 - 24-V batteries 30-80 amp. hr. capacity.
6 - 30 cc. capacity graduated glass syringes.
1 - B-24 crew chief's tool box.
4 - Sqdn. Radar repairman's kits.
4 - Screwdriver kits, inc. spin type and Allen screwdriver.
2 - Sets, instrument wrenches (small).
1 - Manual - Shop procedure.
1 - each light and heavy soldering irons. 110V.
1 - 24 V soldering iron.
5 - 1 lb. spools of resin core solder M-31.

2nd Priority
1 - Gyro test set (Union switch) plus flare arm tester.
1 - Final test panel (Union Switch).
1 - Tube tester (Signal Corps) No. 1 - 56 - J.

3rd Priority
1 - Oscilloscope.
1 - Vacuum tube voltmeter.
4 - each. 5 and 10 ohm 20 watts resistors.
1 - 3 position switch (for gyro and final test panels).
1 - set of G.L. 815 tubes (50% spares).
1 - set spare crystals, 1 of each color.
1 - set spare plugs, 2, 4 and 6 way male and female Jones plugs, as follows:-
4-way female-150
6-way female-150
6-way male - 40
2-way male & female - 50 pairs.

[redacted]

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Cos T. Silva.
Do. 2. of Mice.
4-2-6/7/74)
R+R 5, Dec 6

List of Comments On Azon Received From Mr. T. J. O'Donnell (Gulf Research and Development Corporation)

(1) The General Instrument Company's receivers that have arrived at the field are still too insensitive. They have a sensitivity of 200 to 250 microvolts at 24 volts battery. They are easily adjusted to 100 to 150 microvolts and are then considered satisfactory. However, it seems that they should come adjusted in that way.

The apparatus in the radio frequency assembly still shorts out occasionally. This has been called to the attention of the General Instrument Company and I believe has been corrected.

The voltage regulator tubes which it was planned to install have not yet made their appearance at the field. The sensitivity of the set decreases rapidly with falling voltage, so that it would be a definite advantage to have the voltage regulator.

(2) In the Emerson receiver the audio bands seem to be too narrow. In more than half of them it is necessary to tune the audio frequency bands for this reason and the tuning has to be rather accurate because the bands are so narrow they seem to be much sharper than is necessary.

On the other hand, the radio frequency bands are too wide. With a signal of 2,000 microvolts in one frequency the adjacent band is energized.

The Emerson radio sets are all too sensitive to noise produced by the equipment. They are sometimes likely to be re-energized by the radiation from the servo motors. It is suggested again that they should be biassed below cut-off so as to eliminate the noise output which is present in the receivers that have arrived at the field.

(3) The radio sets are always re-tuned in the field. It is thought, therefore, that there is no reason why the manufacturer should not tune the radio set in the middle of the band and send all of them in the same conditon, as far as tuning is concerned.

(4) The only criticism of the gyro equipment is that the caging slot on the inner gimball is weak and sometimes breaks during shipment. The caging is very satisfactory in that it does not uncage due to shocks under any conditions that shipping encounters.

(5) The batteries are satisfactory from every standpoint and the hypodermic syringes usedhave resulted in the filling being accomplished in very much less time than was posable with the old syringes.

(6) The mechanical construction of the tail assembly seems to be satisfactory from every standpoint. One mainswitch has shorted, but this is a condition that was reported earlier and has been corrected.

(7) (d) It is suggested that the protective relay put in the flare firing

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circuit is unnecessary, for the reason that the protection is naturally applied by the bombardier's routine. His routine during a mission is the following:

(i) Immediately after take-off he turns on the warm-up circuit.

(ii) During the climb before reaching the altitude where oxygen is necessary, the bombardier goes to the bomb bay and removes the safety pins from the nose fuse and from the kick-out switch. At this time he also plugs in the flare.

(iii) When turning on the bombing run he arms the flare.

(iv) Immediately after release of the bombs, he turns on the plate power of the transmitter (the filament power of the transmitter is turned on on the ground or earlier in the flight).

(v) If the ship returns with any of its bombs, the bombardier inserts all the safety pins and pulls the flare plug before landing.

It will be seen from this procedure that all the protection that was intended to be provided by means of the protective relay is already provided by the routine that is followed by the bombardier.

Attached is the Bombardiers' Check List, for your information.

[redacted]

BOMBARDIERS' CHECK LIST

PRE-FLIGHT

After bombs with tail units have been loaded, the following check will be made before take-off:

1. Plug in Azon kick-out plug on one bomb.

2. Turn on warm-up switch on Azon Panel.

3. Turn on transmitter filament switch on transmitter. Allow to warm up 30 sec. to one minute.

4. Turn on carrier switch on control box and give right, center, and left signals of at least five seconds duration each. Radio man or other member of crew will observe action of Azon rudders for proper functioning.

5. Unplug first bomb, plug in second, and repeat above check for each bomb loaded in ship. After check, plug in all bombs.

6. See that arming wire is inserted through kick-out plug and extends not farther than four inches, and is secured by a Fahnstock clip.

7. See that all bombs are properly fused, set for instantaneous action and that arming wire is installed and secured with Fahnstock clip.

8. When all units are thoroughly checked, all switches but the carrier switch may be left on if take-off is to be made right away. (If take-off isn't scheduled for some period of time, all switches should be turned off.

IN FLIGHT

1. Bombardier will go to bomb-bay and plug in the flare plug on each unit, remove, kick-out plug pin (after inspecting arming wire), and remove safety cotter pin on nose fuze.

2. The flare arm switch on Azon panel will be turned on during bombardiers level on first run when he is certain he is going to release his bomb.

3. The carrier switch on the control box will be turned on at the moment of "Bombs Away", and should be turned of immediately after impact.

KICK OUT PLUG PINS AND NOSE FUZE COTTER PINS SHOULD BE SAVED, AND IF BOMBS ARE TO BE BROUGHT BACK THEY WILL BE INSERTED BEFORE LANDING AND FLARE PLUGS WILL BE PULLED OUT.

BEFORE LANDING

1. If returning with bombs, bombardier will insert safety pins in nose fuze and kick-out plug and pull out flare plug.

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CONFIDENTIAL

673-21

ARMY AIR FORCES
MATERIEL COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

VB-1 deleted

Lt. Colonel P. F. Helmick
Ble:54-7:N Ext.2-7127
Date 20 July 1944

SUBJECT: VB-1 (Azon)

OFFICE
~~SECTION~~ Equipment Laboratory

SERIAL No. ENG-54-673-15-W

Contract No.
Expenditure Order No. 673-21
Purchase Order No.

A. PURPOSE:

1. To recommend further development of VB-1.

B. FACTUAL DATA:

1. Up until the introduction of the VB-1 to combat, nearly all drops had been made with single bombs. Employed in this manner, the fact that each bomb had slightly different aerodynamic and control characteristics was of no importance.

2. Most of the targets which it was desired to attack in the Italian Theater were defended so heavily by anti-aircraft fire and enemy fighters that more than one run-in on the target was not practicable. Therefore, the entire bomb load had to be released at one time. The controllability of VB-1 under these conditions was still of great value, inasmuch as it would conceivably permit the accurate placement of the bomb pattern.

3. However, the dispersion resulting from the discrepancies noted in paragraph 1, above, caused a wide dispersion in the pattern, and the consequent reduction in effectiveness was such as to lose a large percentage of the potential value of the weapon. This dispersion became particularly objectionable at altitudes above fifteen thousand feet.

4. In an attempt to limit this dispersion with the facilities at hand, a method of tying the bombs together by means of a wire or cord was tried. The bombs were connected by a twenty-five or thirty foot length of wire or strong cord, the excess coiled neatly and held by gummed paper tape. On the attack, all bombs were dropped in a close train or salvoed. The result was a group of bombs, each connected to the others by the wire, whose "spread" during the fall was restrained

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No. of pages - 3

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to the length of the wire. Controllability was apparently little effected, and even when the wire broke it was usually during the last part of the fall. The resulting pattern was quite compact.

C. CONCLUSIONS:

1. That the above described method was merely a makeshift means to an end. However, it did show the promising results that could be obtained if some means to reduce dispersion were found. It also allowed the effective use of the weapon without radically altering the standard tactics employed. By reducing the inherent dispersion, it could logically be used by a large number of aircraft and allow the accurate placement of the entire pattern. This would allow attacks on such targets as marshalling yards and elongated factory areas down the long dimension, rather than across at some large angle as in the practice with ordinary bombing, and would therefore insure almost one hundred per cent hits rather than the twenty to fifty per cent normally expected in the target area.

D. RECOMMENDATIONS:

1. It is recommended that the following action be taken by the organization designated below:

a. Engineering Division, Materiel Command, Equipment Laboratory:

(1) That VB-1 be further developed with the object of reducing the dispersion noted above. These developments might be in the form of "delayed stabilization," i.e. have the bombs rotate during the first third or half of the bombs fall and then stabilize or some means of making the bombs more uniform and aerodynamically

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similar. This latter is not thought to be practical in production quantities.

Concurrence:

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Distribution:

Ch., Mat. Div., AC/AS, MM & D
Eval. Branch, Tech. Data Lab. [redacted]

Prepared by PAUL F. HELMICK, Lt. Colonel, A.C.
(Name)

Approved by G. V. HOLLOMAN, Colonel, A.C.
Chief, Equipment Laboratory

Approved by F. O. CARROLL, Brig. General, USA
Chief, Engineering Division

Cy to Capt Evans

C73-21
V18-1

CONFIDENTIAL

HEADQUARTERS 753RD BOMB SQUADRON (H)
458th Bomb Group (H)
AAF 123, APO 558

25 July 1944

SUBJECT: Report of AZON Project in the United Kingdom.

TO: Commanding General,
Air Service Command,
Fairfield, Ohio.

ATTN: Colonel P. E. Shanahan,
Chief, Communications Maintenance Section.

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1. This report will detail the installation and maintenance problems encountered by the Azon Mission in the United Kingdom from 22 June 1944 to 15 July 1944. Attention is also directed to the report of Captain J. H. McClennan, Subject: Azon Project In Italy, dated 15 June 1944, File Z-88808. Since findings of the two Groups did not agree in all respects, the differences will be noted. Also, the special expenditures listed in Captain McClennan's report, pertaining to the shop procedure of the Azon work, apply as well to the United Kingdom group, and will not be repeated.

2. The Azon group in the United Kingdom was led by Major R. K. Weltrook of IID Air Force, and Major M. J. Hand of the Air Communications Office. Mr. T. J. O'Donnell, of Gulf Research Laboratory and M.D.R.C., also accompanied the project in addition to the assigned Air Service Command representative. Major Hand and Major Weltrook immediately contacted "XYZ", USSTAF and VIII Air Force Headquarters and arranged all priorities and accomodations at these higher headquarters. As a result, every cooperation was afforded the project at all other bases in the United Kingdom that were visited. This very obviously expedited the organization and operation of the project.

3. The Squadron, consisting of 20 B-24's, and their crews, the eight enlisted technicians, and the officers and civilian listed above were assigned and attached to the 753rd Bomb Squadron, 458th Group, 96th Combat Wing, at APO 558, N.Y.C. Major O'Neill commanding. Immediately, workshop and storage space and every possible help was given in order to get the project in operation as soon as possible.

4. Fortunately the project brought with it 100 bail gas cylinders and all the necessary equipment for use in the workshop with a few important exceptions. The fact that most of the equipment was brought along helped matters considerably, since most of the equipment was NOT readily available over there. Equipment NOT available, and most vital, were the following items:

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a. A 230/110 volt step-down transformer of 2 to 3 kva capacity. This was most important, since most, if not all of the American bases were former British bases, and the power available was strictly of British origin, down to the wiring and electrical fittings. The only available 110 volt source was through the use of gasoline generators, which also were few in number, and more necessary in the hangars. A transformer was obtained from British sources, and the troubles thus overcome.

b. Tools. All workshop tools, and those necessary for assembly of the tails on the bombs in the planes were hard to get. Complete tool kits, soldering irons, wrenches etc., were available only after long delays. In fact, some of the equipment was just arriving after two months of operation. There were, of course, some available which were brought along, but the small number on hand made all operations more time consuming and wasteful than they should have been. Several missions were long delayed because of the long time necessary to load all the equipment for an especially heavy mission.

c. Spare parts for use in installation of more planes and for routine maintenance, and for shop equipment. There was an immediate call for additional installations on eight planes, and the material necessary was not on hand or immediately forthcoming. Improvisations had to be made which, fortunately, did not hamper too seriously the effort of the group. Spare parts had to be robbed from the equipment already in use, taking pieces from here and there where they could be done away with. This resulted in a complete cannibalization of the equipment, and left no spares for even minor maintenance without putting some ship out of the operations. If the squadron had been less fortunate in its missions over enemy territory, the project might not have fared as well as it did. A list of the necessary workshop equipment, and emergency parts for installation and maintenance is included in Appendices I and II. Lack of parts of an even more critical nature, such as special tubes and crystals, put some sets out of commission and left an unbalanced group of transmitters during the period when other projects (Caster) began to interfere with this project because of the immediate, higher priority demands for this equipment.

5. On all the missions accomplished there were very few causes for complaint from the viewpoint of equipment failure. To begin with, the Azon tail equipment seems to be exceptionally well built, and the packaging for overseas shipment was excellent. The condition of the equipment when received in the theatre was most satisfactory. This does not agree with the report of Captain McClennan, who experienced many difficulties because of rough handling of poor packaging. It is impossible that, due to his earlier report, the equipment was more carefully packed and handled when it began coming

[redacted]

to the VIII Air Force. There was but one slightly damaged tail assembly received. The internal components of this unit were in good condition, and the tail surfaces themselves were repaired.

a. Humidity and dampness also had little apparent effect on the tails. The 100 units brought with the squadrons were all carried in the bomb racks, uncrated, and exposed to the perils of the southern route to the theatre for two weeks. The effect of this treatment was negligible, as the tails worked perfectly after very little adjustment, when set up in the workshop. As a result of this, the heated workshop first applied for was soon cooled off to make it more comfortable for the men.

6. A negligible amount of 3rd and 4th echelon maintenance was necessary to make tails ready for operation. Rather, only the normal routine checks were necessary on 90% of the units. It was found, however, to be absolutely necessary to completely check all units, realign receivers and check gyros before final assembly and loading. The procedure followed was most similar to that noted by Captain McClennan. It was more efficient and convenient to set up a shop assembly line and to readjust the equipment from the standards set up in the shop gained from the specific equipment with which these units had to work. As a result, at least 100 units were ready at all times for use on missions, and interval between missions was used to repair or adjust equipment which did not come up to specifications. Of the 100 units used up to 15 July 1944, less than 10% had to be replaced as unsuitable.

a. There were but three gyros totally unsuitable and about 10 which required minor adjustment or repair. There was nothing not easily handled, but they were things which should not have escaped the factory inspections.

b. Of the receivers, there were 10% that had to be repaired, and this came within the spares allowed. It was the opinion that the General Instrument receivers were the better of the two types, especially at first. It was found that the Emersons had too wide an RF section, and too narrow an audio section. The G.I. receivers on the other hand, were too insensitive to suit us, and had to be readjusted. A range of 60 to 150 microvolts input at 24 volts supply was the requirement and there were few that could not be made to satisfy the demands by tube shifting, and realignment.

c. It was found that the batteries were not exactly up to standard. At first, the batteries, if not used after filling, because of a scrubbed mission, could be easily recharged to proper voltage after 24 hours or more. The second shipment

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of tails received, however, had many batteries which did not readily charge up to proper voltage in spite of the additional charging, or which did not maintain proper voltage under load after such recharging periods. These just about used up the spares provided, but were still within the 10% spare limit.

d. The remainder of the tail assembly was more than satisfactory. Only one servo motor did not work, and it was readily fixed. One tail was damaged upon receipt, and it was repaired.

e. There were about 10% flare failures. This was by far the biggest source of trouble, and it occurred at a time when nothing could be done about it, whereas all the other troubles were found before use, and repaired. It was felt that the construction of the flares was not at all satisfactory. Three flares broke apart into three pieces after the bombs had been released. Several more came on late, near the end of the drop, and several more failed to ignite at all.

f. In summary, the only mechanical failures of the bomb in flight were due to flare troubles and no other. Not one bomb failed to respond to control due to causes traced to equipment failure. The few failures reported were eventually laid to personnel failure. When several bombardiers reported control of the bomb in one direction only, the pictures were examined, and it was decided that the controllers had over-controlled, thus the bombardiers had deflected the bomb too far in one direction, (beyond the target line), and when reverse control was applied, the apparent response of the bomb in the time remaining was not too appreciable. One mission, two planes having the same frequency of control joined the same element because of late take-offs and marshalling confusion. As a result, these two planes controlled and countercontrolled each other's bombs, with poor results. All other bombs on these missions responded perfectly.

7. Mention might here be made of the excellence of the eight technicians assigned to the 753rd Squadron. They were outstanding in their technical knowledge, ability, enthusiasm, and willingness to work. They worked all hours and did all jobs with but little complaint. These men handled their jobs with a minimum of supervision necessary and relied on their officers mainly for general orders, procurement of material and the like. These men left the 1st I & M with no ratings, but were all made sergeants (6) and staff (2) through the efforts of Major Rand before they departed from the P.O.E. Squadron T/O's did not allow for their ratings overseas, however, but they were not taken away from the men. The eight men

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(AFR 11-30)

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were none too few for the work to be done in a B-24 Squadron. In fact, the aid of the ordnance men, to help load and tails on the bombs before a mission, was enlisted in order to be able to get the squadron off on schedule. Since time was an important factor there, more men were needed to get the job done quickly. With the B-26 groups, even more men are necessary, since the B-26's fly two to three missions a day sometimes with only a few hours notice.

a. Lt. B. J. Scharff, Group Signal Supply Officer, was left in charge of the 753rd Aron Project. He was very capable of handling it.

8. In the 9th Air Force, the B-26 Aron project was assigned to the 598th squadron of the 397th group, at APO 140, N.Y.C. This squadron had 16 ships equipped with aron assigned to it, although only 15 arrived. One was lost in a crash in England. There were also 16 technicians assigned. There was absolutely no equipment sent over with the technicians, nor was any expected. From lists compiled by us in the 8th Air Force Squadron, an attempt was made to procure as much identical equipment as possible. Since such test equipment and tools are very critical in the U.K. identical equipment was not obtained in all cases, but satisfactory substitutes were obtained with much persistence. Since the project was completely unknown to practically all concerned, there was great reluctance to part with desired articles; but caution of a high priority and a few generals at higher headquarters finally produced the right results. The equipment developed by Union Switch and Signal Company for the workshop check of the tail units and assemblies had to be built by us there, since it, too, was not sent over and was most necessary. Here again, lack of parts peculiar, evidently, to the Aron equipment only, were impossible to obtain and hence held up operations considerably. Finally, a tail which had arrived with fins completely damaged was cannibalized and the parts used. Of the units available to the 9th Air Force group at the time this officer departed, only one receiver failed to work properly in the workshop, and no other parts (but the damaged tail) were at all unsatisfactory.

9. The technicians with this squadron were not too satisfactory. They had neither the background, nor the enthusiasm of the first group. They apparently had been only first echelon maintenance men, and knew very little about radio principles. The instrument men, however, were much more acceptable than the radio men. A thorough review of all the necessary work they had to perform was accomplished and the squadron was left in the hands of Lt. Spangler and Lt. Dontzin of the 397th Group Communications and Radar offices. No missions had been accomplished up to 15 July 1944, so no results were observed. Weather was bad as usual.

10. The following recommendations are offered:

[redacted]

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a. Assignment to special projects of thoroughly qualified and trained technicians who have the background and experience necessary for the success of these special projects. There are enough of such men available, and it is detrimental to send, instead, men who have been trained only in the BASIC fundamentals of 1st echelon maintenance, and who do not know what they are doing, beyond the mere mechanical operation.

b. Complete test equipment necessary for all phases of the project work to be carried along with the project, to the theater of operations. Especially, where non-standard, special jigs and test panels are required, these must absolutely be brought along. No parts are available, and long delays are occasioned in making them or ordering them. There are no organizational equipment lists for special projects, hence special or standard test equipment must be taken from someone else, or delayed must be endured while the equipment is ordered and received from the states. Tools, special and standard, are included in this list. They also, are not available for special projects unless taken from others, or bought from the British, necessitating complications and delay. Tools are also wont to disappear, unless careful watch is taken over them at all times. Anyone wandering near a plane, or the shop, might just pick them up and take them away without anyone being the wiser-until they are needed again. They are that scarce and critical.

c. Sufficient parts for complete installations and for setting up of shop equipment. Any parts peculiar to the project equipment only are not likely to be found in the depots. Certain plugs wiring, and parts, needed for ship equipment to speed operation are not available unless sufficient spares are brought along. Emergency or special installations demanded by the theatre commanders or their representatives also catch the project short and embarrass it.

d. Send the operating squadrons a list of any changes in the equipment, as the changes are made, and instructions on how to use new additions. The destructor equipment arriving at the 9th Air Force Base was unknown of up to that time, and no one recognized the type of destructor as similar to that of any other equipment. Lack of such instructions, especially to inexperienced personnel, means reduction in efficiency and value of the use of any new additions or changes.

/s/
DAVID M. BALTIMORE,
Lt., Signal Corps.

[redacted]

Y-13879

AAFMC-265-A-WF-3-7-44-100M

Carbon Copy
Col. Wheeler
70.210 Misc
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Int-S

129 Confidential

INTER-OFFICE MEMORANDUM

ARMY AIR FORCES
MATERIEL COMMAND
Office of The Commanding General

Lt. R. S. Risley
Ajbj 5L-7A; Ext. 3-0114
Wright Field, Dayton, Ohio

Date July 1944

TO: Chief, Equipment Laboratory, Engineering Division, Wright Field.

SUBJECT: Special Weapons Branch Daily Report.

1. PQ-14 Automatic Devices. Simultaneous flight tests are now being made in a PQ-14B radio airplane target on an automatic 180° turn-around device and a barometric altitude control device. These devices will simplify operation of these targets for anti-aircraft practice. (RESTRICTED)

2. AZON Requirements. The Air Communications Officer estimates that the 1945 requirements for AZON tail assemblies will be 100,000. (CONFIDENTIAL)

3. AZON Controllable Missile. As a result of a request from Ordnance Section, it was found that the AZON bomb could be lengthened two inches to allow for a tail fuse and still fit in the B-17, B-25, and B-26. It would be too long for the top two positions in front bay of the B-24. (CONFIDENTIAL)

S. R. STEWART,
Colonel, Air Corps,
Chief, Special Weapons Branch,
Equipment Laboratory.

Copies to:
Lt. Colonel F. H. Richardson,
Lt. Colonel W. L. Norvell.

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(AFR 11-30)

[redacted]

Signature

91

CONFIDENTIAL

[redacted]

Anti-Dispersion Device

Captain J. E. Evans
hle:54-7N:151278 Ext. 2-[illegible]

1st Ind.

Hq., Materiel Command, Wright Field, Dayton, Ohio. 27 JUL 1944

To: Commanding General, Army Air Forces, Washington 25, D. C.
Attention: Development Engineering Branch, Materiel Division,
Asst. C/AS, MM & D.

1. In reference to the above project, the following has been accomplished:

a. 75 VB-1 units have been procured and are now available at Tonopah, Nevada, for anti-dispersion tests.

b. The Gulf Research & Development Company, under N.D.R.C., has modified the necessary cameras for a complete photographic record of the anti-dispersion tests to be made.

c. The Materiel Command has arranged with the Schwien Engineering Company in Los Angeles, California, for the anti-dispersion modification for 51 gyros to be used in the subject tests.

2. The anti-dispersion tests are expected to begin on or about 5 August 1944 and continue for approximately one month from that date. 25 VB-1 units as produced at present, will be dropped to determine inherent dispersion for the present model [illegible] will then be dropped using the modified gyros.

For the Commanding General:

W. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

1 AUG 1944

Capt. [illegible] Eng. Sec., E.D.

COM. GEN.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
CONTRACT
INSP.
PROD. DIV.
PROD. ENG.
PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
OTHERS

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(AFR 11-30)

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MI-225
CENTRAL FILES

5391

AAFMC-190-WF-5-20-42-2 MI.

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F ;JDA:rr-70-5E
2. July 1944

File VB-1

28 July 1944

TRIP REPORT

Date: 12 July 1944 through 14 July 1944

Trip to: Union Switch and Signal Company, Swissvale, Pennsylvania

Conferred with:
Capt. Fuerst, Pittsburgh Sub-area Representative
Mr. W. Adams, Project Engineer
Mr. J. S. Crosby, AAF Inspector
Mr. Cadwallader, Vice President of Union Switch & Signal Co.
Mr. B. E. O'Hagen, Electrical Engineer
Dr. T. O. Grondahl, Director Research
Mr. W. A. Sellan, NDRC Engineer

Factual Data:

1. 20,000 Azons are now on order and 90,000 more are to be procured in the immediate future. To insure continued production rates and expedite development of new sources, the undersigned, with Mr. Conrad Zierdt of the Aircraft Radio Laboratory visited Union Switch's Plant.

2. Reports on AZ-1 operation from theatres indicate a 30% failure rate of radios due largely to damage from mechanical shock. Also Battery filling arrangements cause spilling of acid.

3. Final test of Azons employs an R-F generator. Audio modulation is presently furnished by an RC-166 radio transmitter with cutoff R-F stages. This ties up needed equipment and involves use of unreliable dynamotors.

Action Taken:

1. The assembly line was inspected and components examined. Mr. Adams and Capt. Fuerst offered valuable comments on their experience in getting Union Switch into production.

2. a. Investigation shows the Signal Corps radio "shock" mount is for vibration isolation only. The gyro, which has given no trouble to date, is seperately packed and floated in the crate. It will be possible to handle the radio in similar manner. However, 5% of the radios now received by Union Switch are inoperative, and Signal Corps will have to eliminate the cause of this high rejection rate before a packaged radio can be accepted for crating.

   b. The small size of filling and venting holes on batteries and the shape of the electrolyte container and filling syringe conspire to make handling difficult. A new battery is being designed and a new container can be provided.

3. Aircraft Radio Laboratory will furnish Union Switch the critical filter components necessary to construct an audio generator.

[redacted]

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Trip Report (continued)

4. It was inadvertently discovered that the three existing models of radio AN/CRW-2 have different external physical characteristics and that a fourth type being designed uses a different arrangement. Mr. Zierdt was informed of the necessity of coordinating such changes with Production Engineering in order that Air Forces Equipment can be correctly engineered.

Conclusions:

1. Upon determination of the cause of radio rejections a proper method of preparing the set for shipment will be determined and Union Switch instructed as to changes.

2. Better acid handling arrangements will go in production as soon as developed. Pending this, the present arrangements can be made satisfactory by a little ingenuity in the field.

3. Union Switch will shortly have adequate testing facilities.

4. There should be no difficulty in getting a new source into production, if sufficient quantities of batteries and gyros can be produced.

5. A good working liaison with Signal Corps is essential to smooth production of correctly engineered equipment.

Recommendations:

None.

Signed _____
Joseph D. Aronson
1st Lt. Air Corps

Noted _____
ORVILLE A. SCHALLER
Lt. Colonel, Air Corps

[redacted]

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File VB-1

Material for the N.D.R.C. Tests of VB-2.

1 August 1944
Capt. J. H. Evans
2-4274
hle:54-7N:151320

Chief, Ordnance Section.
Att'n: Major J. E. Hatcher.

Chief, Equipment Lab.,
Engineering Division.

1 1. In compliance with directive from the Chief, Development Engineering Branch, AC/AS, M & S, dated 19 July 1944, it is requested that the following equipment be allocated to the Special Weapons Branch of this Office, for use on drop tests of the VB-2:

25 Tail Fuzes, Live, Type T-59

100 Flares, Type T-6

It is requested that fuzes and flares be furnished as expendable items.

2. It is further requested that these items be shipped as soon as possible to the Tonopah Army Air Field, marked for the attention of the Special Weapons Test Unit.

G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Engineering Division.

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HEADQUARTERS ARMY AIR BASE
Office of Director for Operations & Training
Fort Dix, New Jersey

FEG/EBR/hk

File: 470.9

8 August 1944

SUBJECT: VB-1 Flare Failures.

TO: Commanding General, TAF, Mitchel Field, New York.
ATTN: Ordnance Officer
THRU: 1st Bomber Command

95

1. The following report of malfunctions of guide flares used on VB-1 is made in lieu of an Ammunition Condition Report because of the special purpose of the flare. It is believed that the Ammunition Condition Report will not suffice.

2. Twelve (12) guide flares have failed in practice bombing at this base. One flare is received for each bomb to be dropped. Therefore, the flares could not be tested by lots, however, the electrical circuit of each flare is tested before the flare is designated for use. It should be noted that each 1000 pound practice bomb, with the control amparatus costs approximately one thousand five hundred dollars ($1500), and failure of the flare in practice drops renders the drops a total loss.

3. A summation of flare failures follows:

A. Flare, guide T8, 1 Minute, green, Lot 1320b:
Twelve (12) flares of this lot were used in practice drops.
Three (3) flares of this lot failed as follows:
(1) Flare failed to burn. A light smoke instead of flame issued from end of flare.
(2) Flare failed to ignite.
(3) Flare failed to ignite.

B. Flare, guide, T7, 1 Minute, red, Lot No 6E 16:
Sixteen (16) flares of this lot were used in practice drops.
(1) One flare failed to ignite.

C. Flare, guide, T6, white, Lot No 5E 23:
Twelve (12) flares of this lot were used in practice bombing.
Three (3) flares of this lot failed as follows:
(1) Flare stopped burning 20 seconds after igniting.
(2) Flare stopped burning 23 seconds after igniting.
(3) Flare stopped burning 10 seconds after igniting.

4. In addition to the above recorded failures, five flare failures were reported without lot numbers. Three flares burned only five to ten seconds after igniting and two failed to ignite.

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File: 470.9 - 2 August 1944 (Contd)

5. A total of one hundred twenty four (124) flares of ten (10) different lots have been used in practice bombing at this station. Twelve (12) flare failures have been reported.

6. It has been noted that failures of guide flares to ignite can also be caused by dropping the bomb safe and by the flare circuit from the power source to the flare being incomplete. However, there is no indication that the above listed failures were caused by safe dropping and each flare circuit is checked for continuity before the flare is attached to the bomb. The flares that failed to ignite are reported so that the lots of these flares may be further checked.

7. It is believed that the flares that burned for only a short time failed because of the flare mixture. It is further believed that failure due to flare mixture can be greatly reduced by using two different flare mixture lots in each flare, in place of one lot as is now used. Use of two lots of flare mixtures is shown in inclosed drawing. See Incl. 1 and 2.

8. Four flares have been ignited on the ground for demonstration, making dummies for use in class, etc. None of these flares burned completely. Each flare formed a cinder over the unburned portion. See Incl. 3.

For the Commanding Officer:

HOWARD F. GRROAT
Major, Air Corps
Director for Operations &
Training

3 Incls:
Incl 1. Drawing of guide flare
Incl. 2 Explanation of drawing
Incl 3. Photo of guide flare

COPY: ws

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JCR/ma

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Auth: DG, STOUSA
Initials: EW
Date: 28-8-44

French will get the copy from Military Gov.

~~BOMBARDMENT REPORT~~
~~EXAMINATION~~

~~SUBJECT~~: Report on 1st Azon Mission (Sortie No. 342) by 397th Squadron, 397th Bombardment Group, IX Bomber Command on 4 August 1944.

I. ~~TARGET~~:

Railroad embankment and three (3) highway bridges over and under railroad at Epernon, France.

II. ~~AIRCRAFT~~:

Six (6) B-26 aircraft, five (5) of which were equipped for Azon.

III. ~~BOMB LOADING~~:

Total: Ten (10) Azon, fourteen (14) regular.

(a) One (1) lead aircraft - two Azon, four (4) 1000 lb. M-65 standard bombs.
(b) Five (5) Azon aircraft, each carrying four (4) 1000 lb. M-65's, two (2) Azon and two (2) standard bombs.

IV. ~~BOMBS DROPPED~~:

Five (5)	Azon and	two (2) regular	bombs on targets.
One (1)	" "	one (1) "	dropped from bomb bay before take-off.
Two (2)	" "	nine (9) "	brought back.
Two (2)	" "	two (2) "	in aircraft lost to flak.
10		14	

V. ~~BOMB FUZING~~:

One tenth (1/10) second delay nose fuze.

VI. ~~BOMBING ALTITUDE~~:

11,500 feet (ind.)

VII. ~~RESULTS~~: 1st target: (briefed)

One (1) regular bomb (lead aircraft)	275 feet over and to right.
" (1) Azon	hit on tracks short of target.
" (1) "	40 feet left and over.
" (1) "	120 feet right and over.

2nd target: (target of opportunity)

One (1) bomb	40 feet left.
" (1) "	100 feet right.
" (1) "	250 feet right.

Note: Two (2) Azon and one (1) regular bombs were dropped but it is not possible to distinguish between them.

3rd target: not bombed.

VIII. ~~ENEMY ACTION~~: Flak: Meagre accurate heavy flak was encountered in the vicinity of Chartres.
Two (2) aircraft category "a" damage.
One (1) aircraft is missing.

Fighters: None.

DATE: 21 August 1944 [redacted] on

REPORT NO. 297

COPY NO. 6

Incl. 3

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Cod. Schedule
Ex. Lt. Report
R&R 2, 2115 7/2/44

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IX. WEATHER: Cumulus clouds on approach, plus haze.

X. DISCUSSION:

This was the first Azon bombing mission conducted by the IX Bomber Command. In view of the fact no practice drops were made beforehand and that all bombardiers were making their first attempt with controlled bombs, the results can be regarded as good. As is usual in these circumstances, the tendency to over-control, or rather to induce control into the bomb to be sure that it was still responding, was present.

As will be noted from the loading figures given above, the lead aircraft carried standard bombs. The lead aircraft did the sighting and the five (5) remaining aircraft in the formation dropped on the leader. Inasmuch as accurate bombing is equally as important with Azon bombing as with regular bombing, and that the number of available lead bombardiers in the IX Bomber Command is limited, it is anticipated that this method will be used regularly.

On this mission no difficulty was experienced in picking-up the target from the first IP. However, the second target was too close to the first and there was not sufficient time to get set-up. The second target was therefore missed, but bombs were dropped on this same railroad track a few miles further on. Clouds and haze obscured the third briefed target and it was not bombed.

This mission was planned to be comparatively flak-free, and this might well have been the case had not the formation got too near to Chartres from which point accurate flak at almost extreme range was encountered. This flak knocked out one aircraft, which was seen to burst into flames shortly after turning away. All crew members were seen to get free of the aircraft. Flak damage also prevented one aircraft from dropping any bombs by rendering the bomb doors inoperative.

There can be no question concerning the effectiveness of enemy flak at the operational altitude of medium bombardment aircraft, 10,000 to 12,000 feet, and it must be admitted that against defended targets the 30 seconds longer bombing run necessary to control the Azon bomb to the target will be a deterring factor with Azon unless some method can be devised which will offset it. In this connection the most practical method suggested to date, and one which may be tried, is to equip one aircraft with five (5) transmitters and five (5) separate controls to control each of the bombs released by the bombing element which will fly below and ahead of the controlling aircraft. Immediately after release the dropping aircraft will break away in evasive action, meanwhile the controlling aircraft will have been screened against correct prediction sufficiently to permit staying on course the 30 seconds necessary for control purposes. The controlling aircraft would carry no bombs and would be appropriately armored. The most obvious query which this proposal raises is whether or not it will be possible to distinguish between bombs. Some doubts exist on this point, but it will probably be necessary to try it before a definite answer can be given.

J. C. Williams
J. C. Williams
Major, A. C.

Approved: A. G. BUSKIRK
Colonel, A. C.
D/Technical Services

Incl: Strike Photos.

DISTRIBUTION:
Cpy 1 - Air Communications Officer, Wash., D.C.
" 2 - Arm. Lab., Wright Field
" 3 - D/Ops, USSTAF
" 4 - Arm. & Ord. Officer, USSTAF
" 5 - O.S.R.D.
" 6 - ACofAS., M.&.S. Attn: Col. Phillips.
" 7 - IX Bomber Command
" 8 - AMS Files
" 9 - O.S.R.D.
" 10 & 11 Maj. Williams.

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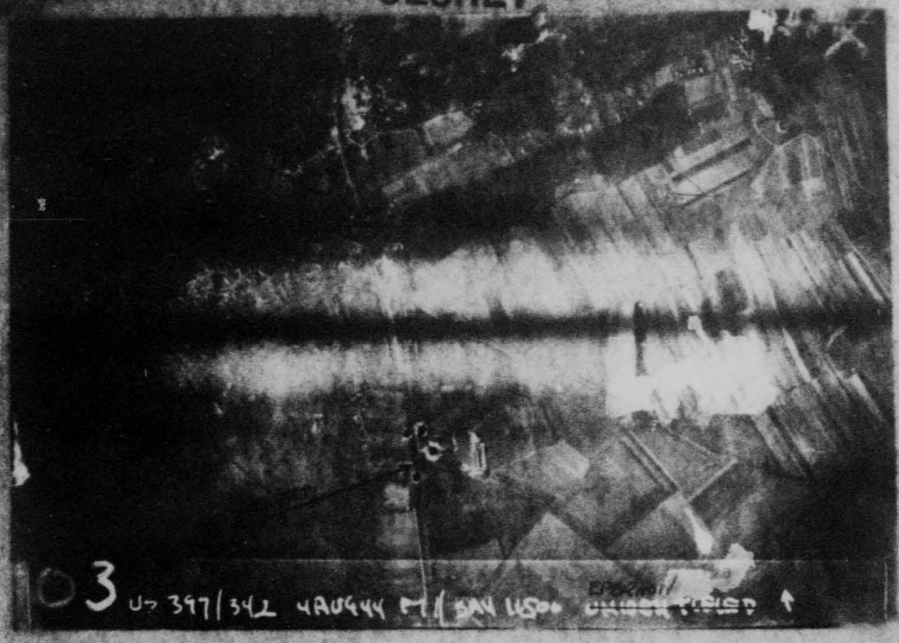

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

Wright Field, Dayton, Ohio

TECHNICAL INSTRUCTIONS

14 August, 1944

Serial No.: CIT-1350, ADDENDUM NO. 7

Subject: Additional Procurement of Azon Tails

To: Production Division

1. Problem Presented:

a. The Office, Assistant Chief of Air Staff, Material and Services and Training has authorized 60,000 Azon tails with standard source for 1,000 pound bombs be procured for preparation in 1945.

2. Factual Data:

a. The maintenance of the 10,000 per month rate of production of Azon tails which is to be reached in November and December of 1944 is also authorized for the above procurement of 60,000 Azon tails for 1945.

b. Reference is made to CIT-1350, Addendum No. 1 which directed the procurement of 10,000 Azon tails for 1,000 pound bombs and CIT-1350 Addendum No. 3 which directed procurement of an additional 10,000 Azon tails for 1,000 pound bombs and addendum No. 5 which directed the procurement of an additional 30,000 Azon tails for 1,000 pound bombs.

c. These Technical Instructions confirm action taken by Production Division on teletype AF-WA-4 [illegible] 6709 dated 10 July which is the authority for these Technical Instructions and which was forwarded to Production Division on 11 July, 1944.

d. It is understood that the Azon tail production schedule planned for 1944 will be 50,000 (which was authorized by CIT-1350, Addenda 1, 3, and 5) and that the approximate schedule for the remaining months of 1944 will be August, 5,000; September 6,000; October 9,000; November, 10,000; and December, 10,000; and it is further directed that the production schedule planned for the 60,000 tails authorized by these Technical Instructions will be 10,000 per month for the first six month.

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ARMY AIR FORCES
HEADQUARTERS OF THE MATERIEL COMMAND

Wright Field, Dayton, Ohio

TECHNICAL INSTRUCTIONS 14 August, 1944

Serial No.: CTI-1150, AMENDMENT NO. 7

Subject: Additional Procurement of Area Bells

To: Production Division

3. Authority:

a. Commanding General, Army Air Forces by teletype WAS 6404 dated 10 July, 1944 from Chief, Production Branch, Office, Assistant Chief of Air Staff, Material and Services.

4. Action Desired:

a. That the Production Division take necessary action to procure an additional 60,000 Area bells for 1000 pound bombs.

b. That the production of Area bells be scheduled in accordance with paragraph 2 d. above and any planned differences from this schedule are to be reported by teletype, through the Technical Executive office, to the Office, Assistant Chief of Air Staff, Material and Services.

By Command of Brigadier General WOLFE:

T. A. SINE
Colonel, Air Corps
Deputy Chief of Staff

cc: Engineering Division
Inspection Division
Procurement Division
Air Service Command (3)

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(AFR 11-30)

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Area
Force Proj. Div
Equipment - 4-1/5pp.
C.O.

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Union Switch and Signal Company
Pittsburgh 18, Pennsylvania

[redacted]

COPY

August 16, 1944

Dr. Vannevar Bush, Director
Office of Scientific Research and Development
1530 P Street, North West
Washington, D. C.

Dear Dr. Bush:

With this letter I am sending you, by way of the Liaison Office, a copy of the diary of my recent visit to the United Kingdom as a representative of OSRD. That document is long and the following is an attempt to give the most important points in brief review.

The Purpose of the trip was especially to study the application of Azon (VB-1), to discuss Azon and other dirigible bombs with our Air Forces and with British scientists who are interested in the problems, and to get acquainted with the work on dirigible bombs that is under way or contemplated in England.

It should be said at once that I had the most excellent cooperation from everyone. Nearly all my activities and appointments were directed and arranged for by Dr. H. G. Stever and Dr. D. P. Langmuir of Mr. Bennett Archambault's office. Major J.C.E. Williams of the Air Technical Section of USSTAF assisted with arrangements and accompanied me on a number of missions, and provided transportation on many occasions. The same spirit of interest and cooperation was evident not only in the London Mission but in all the groups with which I had dealings, both British and American.

Conferences were held with the following groups: (In each case the name of the principal representative is given)

AMERICAN

1. London Mission OSRD
   Mr. Bennett Archambault

2. USSTAF
   Headquarters - Colonel A.R. Maxwell
   Colonel T. Schwartz

   Air Technical Section - Major J. C. E. Williams

   Bovingdon - Major H. J. Band

3. Eighth Air Force
   Major O'neill - Commanding Officer of Azon Group of B-24s

4. Ninth Air Force
   Brig. General S. Anderson

5. Navy - Special Weapons
   Lieut. T. J. Nagel, USN

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BRITISH

[redacted]

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Specially Bn Sqn Doc 4-(1)(pp) 39 SECRET. COPY X

1. Ministry of Aircraft Production (MAP)
   Mr. W. J. Richards, Deputy Director of Scientific Research
   Air Commodore M. Leadham, Director of Air Communications Research

2. Royal Aircraft Establishment (RAE)
   Mr. Scott Hall, Head of Armaments Section
   Dr. J. G. Wilson of Armaments Section

3. Scientific Research Department of the Admiralty (SRDA)
   Deputy Director J. Buckingham

4. Admiralty Gunnery Establishment (AGE)
   Colonel A. S. Kerrison, Director

5. National Physical Laboratory (NPL)
   Dr. W. S. Stiles of the Photometric Dept.

6. Cossors Ltd.
   Mr. I. H. Bedord, Director of Research

There follows a resume of the discussions with these organizations on topics.

1. AZON (VT-1)

Since the Azon was my principle interest it was discussed with all the groups with which I had contact and information in regard to Azon seemed to be exceedingly interesting to all parties.

The operational groups and others who have had contact with the use of Azons were all loud in their praises of the performance of the physical apparatus itself. They said that they could count on the apparatus to be reliable and on the controllability to be adequate for all except the most extraordinary conditions. The only difficulty that they had had were difficulties with the performance of the personnel. The personnel is inexperienced, not only in bombing procedure in combat zones, but inexperienced in navigation, in the use of the apparatus generally and, what is most important, were not sufficiently familiar with the geography of the theatre in which they were working. For these reasons many of the missions failed in whole or part. It is expected that the conditions will improve very rapidly and that then we shall get full benefit of the Azon performance.

In spite of the conditions described, it was stated to be the estimate of General Anderson, whom I did not meet but who was in charge of operations of the Eighth Air Force, that a group of bombers using Azon is six times as effective as a similar group of bombers using standard bombs.

I spent some time with Major O'Neill, who is the commanding officer of the Eighth Air Force group of B-24s that is using Azon, and with his bombardiers and the other men of this group. They gave the above picture and gave a detailed account of the missions that they had made. This account is given in my diary.

It was very gratifying to find in this group, as well as in the Ninth Air Force, that was just getting ready to use Azons with a group of B-26's that there was a consistent interest in a study of the best tactics to be used in the application of Azon. The Eighth Air Force had used new tactics in every one of their missions. It seemed to be a continuous topic of discussion with them. At the time of my visit, they had settled on a rather simple arrangement of

[redacted] FOR OFFICIAL USE ONLY

(AFR 11-30)

Spec Proj Br., Equip Dir-4-(3/5pp) 40

planes and a limited assignment of targets as the best procedure. Anything else seemed to be too complicated to result in successful operation.

In the Ninth Air Force, and I believe this is true also in the Eighth Air Force, there was a group of mathematicians who are making a thorough statistical study of the bombing results. It is believed that from this group we shall get some very vaulable information on the performance of Azons.

A few minor suggestions for improvements of Azon were made and they are all fully covered in the diary so that it is not worth while to discuss them further here. It was estimated that 10,000 Azons per month will probably be required when they come into full use.

The Ministry of Aircraft Production is interested in Azon and was just getting ready to study a considerable number of units that had been assigned to them.

The Anti-aircraft Gunnery Establishment was interested in Azons, principally on account of the possibility that the Azon apparatus might be useful in some of their projects. A great deal of time was spent discussing these possibilites with both WAF AND AGE.

2. Other Uses of Azon Apparatus

During my visit I became acquainted with the following contemplated or already initiated uses of Azon apparatus.

(a) It was planned to try the use of P-38's for bombing with 1000 lb. Azons. For this purpose there was being equipped at Bovingdon a sample P-38 with wing racks for three 1000 lb. bombs and a fourth wing rack to hold a tank which would carry the control apparatus.

(b) Azon apparatus was being tried in bombers for simultaneous release of all the bombs in a formation by the bombardier in the lead ship. It is believed that this will give a better pattern of impacts.

(c) When we were at Bovingdon combat-weary B-17's were being stripped of all their apparatus except that necessary for control and were being equipped with remote control apparatus consisting of Azon receivers and servo motors. The purpose was to use these as controllable bombs carrying a considerable explosive charge. At the time of my visit 6 or 8 ships were already equipped.

(d) The British and the Air Technical Section of USSTAF are cooperating on a project to equip a high explosive armor-piercing bomb with Azon tail structures for control. This bomb is equipped with a rocket to increase its velocity during the last few seconds of its flight. The plan was to attach the Azon tail securely behind the rocket and to try to direct the bomb so that it was going straight for the target at the time the rocket takes hold. It seems a very long shot but it was thought to be an easy thing to try and they were prepared to make some such experiments.

3. Razons and other Projects

In many of our discussions the question of Razons came up and some of the British have a great deal of interest in the possibility of such a unit. The ability to steer in both azimuth and range appealed to them and all I could tell them at the moment was that we should know the answer in a month or two and should be in production shortly thereafter if the results were as anticipated.

[redacted]

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Members of the Royal Aircraft Establishment were especially interested in the Razon sight that we are trying. This consists of an attachment to the regular bomb sight which makes the image of the Razon and the image of the target coincide in the field of the bombsight telescope whenever the Razon is in the appropriate trajectory. This makes it possible to apply only the necessary corrections and makes unnecessary the violent maneuvers that have to be resorted to when such a sight is not used. That sight is being tested at the present time.

4. Dirigible Bomb Projects in the United Kingdom

(a) Number one in these projects is the study of Azon performance and Azon tactics.

(b) Age and Cossors were just beginning the study of plans and instrumentations for a guided anti-aircraft projectile. Cossors had progressed to the point of having developed pneumatic servo mechanisms which seemed very effective and able to provide great forces with a small amount of apparatus. The anti-aircraft projectile that they had in mind looks like a very difficult development. They wanted it to be controllable in all directions and to be able to provide accelerations as high as 30g. It looks like a long development.

(c) Another British project was the high explosive armor-piercing bomb with rocket, mentioned above, which they expect to equip with an Azon tail structure.

(d) The Admiralty Research Laboratory was especially interested in a radar target-seeking high-angle bomb for use against ships. This is also in the speculative stage. They were planning to use semi-armor piercing bombs but had not reached the stage where they had gone into any details, either of the radar of of the servo mechanisms to be used.

(e) The MAP members thought that television bombs should be very effective if television can be operated in a high angle unit. I told them that I thought our experiments indicated that it could be done, but that we still had some experimenting ahead in this field.

(f) There was interest in other target seekers, especially heat seekers, but nothing had been done and it did not seem that any work was being planned in these fields.

Apparently the study of controlled missiles and of development of such missiles was still generally in the speculative stage in England.

5. Study and Discussions of German Bombs.

(a) The flying bomb was foremost in the discussions and I spent a day at RAE studying it. This has been reported on fully in Loga J-3878 and need not be discussed here.

(b) FX 1400 and HS 293. (AFR 11-30) German version of a Razon, and enough parts had been acquired to be able to get a complete picture of its construction. It is very carefully designed and apparently is effectively controlled. The same can be said of HS293 which is the German dirigible glide bomb. The most interesting thing that came out of the discussion on these two bombs was the reasons given by [redacted] for the discontinuance of their use by the Germans. They say that since both of them have to be carried outside of the bomb bay they decrease the speed and maneuverability of the ship to such an estent that it becomes vulnerable and with [redacted] fight protection in the German air force they cannot afford to use such

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equipment. In a supplement to my diary various reports on these bombs are listed, and rather complete information is available.

6. Suggestions for OSRD Liaison

The liaison for Division 5 at the London mission did not seem to be entirely satisfactory to the men who are assigned to it. This feeling is entirely understandable because they have been assigned to represent special weapons activities without having had an opportunity to study the work that is being carried on on this side. They get our reports but do not have time to read them thoroughly with the result that some of the British who do read them know more about it than our men do. I would suggest that Dr. H. G. Stever and Dr. D. B. Langmuir be given opportunities to come to the States every few months to spend a month or so each time. In this way, they can get thoroughly acquainted with what is going on in their field. They have a feeling that very little is being done and that the speculations that have been begun in England are of a more advanced nature than they really are. I believe this frequent return of our representatives would be very helpful.

7. Suggestions for the Military

In my diary there are several suggestions that should be passed on to our liaison office to the appropriate military personnel. Chief among these are the following:

(1) There were several suggestions by men in the field for the training of personnel for the use of Azon.

(2) Everywhere I went there was a request for an instruction book on Azon. This I believe is under preparation by the Army, but as far as I know it has not yet been completed. It is very much needed.

(3) There are many suggestions concerning the construction of Azon, most of which have been taken care of already but they should be passed on so as to make sure that everything has been considered.

(4) A satisfactory film descriptive of the preparation and use of Azon in the field is not available in the United Kingdom.

(5) It is suggested that Major J.C.E. Williams should also be given an opportunity to return to the States frequently to get acquainted with new developments.

All of these suggestions and others which are included in my diary have already been given to the appropriate personnel orally, but I believe they should also bepassed on formally by the liaison office in order to insure that they are handled as promptly as possible.

I hope that you will have time to read the diary because there are many details in which I think you will be interested, however, if you do not and if there are any questions brought up in this letter which you would like to discuss further, I am of course at your service.

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Sincerely yours,

/s/ I. O. Grondahl

Chief, Section 5.2, NDRC

MDAC-S-WF-3-5-42-500M

18 CONFIDENTIAL

Lt. Col. K. P. Royce
veh:90-C
Tel. 3-4334

TELETYPE MESSAGE

CENTRAL FILES 9359

DATE: 25 August 1944

FROM Resources Control Section

ATTENTION: Asst. Chief of Air Staff
Materiel and Services

Attn: Capt. David P. Meeker
Development Engineering Branch

K P Royce Lt Col
for G. H. MORIARTY
Colonel, Air Corps

MX-225

~~RCS-9359~~ . . . REALISTIC ESTIMATED SCHEDULE ON TYPE A-1 CONTROLLABLE BOMB TAIL FIN FOLLOWS: AUGUST - 1800, SEPTEMBER - 3700, OCTOBER - 5500, NOVEMBER - 8000, DECEMBER - 10,000, JANUARY AND MONTHLY THEREAFTER - 10,000. RCS-9359-AFAMC THIS MAKES 1944 TOTAL 37,967 INSTEAD OF PLANNED 50,600. THE ENTIRE 110,600 NOW PLANNED WOULD THUS BE COMPLETED WITH 2633 IN AUGUST 1945. IF IT IS DETERMINED THAT REDUCTION IS NECESSARY, IT IS SUGGESTED THAT RATE OF 8000 PER MONTH ATTAINED IN NOVEMBER BE CONTINUED IN PLACE OF GOING TO 10,000 IN DECEMBER AND AFTER. IN THIS CASE THE PRESENTLY AUTHORIZED TOTAL WOULD BE COMPLETED WITH 2633 IN OCTOBER 1945 AND THE TOTAL THROUGH 30 JUNE 1945 WOULD BE 83,967 OR 76 PERCENT OF TOTAL AUTHORIZATION ~~end~~ AFAMC.

WOLFE, MATERIEL COMMAND

#1523

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(AFR 11-30)

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AFDWA-2E

2nd Ind.

Hdrs. AAF, AC/AS, Materiel Division, Washington 25, D.C. 1 September 1944.

TO: Commanding General, Materiel Command, Wright Field, Dayton, Ohio
Attention: Technical Executive.

1. In reference to the 1st Indorsement there will be no military requirement established for a flare seeker for the vertical bomb at the present time.

2. It is desired, however, to determine whether the flare seeker, having the range of the present device, can actually be installed in the Azon, instead of the radio, to home on the flare of a preceeding bomb -- providing that this study does not interfere with any of the other studies directed to reduce the dispersion of the Azon bomb. 100

3. Since it would be decidedly preferable to use the 1000 lb Azon bomb with the flare seeker in the standard 1000 lb bomb shackles, and since the flare seeker must look down and eventually somewhat backward to see the preceeding bomb, it would be decidedly preferable to have the flare seeking unit, and any necessary accompanying mirror, replace the radio and flare in the Azon tail.

4. It is directed that a report be made on progress of this study by 1 October 1944.

By command of General ARNOLD:

/s/ H. C. Demler, Col. A.C.
For R.C. WILSON,
Colonel, [redacted] Corps,
Chief, Devel. Engr. Branch
Office, Asst. Chief of Air Staff
Materiel and Services.

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[redacted]

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WF-6-5-44-5M-(545)

673-21

File (MX-275)

TELEPHONE - CONFERENCE RECORD SHEET

DATE 2 SEPT. 1944

Name and Location of Activity: AAF.T.A.C., ORLANDO, FLA.

Report on:

( ) Conference

(x) Telephone Call

Government Paid (x) Incoming (x)

Contractor Paid ( ) Outgoing ( )

Approved by

Co-ordination:

Unit Chief P.F. Helmick, Lt. Col. G.C.

Asst. Branch Chief COX

Branch Chief

Return to NPWU

SUBJECT VB-1 ANTI-DISPERSION TESTS AT ORLANDO.

PERSONNEL INVOLVED:

MAJ. J. R. COPELAND, AAFTAC. PROJECT OFFICER

LT. COL. P. F. HELMICK

SUMMARY:

INFORMATION ON PROGRESS OF TESTS OF VB-1 FOR ELIMINATION OF DISPERSION BY TYING BOMBS TOGETHER WAS REQUESTED. MAJ. COPELAND STATED THAT WORK HAD PRACTICALLY STOPPED DUE TO EXCESSIVE RADIO FAILURES. HE ALSO SAID THEY HAD REQUESTED M/C TO SEND DOWN LT. RENZ OF A.R.L. TO CORRECT THE RADIO DIFFICULTIES.

ACTION REQUIRED:

THE ABOVE INFORMATION HAS BEEN GIVEN CAPT. SCOTT OF A.R.L. THIS DATE. CAPT. SCOTT STATED THAT A.R.L. HAD BEEN INFORMED THAT THE VB-1 RADIO SITUATION WAS EXTREMELY SATISFACTORY AT ORLANDO. CAPT. SCOTT WAS INFORMED THAT RADIO TROUBLE WAS DISRUPTING THE TESTS GOING ON AT TONOPAH ALSO.

(AFR 11-30)

(SIGNED) P.F. Helmick

Lt Col AC

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CONFIDENTIAL

COM. GEN. X
CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
EXEC. PROC.
AIR. INSP.
INTELL.
COMPTROLLER
C. O.
BUD. OFF.
PERS. SEC.
ENG. DIV.
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS
102

WCKimar:TSCHP-4
Wright Field, Ohio
21 September 1944

OTI-1350, ADDENDUM NO. 9

Cancellation of Azon Tails

Procurement Division

1. Problem Presented:

a. To make immediate cancellation of all future production of the complete Azon Tail Assembly VE-1, excepting the radio equipment.

2. Factual Data:

a. Procurement has been directed for a total of one hundred ten thousand six hundred (110,600) Azon Tails in OTI-1350, Addenda 1, 3, 5 and 7. Of this quantity, approximately thirteen thousand eight hundred (13,800) will have been purchased before cancellation can be made.

3. Authority:

a. Commanding General, Army Air Forces by teletype WAR-33218, dated 19 September 1944, from Chief, Production Division, Office Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take immediate action to cancel production of Azon Tails as outlined in Problem Presented and advise the Office, Assistant Chief of Air Staff, M&S as soon as possible concerning the total number of Azon Tails produced so that appropriate cancellation of the Signal Corps Receiver may be made.

b. These Technical Instructions cancel OTI-1350, Addenda 3, 5 and 7.

By Command of Lt. General KNUDSEN:

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(AFR 11-30)

T. A. SIMS
Colonel, Air Corps
Chief of Administration

CC: Engineering Div.
Maintenance Div.
Supply Div.
Liaison Office

[redacted]

CENTRAL FILES

AAFMC-190-WF-5-[illegible]

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file VB-1 Dose

TELEPHONE - CONFERENCE RECORD SHEET

DATE 22 Sept 1944

Name and Location of Activity: Non Powered Weapons Unit

Report on:

( ) Conference

(X) Telephone Call

Government Paid ( ) Incoming (X)

Contractor Paid (X) Outgoing ( )

Coordination:

Unit Chief

Asst. Branch Chief

Branch Chief

Return to

Approved by

SUBJECT Report on Activity at Orlando, Fla.

PERSONNEL INVOLVED:

Mr. Nichols- NDRC
Capt. Evans-ATSC

SUMMARY:

1. Mr. Nichols reported that Orlando had little success with the anti-dispersion tests conducted there. The results of thirty mission of about three bombs each has indicated that nylon cord and steel cables of strenght of 1000 lbs. tensile strength is insufficient to hold the bombs in a tight cluster. The violent action with reference to one another in flight has resulted in the failing of the cord most cases. The next move for the Board is to use 5000 lb. cord; however, the use of cord of that strength can prove to be very dangerous.

ACTION REQUIRED: (over)

1. Lt. John S.Capps now assigned to this office will go to Orlando on 23 Sept. to act as liason for the Special Weapons Branch and report to this office all pertainent information concerning Azon.

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(AFR 11-30)

I believe the success of Azon bombs is due to about half the radio receivers failing to respond to signals. It was found in Italy that receivers of low sensitivity would chatter, especially on "Right" signals, when the servo or gyro was noisy electrically. This could be the cause of failure to respond to signals after bombs have fallen several thousand feet and the signal strength is greatly reduced.

(SIGNED) J.S. Evans, Capt. AC

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2. Mr. Nichols stated definitely that the VB-2 was still the responsibility of NDRC and that they were planning the tests at Orlando in about three weeks. He agreed to keep this project officer well informed as to the progress of the preparations. The NDRC sub-unit of this branch expects to have someone present at these tests.

3. It was further indicated that the object of the Orlando tests had changed in that the attempt was no longer to decrease dispersion, but to put up with the present dispersion and attempt to move the pattern in azimuth. The experiment is now on a tonnage basis rather than a precision basis.

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27

VB-1 Vertical Controllable Bomb (Azon)

Chief, Production Div. TSENG TSWLA-405 28 September 1944
Capt. J. H. Evans
2-4274

1 1. Reference is made to a conversation between Brig. General O. R. Cook, Chief, Production Division, and Brig. General F. O. Carroll, Chief, Engineering Division, on 25 September 1944. The following is set forth as the history of the relationship between the sub-contractors, contractors, the Army Air Forces, and other Government agencies involved in the development of the subject bomb.

a. The VB-1 was developed under the auspices of the National Defense Research Committee. The contract was let by this organization to the Gulf Research and Development Company, Pittsburgh, Pennsylvania, who built up completely the first items tested. The tests on the experimental model which were carried out with the aid of Army Air Forces equipment and personnel proved successful and the Union Switch and Signal Company, Pittsburgh, Pennsylvania, was called in by N.D.R.C. to go to work on the production drawings for the VB-1. The Union Switch and Signal Company in turn contacted Schwien Engineering Company, Los Angeles, California, and Willard Battery Company, Cleveland, Ohio, and White Rodgers Motor Company, St. Louis, Missouri, as agencies for the procurement of gyros, batteries, and servo motors respectively. Schwien Engineering Company took Gulf's drawings for the gyro and evolved a gyro which was satisfactory; Willard supplied a standard servo motor with only slight modification. The production model complete, N.D.R.C. purchased two hundred units which were tested with Army Air Forces equipment. Up until this time it is correct to assume that all development costs were paid for on N.D.R.C. contracts because even though Army Air Forces had shown extreme interest in the development, it had not entered into any agreement with any of the above contractors nor obligated itself for any desired quantities. The tests of one hundred Production units showed the weapon to be valuable tactically, and the Army Air Forces negotiated a contract with Union Switch and Signal Company for ten thousand units.

2. With the exception of Schwien Engineering Company, the development cost accrued by the sub-contractor can be considered very small, but it is recommended that the N.D.R.C. contracts concerning this development, be reviewed in order to determine what development costs if any remain unsettled.

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

[redacted]

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ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON, D. C.

CONFIDENTIAL

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON, D. C.

28 September 1944

SUBJECT: PEC Case A-42
Azon Tail Assembly

TO: AAF, Air Technical Service Command,
Wright Field, Dayton, Ohio
Attn: Materiel Command
Chief, Procurement Division

1. Inclosed herewith is PEC Form D authorizing cutback of Azon Tail Structure, Type AZ-1 (Guided Missiles). You will note that approval was granted on the condition that "major case procedure will be followed *** except as investigation may determine that it is not necessary". It is the understanding of this office that major case procedure is being followed. It is suggested that this document form a part of the permanent contract files.

By Command of General ARNOLD:

FREDERICK M. HOPKINS, JR.
Brig. General, U. S. A.
Chief, Resources Division
OAC/AS, Materiel & Services

Incl:
Form D

[redacted]

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FORM GA-1867-A (7-17-44)

UNITED STATES OF AMERICA
WAR PRODUCTION BOARD

R 157

PEC FORM D

RECOMMENDATION OF THE PRODUCTION EXECUTIVE COMMITTEE ON CURRENT CUTBACKS

DATE: September 27, 1944

D

SERVICE OR BUREAU: Army Air Forces

CASE NO. A-42

TO War Department

Attention: Major William Hodgkinson, Jr.
Office AC/AS Materiel & Services
Resources Division

PROGRAM OR END ITEM

Ascn Tail Assembly - Guided Missiles

CONTRACT ITEM

Ascn Tail Structure Type AZ-1

CUTBACK

Cancellation of 22,000 units at Union Switch & Signal Co., Swissvale, Penna., and 14,800 units at G and A Aircraft Co., Willow Grove, Penna.

[redacted]

THE PRODUCTION EXECUTIVE COMMITTEE, WAR PRODUCTION BOARD, HAS REVIEWED THE PROPOSED CUTBACKS OF PRODUCTION PRESENTED BY THE War Department ON P.E.C. FORM B DATED September 26, 1944.

THE PROPOSED DISTRIBUTION OF THE CUTBACKS IS APPROVED. The major case procedure will be followed in this case except as investigation may determine that it is not necessary.

Arthur H. Bunker, Vice Chairman, PEC

FORM GA-1868
(9-18-44)
R 357
(9/20)

UNITED STATES OF AMERICA
WAR PRODUCTION BOARD

PEC FORM B

DETAILED ADVICE OF CURRENT CUTBACKS

REQUIRED PRODUCTION	PREVIOUS	REVISED
1944	23,500	0
1945	13,300	0
TOTAL	36,800	0

CONTRACT ITEM: Aron Tail Structure AZ-1

PAGE ___ OF ___ PAGES

CASE NO.: A-42

DATE: 26 Sept. 1944

B

SERVICE OR BUREAU AND BRANCH: Army Air Forces

UNIT: Each

1. NAME OF CONTRACTOR	Union Switch & Signal		G and A Aircraft Co.					
2. LOCATION OF PLANT	Swissvale, Pa.		Willow Grove, Pa.					
3. DISTRICT	Eastern		Eastern					
4. PRESENT MAXIMUM MONTHLY CAPACITY	3500		200					
5. MONTHLY CAP. TO BE RETAINED	None		None					
6. MONTHLY PROD. SCHEDULES	CURRENT	PROPOSED	CURRENT	PROPOSED	CURRENT	PROPOSED	CURRENT	PROPOSED
a. Oct.	4,000	0	1,500	0				
b. Nov.	5,000	0	3,000	0				
c. Dec.	5,000	0	5,000	0				
d. Jan.	5,000	0	5,000	0				
e. Feb.	3,000	0	300	0				
f. Mar.	0	0	0	0				
7. UNDELIV. QUANTITY ON CONTRACT	22,000		14,800					
8. QUANTITY TO BE CANCELLED	22,000		14,800					
9. W.M.C. LABOR AREA	72							
10. a. ESTIMATE OF TOTAL NO. OF EMPLOYEES AT PLANT								
b. ESTIMATE OF NO. OF EMPLOYEES WORKING ON THIS ITEM								
c. ESTIMATE OF NO. OF EMPLOYEES TO BE RELEASED FROM PLANT AND APPROX. DATE								
11. PERCENT OF CONTRACT SUBCONTRACTED								
12. UNIT COST								
13. a. QUALITY OF PRODUCT								
b. ENGINEERING								
c. MANAGEMENT								
14. TYPE OF FACILITY								
15. EST. OF SQ. FT. OF FLOOR SPACE MADE AVAIL. & APPROX. DATE								
16. WILL PRODUCTION EQUIP. BE RELEASED? APPROX. DATE								
17. PROPOSED ACTION AND DATE TO BE TAKEN	Immediate cancellation		Immediate cancellation					

18. REMARKS *(See reverse side for additional space)*

[redacted]

0989

FORM GA-1867 (7-17-44)
R 157 (9/26)

UNITED STATES OF AMERICA
WAR PRODUCTION BOARD

FORM A

PRELIMINARY ADVICE OF CURRENT CUTBACK

DATE 26 Sept. 1944

Army Air Forces

CASE NO. A-42

PROGRAM OR END ITEM
Axon Tail Assembly - Guided Missiles

CONTRACT ITEM
Axon Tail Structure Type AZ-1 MK-225

UNITS AND VALUE TO BE DELIVERED IN	PREVIOUS		ADJUSTED	CUTBACK	
a. Oct.	5500	$3,025,000		5500	$ 3,025,000
b. Nov.	8000	4,400,000		8000	4,400,000
c. Dec.	10000	5,500,000		10000	5,500,000
d. Jan.	10000	5,500,000		10000	5,500,000
e. Feb.	3300	1,815,000		3300	1,815,000
f. Mar.	0	0		0	0
g.					

REMARKS

Prime Contractors:

Union Switch & Signal Co., Swissvale, Pa.
G and A Aircraft, Willow Grove, Pa.

Subcontractors:

Schwein Company, Los Angeles, Calif.
White-Rogers Co., St. Louis, Mo.

[redacted]

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BY FREDERICK M. HOPKINS, JR., BRIG.GEN., USA
SIGNATURE

GPO—War Board 119350—

26

[redacted]

446th Bombardment Squadron (M) AAF
321st Bombardment Group (M) AAF
APO 650

29 September 1944

SUBJECT: The Azon Project in Corsica.

TO : Chief, N. P. W. U., Special Weapons Branch,
Equipment Laboratory, Materiel Command,
Wright Field, Dayton, Ohio.

1. While results in the B-25 type aircraft appear to be more encouraging than those obtained in the B-17, it is obvious that there is still considerable room for improvement. Many very close near misses have been obtained with two bombs each dropped from three of six B-25's. It is believed that with greater numbers of planes, attacking the target in a column of, say, three flights of six aircraft each, the interval between flights being equal to or greater than the time of fall, there would be almost 100% certainty of destroying the target. But one or two 1000 lb. bombs, with instantaneous fuse settings, apparently does very little damage to a steel trestle. In view of past experience with duds, the one-tenth second delay nose fuse setting was not desirable. Too, the bomb would probably pass through a steel-trestle type bridge before going off. New fuses with .01 second delay are now available and should obviate those troubles.

2. For two weeks this group has suffered such a shortage of combat crews that it has been impossible to fly both Azon missions and their normal commitments. Higher headquarters states that the situation cannot be expected to improve in the immediate future, so that the outlook for more Azon missions is dim. At the present 183 units are on hand at this base, and 1112 units are in Naples or enroute here - a three month supply, with missions every day. With winter and unfavorable weather almost upon us, it will take much longer to consume them. It therefore seems necessary to have six B-25 crews, especially earmarked for the Azon project, sent here immediately from the States, if more Azon missions are to be run before the war in this theater is over. The six original Azon bombardiers are still available and so these crews could be sent less bombardiers, but the needs of the group are such that they could be made use of - if sent.

3. Some 75% of the Azon units - as dropped - have controlled properly. Flares failing to ignite or burning off have caused the majority of failures. Of those which fail to control when dropped no accurate survey of failures can of course be made, but an idea may be obtained by scanning the inclosed report on work done upon units as received - before they can be dropped.

RECEIVED

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(AFR 11-30)

[redacted]

FRANK C. LIGHAR,
Major, Air Corps,
Project Officer.

Y-56016 106

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Det H, 9003D ARF BASE UNIT (BOMBARDMENT)
TEST AND DEVELOPMENT SECTION
PINECASTLE ARMY AIR FIELD, PINECASTLE, FLORIDA

3 October 1944.

SUBJECT: Daily Report - Azon Project at Pinecastle, Florida.

TO : Director, Air Technical Service Command, Engineering Division, Equipment Laboratory, Wright Field, Ohio. (Attn: Special Weapons Branch, Capt. J. H. Evans).

1. The following information on the activities at Pinecastle Army Air Base in connection with Azon was obtained 2 October 1944.

2. Anti-Dispersion Tests - The test originally intended for this date awaits special hose connectors and will be run in two or three days. This will probably be one of the last cable connected tests unless the results are unexpectedly successful.

3. Moving Pattern in azimuth - a long discussion took place today in planning the number and formation of ships and the assignment of control to a given bombardier. Capt. Neff is particularly concerned with the tactical use of this form than and considers the known difficulties arising from trying to "sell" unorthodox formations to the various forces and from splitting responsibility. The latter point arose from the contention of Mr. Bollen, Mr. O'Donnell and the undersigned that one of the leading ships should instigate release of the bombs and one of the last ships should carry the transmitter and the control box for better visibility and transmitting pattern. For the purposes of test, we feel that the entire proposed flight of nine ships should be in a formation as tight as possible and longer than it is wide.

This discussion, with the arrival this evening, of Major [illegible] and of Mr. Nichols this morning, will probably be continued and some of the tactical considerations may be dropped until the pattern from the first few drops is observed.

Before these tests are conducted, the ships must be wired, and parts used, that are being brought from Wright Field. To avoid delay, the wiring is to be attempted here.

To illustrate what is possible to be recorded with moving pictures, a film of Razon drops was shown to Major Moulton and Capt. Neff. The excellent results are to be duplicated with cameras now being prepared by Mr. Bolinger in Pittsburgh and arrangements for developing the films here are being made because of the unfortunate results obtained where they were sent away before.

4. VB-2 Tests - Twenty-nine new style VB-2 units have arrived and thirty more are expected. These units have the fuse arming motor, 20 degree

(AFR 11-3[redacted]

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Ltr., Subj: Daily Report - Aron Project at Pinecastle, Florida, Cont'd.

rudder operation and brackets for a flare which should be three inches long and twelve inches in diameter. These flares are not yet here and they are necessary if these units are to be mounted on internal bomb racks. It is hoped, although progress is apparently being made to obtain external racks for the B-17's, that these units will fit in the rear bay of a B-24, with 5 inch flares or that some device can be used, for test purpose only, to fold the flare out of the way in the bomb bay. The units are also supplied with a six prong kickout plug providing a circuit to permit arming or disarming of the flare at will.

In addition to the receivers brought by Mr. Andrews, Major Rand has promised that more can be obtained which can replace the unsatisfactory lot here at present. There should be no delay on any of the tests for lack of good receivers.

Another problem is the procurement of T-39 tail fuses, suitable for use with these units. These are expected by express shortly.

5. As suggested in recent telephone conversation with Capt. Evans, attempts have been made to locate any previous reports on Aron work conducted here. There have been no such reports but it is hoped that a log of tests kept here will afford more information. The next daily report will cover this.

John S. Capps
JOHN S. CAPPS
1st Lt., Sig. Corps.

[redacted]

Carton [illegible]
Spec. Weapons Sect.
Bk, Mat'l Div-17

57

SECRET

HEADQUARTERS
NINTH AIR FORCE
OPERATION RESEARCH SECTION

APO 696 U.S. Army

8 October 1946

SUBJECT: Reports on Guided Missiles Eto Theatres.

TO: Hq., AAF, Rm 4 D 154 Pentagon, Washington, D. C. Attn: Lt. Colonel R. E. Elwell, Actg. Chief, Operations Analysis Division

1. In reply to your letter 21 September, the Operational Research Section of the Ninth Air Force has no knowledge of any use by this unit of the GB-1, GB-4 or Caster guided missiles. The Aphrodite has been used on one operational mission after which the aircraft was abandoned. The use of this bomb does not appear to be indicated for use in this Theatre where heavy flak opposition is almost invariably encountered. Moreover, the results to be obtained by such methods do not appear to be substantially better than those using our ordinary bombing techniques.

LAWRENCE S. TAYLOR
Chief, Operational Research Section

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(AFR 11-30)

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HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND

Wright Field, Dayton, Ohio.
7 October 1944

SUBJECT: Azon Tail Assemblies
Contracts 33-038 ac-4458
33-038 ac-3167 and 33-038 ac-4307
Production Status

TO: Commanding General
Army Air Forces
Washington 25, D. C.
Attn: Major V.A.Stace
R&R Section,Devel.Engr.Br.Mat.Div. AC/AS, M&S

1. Complying with telephone request of Col. Richardson to Major Marshall and confirming telephone conversation with Capt. Hecker on Saturday, 7 October, the following is a summary of production status as reported by Readjustment Division.

2. Union Switch & Signal Company, Swissvale, Pa., contract 33-038 ac-3167:-

a. Total quantity completed on this contract 3471. Can complete 1,000 more from parts on hand at approximately $100 per unit. The parts on hand include sufficient Sahwein gyros and White-Rodgers servos so that no further receipts of these items will be necessary.

b. The company has parts partially completed in quantities sufficient to complete this contract for 10,000.

c. Production figures summarized are as follows:

August	150
September	2721
October, authorized by termination	600
Total now to be delivered on this contract	3471
Additional proposed by par. 2 a	1000
Total if additional quantity is accomplished	4471

d. The above is in addition to the quantity of 10,600 delivered on a previous contract and a small quantity delivered on an experimental contract prior thereto.

e. Union Switch & Signal are reported to be entering an immediate request for partial payment of $3,000,000. It is estimated that the total settlement will involve termination costs to the government of $4,000,000 to $5,000,000.

[redacted]

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3. Schwein Company, Los Angeles

a. Have laid off between 150 and 175 employees.

b. Have on hand completed but not shipped 550 gyro assemblies. Have no parts in process.

4. White-Rodgers Company, St. Louis, Mo.

a. Are laying off about 300 people.

b. They have 412 completed servo units not shipped.

c. They have 8,000 partially completed units in process. It is estimated that it will cost approximately $150,000 to complete these.

d. White-Rodgers have had in process an action with the Defense Plant Corporation for increased facilities to meet the High Azon requirement rates previously established. Industrial Service Branch, Resources Control Section, is currently taking action to stop expenditures thereunder.

5. G&A Aircraft Company, Willow Grove, will not complete any Azonz. They are known to have only 25 White-Rodgers servo units. Information will not be available until Monday morning as to the quantity of Schwein gyro assemblies they have on hand.

For the Director:

GEORGE E. PRICE
Colonel, Air Corps
Chief, Production Section

NOTE: On 10 October information was received that there are 1000 gyros and 525 servos on hand at G&A Aircraft Co.

VAS 4908

[redacted]

Lt. Col. Stace/lb/4908

[redacted]

(AFMA-2C)

28 October 1944

SUBJECT: Possible Further Completion of Axon Tail Assemblies.

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Procurement Division (TSCP)

1. Reference is made to a letter of 7 October 1944 from the Air Technical Service Command, subject "Axon Tail Assemblies Contracts 33-038 ac-4458 33-038 ac-3167 and 33-038 ac-4307 Production Status."

2. Paragraph 2a of this letter makes the following statement:

"Total quantity completed on this contract 3471. Can complete 1,000 more from parts on hand at approximately $100 per unit. The parts on hand include sufficient Schwein gyros and [illegible]-Rodgers servos so that no further receipts of these items will be necessary."

3. Confirming conversation of 27 October with Major Marshall, it has been decided that the 1,000 additional tails specified in paragraph 2a should not be completed due to the decision that a sufficient number of Axon equipments are already on hand.

By command of General ARNOLD:

[illegible]
Colonel, Air Corps
Actg. Chief, Engr. Br., Mat. Div.
Office, Asst. Chief of Air Staff,
Material and Services

AMIA-2

[redacted]

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WAR DEPARTMENT

WASHINGTON

7 October 1944.

MEMORANDUM FOR: General McClelland.

SUBJECT: Procurement fo Components for Guided Missiles.

I am advised that because of the recent cut-back in the Azon program there no longer exists an immediate need for certain components of this equipment, namely servo-motors now manufactured by the White-Rodgers Electric Company, and gyro devices now manufactured by the Schwein Engineering Company. These companies, I understand, are our only sources of these components and, if the orders which have been placed on them for these components are cancelled, they will have no choice but to re-convert. This will result in the dissipation of their facilities and personnel, and, should we subsequently need components which they alone are now capable of producing, there would be considerable delay in recreating facilities.

It is probable that in the near future, requirements will exist for certain new guided missiles now in final stages of development and testing. These devices will require components similar to thos employed in AZON. It would seem wise, therefore, to maintain sources of supply now in existence for the production of such components rather than to permit the only sources to be destroyed and accept the delay involved in recreating these sources or new sources when the need arises.

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Therefore, in accordance with authority granted me to act for the Commanding General, Army Air Forces through the medium of your office in the implementation of all projects and programs in any way concerned with communications, and in accordance with a directive of the Chief of Air Staff charging you with responsibility for all phases of controlled missiles, requirements, development, experiment and procurement, I am instructing you to take necessary action to insure that facilities are maintained for the production of the above mentioned types of components, at least until such time as a definite requirement exists for such components or until it is apparent to you that no such requirement is likely to arise in the forseeable future.

/s/ Howard L. Bowles,
Special Consultant to the
Commanding General, AAF.

CC: Gen. Giles
Gen. Echols
Gen. Craig

[redacted]

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(AFR 11-30)

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Procurement of Components for Guided Missiles

Asst C/AS, M&S, Materiel Division — 8 Oct. 1944

Air Communications Officer

1
Gen Rives/mh/6324

1. Attention is invited to the attached memorandum dated 7 Oct 1944 from the Special Consultant to the Commanding General, Army Air Forces.

2. In compliance with this memorandum it is requested that immediate action be taken to continue the delivery of White-Rodgers servo-meters and Schwein gyros (used in Azon assemblies) on the basis of 2,000 per month for a period of six months. This office has been advised that the quantities and delivery schedules proposed will permit these two companies to continue in operation until such time as it can be determined whether or not there is a further need for the devices they manufacture.

3. Continued production of these two Azon components is desired in order to assure a supply of these items for Azon, Felix and Rock projects where the gyros and servo-meters interchangeable.

TOM C. RIVES
Brig. Gen. USA
Deputy Air Communications Officer

1 Incl.
Memo from Dr. Bowles, 10-7-44

TO: AC/AS, OC&R — Date:

FROM: AC/AS, M&S — Comment No. 2
JFP/mmm/71500

Forwarded to your office for comment in accordance with the provision of Par. 5a, Section I, AAF Reg. 20-46, 2 Oct. 1944.

[redacted]

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Agr in Conclusion
Sec

Procurement of Components for Guided Missiles

AC/AS, M&S

13 Oct. 1944

AC/AS, OC&R, Requirements Division

3

Col Sweetser/ltm/73405

1. Comments 1 and 2 and inclosure noted.

2. Dr. Bowles' Memorandum, 7 October 1944, indicates that no military requirement exists for certain additional communications components and notwithstanding this, directs continuing of specific manufacturing facilities.

3. Inasmuch as the question of military requirement has been reviewed and settled, and the propriety of continuing a manufacturing facility is not within the preview of this Division, no comment is considered appropriate either as respects the additional procurement or the propriety of procedure.

1 Incl
n/c

AFREQ/T _____

MERVIN E. GROSS
Brigadier General, USA

[redacted]

0-Azon 75.31C 65 SECRET
Azon. Weap. Test 1B-2.
Marshall

HEADQUARTERS ARMY AIR FORCES,
Office, Asst. Chief of Air Staff, Materiel and Services

Inter-Desk Memorandum Maj.V.A.Stace/18/4908 - AFMA-2C

TO: MAJ.GEN. O.P. ECHOLS

Date 10 October 1944

SUBJECT Cancellation of Azon Production

1. The Azon tail replaces the tail of a standard 1000 lb. bomb, and can be remotely controlled right or left.

2. Procurement authorizations:

	For 1944 Deliveries	For 1945 Deliveries
Original	10,600	
6 April 1944	10,000	
15 June 1944	30,000	10 July 1944 60,000
1944 Total	50,600	1945 Total 60,000

3. Orders actually placed and deliveries prior to cancellation:

	Orders Actually Placed	Deliveries to 4 Oct. 1944
Union Switch & Signal	35,600	14,070
G&A Aircraft	15,000	0

It is probable that approximately 1000 to 5000 more tails will be completed from components now on hand.

4. A R&R from the Air Communications Officer, coordinated by AC/AS, OC&R, was received on 19 September 1944, requesting that immediate action be taken to cancel all further production. A teletype directing this cancellation was sent to the Air Technical Service Command on the same day. On 4 October 1944 the Air Technical Service Command cancellation notices went to the vendors.

5. The apparent reasons for cancellation are:

a. "Train" drops did not prove successful due to wide dispersion.

b. Azon is a "good weather" weapon and must be watched until it hits.

c. Bridges became taboo as targets in France.

d. Control of the air and plentiful supplies encouraged standard "high tonnage" bombing procedures.

e. Azon stocks in U. K. increased rapidly and on 14 September 1944 U. K. reported eight months stock and requested that shipments stop.

[redacted]

From [signature] H2
R. F. PHILLIPS, Col. A.C.

THIS FORM WILL NOT BE USED OUTSIDE THE AC/AS, M&S

Address reply to ENVELOPE to:

3

Director
Air Technical Service Command
Reference TSLA-405 100674
Wright Field, Ohio

Lt. W. H. Hensihle
Ext. 2-7127
AIR TECHNICAL SERVICE COMMAND

Spec
Resp
file
10-11-44

13 October 1944

Government Furnished Equipment on
Contract No. W33-038-ac-3167.

AAF Sub-Area Representative,
207 Old Post Office Building,
Pittsburgh, Pennsylvania.

1. An N.D.R.C. letter dated 2 October 1944, requests that thirty each radio receiver AN/CRC-2 or AN/CRC-2A be furnished the Union Switch & Signal Company for use on VB-2 bombs being built under N.D.R.C. contract No. OEMsr-1285 for tests by the Army Air Forces Board. The subject letter expresses preference for equipment manufactured by the General Instrument Company to be furnished if possible.

2. A considerable quantity of such receivers are currently on hand at the Union Switch & Signal Company intended for use as Government furnished equipment under contract No. W33-038-ac-3167. It is considered advisable to transfer the desired number of receivers from the VB-1 program to the VB-2 work.

3. It is therefore requested that thirty each radio receivers be transferred to the VB-2 project as outlined above and that the Air Technical Service Command be notified of the quantity of Emerson and/or General Instrument equipment concerned under such transfer of accountability.

By Command of Lieutenant General KNUDSEN:

GEORGE E. PRICE,
Colonel, Air Corps,
Chief, Production Section,
Procurement Division.

Copy to:
District Supervisor (Eastern)
Att'n: Dist. Engin. Div. Lia. Sec.
Union Switch & Signal Company
Att'n: Mr. H. E. O'Hagen
National Defense Research Committee
Att'n: Mr. Hugh H. Spencer
Inspection Division

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Maj.V.A.Stace/lb/4908

Subj: Development of a Light-Seeker for the Azon Bomb.

4th Ind. (AFMA-20)

Headquarters, Army Air Forces, Washington 24, D.C. 18 October 1944

TO: Director, AAF-Air Technical Service Command, Wright Field, Dayton, Ohio
ATTN: Engineering Division (TSEEG)

1. In reference to paragraph 2 of the 3rd Indorsement, the flare seeker would only be used in place of the radio because the individual bombs, each controlled by radio, have too wide a dispersion when dropped in train.

2. If other methods controlling the dispersion of guided vertical bombs seem more feasible, it is satisfactory with this headquarters to discontinue any study on the use of the flare seeker in the vertical bomb.

3. It is understood, however, from a conversation of 14 October 1944 with Lt. Col. Hyman that he found there was theatre interest in this project in his late visit to U. K. and that further contacts are being made with Fairchild to determine whether a development program can be started.

By command of General ARNOLD:

R. C. WILSON
Colonel, Air Corps
Acting Chief, Engr. Br., Mat. Div.
Office, Asst. Chief of Air Staff,
Materiel and Services.

AFMA-2

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24. Mar. Doc. - 27-12/1pp.

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HEADQUARTERS, ARMY FOREIGN TRADE SERVICE COMMAND
Maj. H. F. Marshallrum
Tel. 2-5233

20 October 1944

SUBJECT: Azon Termination
Contract 33-038 ac 3167, U.S. & S., 10,000
Contract 33-038 ac 4307, U.S. & S., 15,000
Contract 33-038 ac 4456, G & A, 15,000

TO: Commanding General
Army Air Forces
Washington 25, D.C.
Attn: S & R Section
Develop. Engr. Branch
Materiel Division
AC/A., M & S
Major V. A. Stace

1. While formal information has not been received from Re-adjustment Division as to the quantity of Azon assemblies completed prior to the termination, reliable informal information has been obtained that:-

a. Union Switch & Signal on contract 33-038 ac 3167 will complete 3471 of the quantity of 10,000 so that the quantity cancelled is 6,529.

b. Union Switch & Signal will not complete any of the quantity of 15,000 on contract 33-038 ac 4307.

c. G & A will not complete any of the quantity of 15,000 on contract 33-038 ac 4456.

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2. The above information has been given to the Ordnance Officer at this headquarters and is being transmitted thereby for action by Ordnance.

3. The Dayton Signal Corps Supply Agency has been notified informally to stop shipments of radios. It is requested that the above quantity information be furnished to the Office of Chief Signal Officer so that formal instructions may be issued to the Dayton Signal Corps Supply Agency.

4. Formal notification as to final quantities of gyros, servos and batteries on hand has not been received as yet from Re-adjustment Division but is being expedited. In the meantime it is believed that the following quantity information previously given in reply to teletype AAR-05066, 11 October 1944 can be used for present purposes.

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Subj: Azon Termination
To: CG, AAF, Washington, D.C.
Date: 20 October 1944

Gyros - Approx. 10,000
Servos - Approx. 6,000
Batteries - Quantity unknown

5. Property Disposal Section, Readjustment Division is already asking for advice as to disposition of these items. Normally Readjustment Division has authority in the absence of other specific instructions to dispose of CFE items like these or to move them to a surplus storage depot. Readjustment Division has been asked to withhold any movement pending the report of final quantities for submission to your office for advice as to the disposition desired.

6. Advice is requested on the basis of the above preliminary quantities as to the disposition of these items so that prompt action can be taken on receipt of final quantity information.

For the Director:

[illegible]
Colonel, Air Corps
Chief, Production Section
Procurement Division

CC: Office, Chief of Administration
[illegible]
Chief, Radio Branch
Attn: Mr. Wappler
Chief, Special Devices Branch,
Engr. Div. [illegible]
Mr. Greenbaum, [illegible]
Special Devices Div.

AFMC-266-WF-10-27-43-50M

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ARMY AIR FORCES

AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND

TSENG

MEMORANDUM REPORT ON

Captain J. H. Evans:hle
Ext. 2-4274
Date 25 October 1944

SUBJECT: VB-2 Vertical Controllable Bomb, (2000 Pound Azon).

OFFICE
~~SECTION~~ TSELA-405

SERIAL No. TSELA-40-673-16-X

Contract No.
Expenditure Order No. 673-21
Purchase Order No.

A. Purpose.

To report on trip to Tonopah Army Air Field from 4 August to 9 September 1944.

B. Factual Data.

1. Personnel present were:

Air Technical Service Command	Gulf Research & Development Co.
Captain J. H. Evans	Mr. R. D. Wyckoff Dr. J. P. Molnar
N.D.R.C.	
Mr. A. J. Wollan Mr. Nichols	

2. The VB-2 is a 2000 pound version of the VB-1 (Azon) using identical gyros, radio, and battery as the VB-1. It differs from the VB-1 in that it is larger, requires a shorter flare and uses stronger solenoids. The VB-2 is carried on the standard rack positions in any airplane that will carry standard 2000 pound bombs.

3. Twenty VB-2 Vertical Controllable Bomb units were shipped to Tonopah for drop testing; however, only twelve were dropped. The program was set up specifically to test the aerodynamic characteristics of the units. All of the bombs in this series of tests were carried on the standard external racks of a B-17 airplane as the short flares were not available and the bombs were too long to be carried internally. The bombs were dropped together because it was felt that a better estimate of control could be obtained by observing and photographing the parallel flight paths of the two bombs. The tail fuses for the VB-2 were not tested at this time as they were not available.

[redacted]

MX-225

(AFR 11-50)

No. of pages - 3

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[redacted]

Memo. Report No. TSELA-4.0-673-16-X
25 October 1944

4. The scoring of the hits of this test is not important to this report because as stated in paragraph 3, above, the program was set up specifically to test the aerodynamic characteristics of the units; however, photographic records of the drops are available in the files of Section 5.2, N.D.R.C., Cambridge, Massachusetts. The first mission of two VB-2 bombs proved to be of no value as the airplane lost one engine at 8,000 feet on the climb to altitude and the bombardier was forced to salvo the bombs before the warm-up switches were turned on. The bombs spun and failed to respond to control. Mission No. 2 was completed from 15,000 feet above the ground with the units erecting properly and taking the control as given; however, it was noted on this flight that the control available was much less than that for the VB-1 and more control was desirable. Mission No. 3 was run to verify Mission No. 2; however, the "low-power" switch on the RC-186 transmitter was left in the "on" position accidentally and although the units erected properly, they responded to only the first control because of the weak signal transmitted. The last mission being inconclusive, a fourth mission which verified the conclusion from Mission No. 2 was completed from 21,000 feet indicated altitude. Ten degrees was calculated to be the desirable rudder travel increase and this additional travel was incorporated in the next four units. Both the fifth and sixth mission proved successful with the bombs erecting properly and taking the control applied. Out of twelve bombs dropped, eight bombs performed satisfactorily for the full flight and two although responding to only the first control, probably would have operated satisfactorily if the proper signal strength had been transmitted. Flare failures were witnessed on two of the above missions; however, the flares failed in only the last six and eight seconds of flight and in no way hindered the tests. Failures on the same Lot. No. MM5E-25 were reported by the combat theaters coincident with the report to Ordnance on these failures and action has been taken to correct the fault.

C. Conclusions.

1. That aerodynamically the VB-2 bomb is satisfactory.

2. That a ten degree increase in rudder travel is desirable.

D. Recommendations.

1. It is recommended that the following action be taken by the organization designated below:

a. Section 5.2, N.D.R.C.:

[redacted]

5a

Memo. Report No. TSELA-4C-673-16-X
25 October 1944

(1) That N.M.R.C. set up a program to test the new flare and tail fuse for the VB-2. (action initiated)

(2) That N.M.R.C. incorporate the ten degree additional rudder travel in the production model of the VB-2. (addition complete)

John H. Evans

Concurrence:

Prepared by JOHN H. EVANS, Captain, A.C.
(Name)

Approved by .....
Chief, ...

Distribution:
Mat. Div., AC/AS, M & S
Section 5.2, N.M.R.C.

Approved by H. Y. SMITH, Lt. Colonel, A.C.
Chief, Engineering Standards Section.

[redacted]

MX-225

Y-55442-1

Azon
14-1943
C7

CONFIDENTIAL

OFFICE FOR EMERGENCY MANAGEMENT
NATIONAL DEFENSE RESEARCH COMMITTEE
OF THE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P STREET NW.
WASHINGTON, D. C.

Union Switch and Signal Company,
Pittsburgh 18, Pennsylvania
October 27, 1944

Commanding General,
Air Technical Service Command,
Wright Field, Ohio.

CONFIDENTIAL

Dear Sir: Attention: T.S.E.L.A.-4C5 TSELA 4C5
Captain John H. Evans

This will remind you of our conversation of this afternoon when you promised to send me a copy of the Azon training film TF-1-376A. It will be very helpful for me to have this film, and I shall appreciate very much your sending it.

Since I started to dictate this letter I have talked to Mr. Spencer, and have asked him about the electric arming of the VB-2, and he thinks that we should continue as we have started for the present and let the Army make the change whenever they desire to do so.

We discussed the question of the tail fuse on VB-1, and agreed that that information is something that we ought to have as soon as possible because of its bearing on Razon. I wonder if that test can be included in the first part of the program at Wendover. I should like to know and would appreciate it if you will drop me a line.

Very truly yours,

L. D. Grondahl

Chief, Section 5.2, N.D.R.C.

LDG/RP

[redacted]

Y-74086

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5 File VB-1

COPY

COPY

L. N. SCHWIEN ENGINEERING CO.
5736 West Washington Boulevard
Los Angeles, California

Telephone Webster 7274

October 28, 1944

Commanding General
Materiel Command
Wright Field
Dayton, Ohio

ATTENTION: T. S. B. P. R. 4Q

Subject: Cancellation of Contracts

Gentlemen:

Referring to cancellation of Contracts numbered W33-038-ac-4458 and W33-038-ac-4307, our claim will total $809,293.32. This figure is subject to verification of physical inventory which we anticipate will be completed on or before November 11th, 1944. This claim includes materials purchased for completion of the contracts, processing parts by this company, and all sub-contractor's claims for cancellation costs, which we will establish to be fair and reasonable.

Due to the fact that a large number of parts have been fully processed and the balance in various degrees of completion to cover the full amount of the contracts above mentioned, we will be able to complete 12,000 gyros at the established contract price of $108.90 each, and reduce the amount of the above mentioned claim to $328,892.32. Should we receive a contract for 18,000 gyros at the contract price we could further reduce the claim to $237,684.32 and if 24,000 gyros were ordered the claim over and above the contract price for the gyros would be but $171,021.32.

Regarding the completed gyros now held by prime contractors, these items can be used in AZ-2 without change and for use in Razon or Felix the necessary changes can be made at the present locations of the instruments at a cost of $3.00 per unit.

It has been our endeavor to complete the contracts in force at the earliest possible moment to meet the requirements and demands of the military services and this endeavor on our part is evidenced by the large number of completed, or nearly completed, parts ready for final assembly.

Very truly yours,

L. N. SCHWIEN ENGINEERING COMPANY

/s/ L. N. Schwien

L. N. Schwien
General Partner

LNS:hh

118

V 1882

MDAC-446-WF-12-24-41-5M sets of 5

Authority for: 47 ☐ A. ☐ B. ☐ C. ...cation ☐ D. Test

VB-2
Expenditure Order No. 679-52
Account No. 114

I. DETAILS OF WORK AUTHORIZED (Make definite and concise):

To cover 1) liaison with Section 5.2, National Defense Research Committee in the development of the VB-2, 2000 pound Vertical-Bomb, Visually Controllable in Azimuth Only (Azon), and 2) experimental-testing of subject equipment.

FOR OFFICIAL USE ONLY [redacted]

Authority: Classified Ltr. dtd. AAF AC/AS, MWD to CG Material Command dated 26 June 1944. (AMC 11-30)
Subject: Collaboration with the NDRC Guided Missiles Program.

II. FILL OUT ONLY PARAGRAPHS ON ITEMS CHECKED ABOVE.

USE FOR ADDENDUM ORDERS ONLY
a. Revised from $ ..... to $ .....
b. Revised from $ ..... to $ .....
c. Revised from $ ..... to $ .....
d. Revised from $ ..... to $ .....
e. Revised from $ ..... to $ .....

A. STUDY. a. If development of equipment is proposed, is it new, modified, or for substitution. b. Why necessary? c. State complete program proposed with probable total cost as estimated before study is made. d. Give in detail work to be covered by this study. e. Indicate character of report of this study which is to be prepared.

a. Purpose

A 2000 pound (VB-2) version of the production 1000 pound (VB-1) Azon is being developed by NDRC. The heavier bomb will be controlled by a special tail fin assembly containing gyros, optic stabilizing equipment, a servo mechanism, and a radio receiver; such tail assembly being similar to, but larger than, the special tail used on the VB-1. This type of control equipment makes it possible to visually control the missile from a carrier aircraft in such a manner that sighting errors in azimuth may be corrected during flight of the bomb.

b. Action to be taken

The major portion of the development costs will be borne by NDRC; however, expenditures by ATSC will be required during the development stages to cover the advisory assistance extended by the AAF and to cover such incidental items of government equipment which may be required to expedite development. Additional expenditures will be required for the experimental testing program conducted by the AAF using AAF equipment and personnel, and for the transition during which the missile is converted from an experimental classification to a production one. Transition will include preparation of production specifications and prints, and preparation of operating manuals.

No outside purchases required.

B. DESIGN. (Copy of Report on Study to be attached.) a. Type designation recommended. b. Kind of drawings to be prepared. c. What test items will be constructed and tested during design work?

C. FABRICATION. (Attach assembly drawing of item or fabrication instructions.) a. What new or modification of present manufacturing equipment at the Division is necessary. b. List outside purchases required and estimated cost.

D. TEST. (Attach test requirements.) a. What kind of report is required. b. What new test equipment will be needed?

III. PERSONNEL.
a. Name of Project Engineer. a. Capt. J. H. Evans
b. List of Branches which will be required to do work. b. Equipment Lab., Aircraft Radio Lab., Aircraft Lab., Tech. Data Lab.

V. ESTIMATES. (For items checked above). Overhead omitted.

a. Material	b. Eng. & Drafting Labor	c. Fabrication Labor	d. Test Labor	e. Total Cost	f. Estimated by
200	$ 500	$ 500	$ 1500	$ 3300	J.H.E.

ENGINEERING PROGRAM.
a. State Project and Item Number on Engineering Program. Project 611-4
b. If not on Program state modification proposed. Item 673-6

Initiated by L. F. Shenebrock Branch Equipment Date 4-NOV 1944 Coordinated by .....
Approved by Branch Chief C. N. HILLMAN Colonel, A.C. Approved Section Chief R. G. CARROLL Brig. General, U.S.A. Approved Executive .....
Close out requested (Date) ..... Reason .....
Signed ..... Branch Chief Approved ..... Section Chief

TRIPLICATE

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B 375 K

[redacted]

8 Nov. 1944
1935 Z

FROM: WASHINGTON, D. C.

TO: ATSC WFO

IN REPLY CITE: WAR 57648

Classification of contract document S and termination papers Ason tail assemblies is subject. Reference letter your office dated October 16, 1944 requesting declassification on Ason contracts and other papers for termination and salvage matters. Authority is granted to remove the classification of the contract (WAR 57648 attention: Procurement Division, Major H F Marshall, TSBPR4Q (to Wolfe from Wilson AFDMA-2 signed Arnold) document and all papers in connection with termination except specifications and engineering data

120

ACTION: ATSC WFO

GM-IN-1730 (Nov. 8, 1944) 2343 Z jmr

DISTRIBUTION: KAS

1. TSBUY Action
2. Cable Secy
3. TSGKP (TSGKP2A) W

[redacted]

Copy 3

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CONFIDENTIAL

[redacted]

AIR TECHNICAL SERVICE COMMAND

Ext. J.H.Evans:mep
Ext. 2-9182

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL: TSENG (TSEPL-314)

COM. GEN. X
CH. STAFF
DEP. CH. STAFF
TECH. EXEC.
ADJ. GEN.
EXEC. PROC.
AIR. INSP.
INTELL.
COMPTROLLER
C. O.
BUD. OFF.
PERS. SEC.
ENG. DIV.
PROD. DIV.
INSP. DIV.
PROC. DIV.
OTHERS
121

Allocation of VB Tail Fin Assemblies.

Commanding General,
Army Air Forces,
Washington 25, D.C.

MX-225

Attention: Chief Engineering Branch,
Materiel Division, AC/AS M & S.

1. This office learned from the Supply Division ATSC that the remaining stock of VB-1 type A1 tail fin assemblies now at Gadsden, Alabama will be depleted within a two month period. With the depletion of this stock there will be no VB-1 fin assemblies within the continental limits of the United States.

2. In order to continue experimental tests on the Spazon project and the tail fuses modification project for the VB-1, it is necessary that some 200 VB-1 units be available in this country for test drops. Therefore, it is requested that 200 each VB-1 tail fin assemblies type A1 be allocated to the Engineering Division Wright Field, Ohio for use on the Spazon and tail fuses projects. These units are to be held at Gadsden AAF Specialized Depot for shipping instructions which will be forth coming as the projects progress.

3. It is requested that this office be notified when and if the allocation is effected.

For the Director:

G. R. WINDSOR, Maj.

F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

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(AFR 11-30)
[redacted]

AAFMC-190-WF-5-12-44-375M

MX-225 FILES

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AAFMC-266-WF-4-7-44-50M

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P-1

ARMY AIR FORCES
MATERIEL COMMAND

MEMORANDUM REPORT ON

SUBJECT:

Date 22 November 1944

OFFICE

Contract or Order No.

SERIAL No. 16-A-2

Expenditure Order No.

[redacted]

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26-A-2

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(AFR 11-30)

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AAFMC-266-WF-8-1-44-50M

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[redacted]

P-2

[illegible] 16-A-2

[illegible]

[illegible]:

1. [illegible]

2. [illegible]

3. [illegible]

4. [illegible]

5. [illegible]

6. [illegible]

II. [illegible]:

Distribution: [illegible]

Prepared by [illegible]
(Name)

for S R Stewart, Col. AC.

Approved by [illegible]
Chief, [illegible]

Approved by

FOR OFF[illegible] ONLY
(AFR 11-30)

[redacted]

Concurrence:

1

CONFIDENTIAL

Wpns. Div. Exec. Report No. [illegible]-3-673-16-A-2
22 November 1944

ATTACHMENT A.

Personnel.

Pilots and crews of Squadron "B", [illegible] N. D. were available to carry out the missions, Base personnel in Armament and Ordnance aided in preparing the planes, and technically trained personnel of the Test and Development Section prepared and installed the Zeon equipment. This personnel, directed by Capt. [illegible], included a T/Sgt. in charge of the shop, 2 squadron motor men, and any enlisted man trained previously on Zeon at Ft. Dix, N. J. It is expected to expand this enlisted personnel as the tests progress requiring a greater proportion of tested and installed equipment. Later these are expected to be used to work on Japan, Iwojima and Kelix.

Equipment.

There are 14 B-17G tested equipped to squadron for use. The greatest number used at any time for Zeon tests has been 10. It is believed that this number could be maintained for future tests providing that projects of higher priority do not require their use. The squadron handles several projects at a time for the Army Air Forces Board. For the testing of Zeon equipment, a complete workshop has been established including the necessary standard signal generator, audio oscillators, power test table and battery charging equipment. It is expected in the near future to duplicate all of this equipment to make it possible to handle the increasing volume of work.

For those bomber crew members who are required to control the Zeon bomb in flight, there is available at the headquarters base of AAFTAC a bombing trainer which has been modified to show the proper method of control and it is believed to be of considerable training value. Although the standard Zeon control panel and control box are not provided, a control switch is provided whereby the student can control the motion of a spot of light, representing the bomb plane, on a simulated bombsight. The reaction of the spot to control is logical enough of the actual bomb to permit the student to acquire a proper sense of timing, although the lateral motion of the spot sometimes reacts a spot a slightly in excess of what would normally be expected. The equipment necessary for this modification of the trainer is rather extensive and expensive but might be desired to show the action of "bomb" operator control to take place as is obtained with Razon which require considerable more equipment and expense.

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(AFP 11-30) I-[illegible]

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Engin. Div. Memo. Report No. [illegible] 16-A-2
22 November 1944
Appendix 3.

[redacted]

[redacted]

Aspin. Ltr. Desc. Report No. [illegible] 16-A
[illegible] November 1944

ANNEX 4

Dispersion Tests.

[illegible] Four tests were made during October, 1944 in which five dummy bombs were dropped with one standard fuze [illegible] feet. The object was to determine the effect of natural alignment of the [illegible] on their dispersion. Therefore, the receivers and the [illegible] were replaced with an equal weight of sand, the rudders were locked in a neutral position, and no control was attempted. The gyros were properly corrected so that the fuze bomb indicated a position with the fuze vertical. On one occasion, four of the fuze bombs fell in a close pattern within [illegible] feet of the standard bomb, the fifth falling [illegible] feet to the right. On a second occasion, three fell within [illegible] feet of the standard bomb, one fell beyond it [illegible] feet, and one fell to the left. The other two tests resulted in dispersion in range and deflection over 1,000 feet. In each case, the results of the standard bomb were taken as the part of [illegible] to show that the standard fuze or some spinning of the bomb after release is responsible for the effect of irregularities of the fuze and assembly of the tail.

A second set of five tests was conducted for a similar purpose. [illegible] only difference between these tests and the first four tests, was that the standard bombs were dropped [illegible] feet above, the tails of which were [illegible] speedily slowed, in the order of two degrees, by means of [illegible] between the rudder and the tail. One was allowed to produce deflection [illegible] the right, one [illegible] the left, one [illegible] short in range, one [illegible] long in range. In one case, the [illegible] and formation [illegible] speedily, and [illegible] taking the standard deflection [illegible] operator [illegible] at least 500 feet from the nearest standard bomb. In [illegible] cases, the same results were obtained except that one of the [illegible] failed to disperse [illegible] in the intended direction. In one case it was the bomb intended to go long that fell short, and in other cases, it was the one intended to go to the left that fell [illegible]. Considering the [illegible] of the gyros and [illegible], these failures may be attributed to natural irregularities of manufacture that compensate or part for the intentional error.

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[redacted]

APPENDIX 5.

Moving Pattern in Azimuth.

Two tests were conducted on [illegible] November to determine the effectiveness of a great number of bombs dropped from a tight formation of planes, all supposed together to offset any error in azimuth which a bombardier might make. It was known from previous tests that six-bomb groups dropped in train from one ship was not satisfactory. It was reasoned that the pattern of a [illegible] drop would be greater than that for the one plane only by the width and the length of the formation, and that the central concentration would be considerably greater. The target was about 400 feet wide by 200 feet long. In both tests the plane was [illegible] the bombardier in the leading ship and controlled the entire group of bombs by giving the [illegible] center of the [illegible] element. [illegible] bombs were dropped per plane - approximately [illegible] and [illegible] carried the standard 2,000 lb. bomb while the other bombs [illegible] that the amount of control would [illegible] experience on target [illegible]. The bombs were dropped with 1/20 to 1/10 second intervals. The altitude was 12,000 feet and the indicated speed [illegible].

The [illegible] formation employed was [illegible] generally a tight formation of three elements one behind the other, "Javelin down". The distance between [illegible] was about [illegible] feet. Purposely, the formation tried to [illegible] the target [illegible] from side and the bombers were so [illegible] directly opposite the far edge of the target and 100 feet to the left of the center of the target. Actually, at the time of release, the formation was approaching the target [illegible] at an angle of approximately 15° and the bombardier [illegible] to the fact that the [illegible] bombs fell short of the aiming point an average of 400 feet. [illegible] release equipment, [illegible] equipment and personnel, [illegible] were actually dropped and 12 bombs, of which [illegible] stability, falling [illegible] the standard [illegible], and did not control, falling wide [illegible] and to the left of the formation. The remaining 34 bombs fell within an area approximately [illegible] feet wide by [illegible] feet long. The center of this group, for the most part of equal frequency, was not more than 100 feet to the point [illegible] of the target area. Actual hits in the area were [illegible] but this was not considered to indicate sight [illegible] accomplished alone, if the range error in setting the left-right

[redacted]

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[redacted]

were eliminated, it is estimated that 18 or 20 hits would have been obtained, in heavy concentration.

The mission of 10 November was almost identical to that of the 7th except that the approach was made to the right of the target and the control was principally to the left. Due to a last minute change in the choice of target area the approach was actually made, approaching the target from the right at an angle of approximately 5° and the aiming point was chosen approximately 500 feet beyond the target instead of opposite the far edge. Again, this error also on the target was too standard load and should be disregarded in interpretation of the bomb hits. Eight standard and 42 Razon bombs were actually dropped and of these five failed to stabilize when the bombardier failed to turn on the warm-up switch and three failed to control. Although one bombardier forgot to arm the Razons, the bombs did control. There appeared to be six hits in the target area and it was estimated that there were 15 to 20 hits that would have fallen inside if the range error had been eliminated. Most of the bombs that controlled were noted to take the last reverse control to the right which indicated that the receivers were reacting.

Other missions were flown for comparison purposes, one in which only standard bombs were dropped and one in which 45 Razon bombs were dropped without any control. Some of the data above has been presented in an approximate form since the official plot of results by the photo interpretation officer has not yet been consulted. Also the results of the uncontrolled drop have not been obtained but it is expected that the pattern of this will not be far different than that of the controlled drop. Within a few days it is expected that the controlled drop will be repeated at an altitude of 26,000 feet and these results will also be obtained.

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(AFR 11-30)

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APPENDIX A.

Difficulties and Difficulties.

Because the filaments of the tubes in the receivers are rated below the actual applied voltage and overheating reduces the sensitivity materially, care has been taken to permit warm-up of the receivers for a maximum time of five minutes immediately preceding the actual drop. A take-off on a 40 minute trip to the target, the switches were turned on to maintain the batteries at full charge. After 20 minutes they were turned off to permit the receivers to cool, to obtain maximum sensitivity of the receivers.

During the first tests, it was found necessary to use only Emerson receivers since a large percentage of the lot of General Instrument receivers were not able to be tuned to the proper sensitivity. Later however, a new shipment of General Instrument receivers was obtained from Gulf Research and Development Company in Pittsburgh, Pennsylvania, and these were used in preference to the Emerson receivers because, unlike the Emerson, the tuning adjustments of these receivers were more likely to retain the result to which they were set.

The standard T-7 red flares and T-7 red flares were used in the course of these tests. Although in general the red flares were found to be not satisfactory in brightness as well as best for photographic purposes, these too were found to be not satisfactorily or failed dim during the course of a test drop. For some reason it does not appear to be possible to predict the satisfactory operation of the flares on the basis of ground tests. When burned on the ground, they all seem to operate at maximum brightness for the required length of time. In November a new shipment of red T-7 flares was received from the manufacturer after the action of those on hand had been imported and the last few tests indicated much more satisfactory results.

[redacted]

[redacted]

Engin. Div. Memo. Report No. [illegible]-3-673-16-A-2
2 November 1944
Appendix 6.

A great many of the [illegible] and receivers which were taken from packing cases received in the first shipment were found to [illegible] weld on the wiring underneath the receiver chassis [illegible] plug and switch. In many of these, the wiring [illegible] had turned red. The inside corners of the [illegible] foil bag around all the equipment [illegible] of desiccator was included inside the bag. [illegible] in an open and hanger or had been in [illegible] as indicated by the packing data. [illegible] unit was found in which the [illegible] was lifted off of the [illegible] cracked the wooden [illegible] open directly [illegible] that the source of the moisture [illegible] cellar retained the moisture so that the desiccator was ineffective. This may have been the source of moisture [illegible]

[redacted]

ATSC Form No. 10-8
(17 Oct 44)

26

ROUTING AND RECORD SHEET AIR TECHNICAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters.

Use authorized office symbols to designate addressee and addressee.

Place initials of dictator and typist, telephone number and location to right of signature.

Use entire width of sheet, both sides.

Separate comments by horizontal lines across page.

SUBJECT: CTI-1350 Addendum 9

TO	FROM	DATE	COMMENT NO.
TSTEX Attn: Major William Barstow	Ext. 2-9177 Mr. R. P. Miller/fls TSBPR405	11-28-44	1.

MX-225

1. CTI-1350 Addendum 9 dated 21 September 1944 directs the cancellation of all future production of the complete Azon Tail Assembly VB-1.

2. Cancellation was effected with delivery of a total of 14,071 Azon Tails. Of this total, 3471 each were delivered by Union Switch & Signal Company on contract 33-038-AC-3167. Information concerning the above mentioned quantities has been furnished to the Office AC/AS M. & S. as requested in paragraph 4a of CTI-1350 Addendum 9.

a. The cancellation left large quantities of gyros, servos and batteries, which are being held in storage at the contractors for use in connection with future projects.

3. Since the action desired by CTI-1350 Addendum 9 has been accomplished it is requested that CTI-1350 Addendum 9 be closed out.

B. L. BOATNER
Colonel, Air Corps
Acting Chief
Procurement Division

	INITIALS

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WF. Area B-10-20-44-1 Mil.

TO | FROM | (CONTINUE ON OTHER SIDE) | DATE | COMMENT NO.

54

Lt.Col.Stace/lb/4908

Subj: "Development of a Light Seeker for the Azon Bomb"

6th Ind.

(AFDMA-2C)

Headquarters, Army Air Forces, Washington, D. C.

7 December 1944

TO: Director, AAF-Air Technical Service Command, Wright Field, Dayton, Ohio.
ATTN: Engineering Division (TSEEG)

1. In accordance with conversation of 30 November 1944 between Lt. Col. Hyman, Lt. Col. Stace, and Major Evans, it is understood that your office will study the possible advantages of a light seeker for both the Azon and Razon type bombs and make a definite decision concerning Air Technical Service Command further action on this program.

By command of General ARNOLD:

D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engr. Br., Nat. Div.,
Office, Asst. Chief of Air Staff
Material and Services

AFDMA-2

124

"Development of a Light Seeker for the Razon Bomb"

T[illegible]-317
Mr. [illegible]:[illegible]
[illegible]t. 2-5220

7th. Ind.

[illegible], Air Technical Service Command, Wright Field, Ohio. [illegible] December [illegible].

To: Commanding General, Army Air Forces, Washington [illegible], D. C.
Attention: AC/[illegible], [illegible] Materiel Division, Engineering Branch.

1. The study to adopt a present type light sensitive target seeker for use on the Razon and Razon type bombs is progressing.

2. Procurement is being initiated to have the Fairchild Camera and Instrument Corporation adapt one of their type 545 flare seekers for study and test of the requirements.

[redacted]

7th Ind. to C.G., AAF, Washington 25, D. C. Attn: Engr. Br., Mat. Div., AC/AS, M & S.
"Development of a Light-Seeker for the Azon Bomb".
22 December 1944

3. Several companies are being approached to develop a seeking device designed specifically for use in the Azon and Razon type bombs.

For the Director:

G. V. HOILOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

AAFMC-446-WF-5-14-42-5M sets of 5 COPY 43

Authority for: [x] A. Study [ ] B. Design [x] C. Fabrication [x] D. Test

Expenditure Order No. 673-21

Account No. 01-11A

I. DETAILS OF WORK AUTHORIZED (Make definite and concise):

Study, Adaption and Tests of a Light-Sensitive, Target-Seeking Device as an Anti-dispersion measure.

Authority: Chief, Engineering Division.

II. FILL OUT ONLY PARAGRAPHS ON ITEMS CHECKED ABOVE.

A. STUDY. a. If development of equipment is proposed, is it new, modified, or for substitution. b. Why necessary? c. State complete program proposed with probable total cost as estimated before study is made. d. Give in detail work to be covered by this study. e. Indicate character of report of this study which is to be prepared.

a. Purpose: To provide a target-seeking unit for use as an anti-dispersion measure on the type VB-1 High Angle, Controllable Bomb.

b. Action to be Taken: Study will be conducted, and the method for the adaption to the vehicle will be developed and fabricated. One experimental item will be procured and tested. Upon the completion of satisfactory tests, a quantity will be procured for Service Testing.

USE FOR ADDENDUM ORDERS ONLY

a. Revised from $ ..... to $ .....

b. Revised from $ ..... to $ .....

c. Revised from $ ..... to $ .....

d. Revised from $ ..... to $ .....

e. Revised from $ ..... to $ .....

B. DESIGN. (Copy of Report on Study to be attached.) a. Type designation recommended. b. Kind of drawings to be prepared. c. What test items will be constructed and tested during design work?

C. FABRICATION. (Attach assembly drawing of item or fabrication instructions.) a. What new or modification of present manufacturing equipment at the Division is necessary. b. List outside purchases required and estimated cost.

Outside Purchases:

One Modified Target-Seeking Unit $3500.00

D. TEST. (Attach test requirements.) a. What kind of report is required. b. What new test equipment will be needed?

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125

III. PERSONNEL.
a. Name of Project Engineer.
b. List of Branches which will be required to do work.

R. W. Hommell
Equipment Laboratory

IV. ESTIMATES. (For items checked above). Overhead omitted.

a. Material	b. Eng. & Drafting Labor	c. Fabrication Labor	d. Test Labor	e. Total Cost	f. Estimated by
$4,000.00	$ 500.00	$ 500.00	$ 500.00	$ 5,500.00	R. W. H.

V. ENGINEERING PROGRAM.
a. State Project and Item Number on Engineering Program.
b. If not on Program state modification proposed.

611-4
673-7

Initiated by LE Shanabrook Branch Equipment Date 13 Dec 44 Coordinated by .....

Signed G. V. HOLLOMAN Approved H. Z. Bogert Approved
Branch Chief Colonel, Air Corps Section Chief Colonel, Air Corps Executive .....

Close out requested (Date) ..... Reason .....

FOR OFFICIAL USE ONLY

Signed ..... Approved 125
Branch Chief Section Chief

(AFR 11-30)

[redacted]

TRIPLICATE

19

December 13, 1944

Dr. L. O. Grondahl
Union Switch & Signal Company
Pittsburgh (18), Pennsylvania

Dear Dr. Grondahl:

This letter will serve as a report on our part and observations in connection with the VB-1 fuze tests conducted recently at Wendover Field, Utah.

The preparation of fuzes was under the direction of Capt. Vandenberg, an ordnance officer attached to the Special Weapons Branch at Wright Field. The arming mechanism was of the anemometer type and required a ring insert 1-1/2" long between the sleeve and tail. There was some difficulty with the alignment of holes. Although the rings were drilled to accept the dowel pins in the sleeves in order to get proper alignment, no similar dowel pins had been built into the ring and so the tail unit was aligned merely by the mounting screws. The arming wire to the anemometer had to go through holes drilled parallel to the anemometer axis and hence perpendicular to the direction of pull, since the wire must be brought through a mounting lug. By properly bending the wire in a smooth curve, it could be made to pull out of the holes satisfactorily, but as a general practice, the system does not seem practical. A simple spring and pin unit has been designed by one of our men here at the laboratory which would represent a simple solution to the problem permitting a straight pull by the arming wire.

The preparation of the tail units was under the direction of Lt. D. M. Baltimore, also from Special Weapons. In the first mission, four bombs (T_1, T_2, T_3 and T_4) were dropped, each with an Emerson receiver. (The best receivers were saved for the SPAZON tests.) Only the two lower bombs were equipped with flares, since the results of the flare accident which occurred in the previous mission were still fresh in everybody's mind. One of the flares burned out at about the 20-second point (it turned out to come out of an old batch and not the new ones) and so only one bomb could be followed all the way down. It appeared to respond to control applications all the way. The two without flares appeared to respond satisfactorily early in flight when their yaw angles could be seen and they hit reasonably near the bomb with a good flare. The bomb without a good flare looked good early in flight, but seemed to have failed near the end, although it is impossible to be certain, because of the failure of the flare. The pattern of hits was

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about 500 ft. wide which is not unreasonable for bombs when responding properly.

In the second mission, two bombs with fuzes (T_5 and T_6) and two dummies were dropped. Due to a lack of manpower (several Gulf men were busy taking Dahlmeyer to Salt Lake City), a T/Sgt. Schmidt, one of Capt. Evan's men, was assigned to steer the bomb, and Molnar ran the cameras. In his confusion, Schmidt applied only right control and that only, up to the time the bombs were over the target. They overshot the target by several thousand feet, due to failure of the electrical release and the time lag involved in salvoing the bombs. After the right control was taken off, the bombs appeared to disperse by a rather large amount, namely 800 ft., acting as if one retained control in one direction. Plotting the projected paths may reveal something on this point.

After these two missions, five out of the six bombs were dug up (the sixth was not immediately located) and the fuzes in all of them were found to have armed and fired. Capt. Vandenberg believed that this was convincing evidence that the fuzes themselves functioned properly. The question still remained whether their presence caused any detrimental effect in the aerodynamic behavior of the bomb. It was the opinion of all the officers and Gulf men present, that the failures observed were probably caused by radio failures or other cases of equipment malfunctioning, but to make the case airtight, another mission was planned in which controls would be applied according to a pre-set schedule.

Four such bombs were prepared, T_7, T_8, T_9 and T_{10}. An arrangement was devised for applying a schedule of alternate right and left rudder applications using an old White-Rodgers motor to drive a switch. Two bombs were to have right and left applied alternately at four-second intervals (eight seconds for complete cycle) while two, using slowed-up motors, had right-left application at eight-second intervals. Due to a shortage of gyros, several SPAZON units had to be converted for the purpose. The rate gyro springs were changed, but the lowest rates that could be obtained were around 35 to 45° per second rather than the nominal 25° per second value.

The results of the experiments were disappointing. Two bombs dropped out of the airplane spinning and apparently continued to spin throughout the entire flight. One of these received no rudder control. The other did receive rudder control, but soon went into a violent spin, and, in fact, was thought to be tumbling end over end by ground observers. Of the two that erected properly (but only after an overshoot, due to the high rate gyro settings) only one was given rudder applications. It responded properly all the way down. It is believed that the two bombs which received no rudder application were those that had the slowed-up schedule motors, which had so much resistance added in series that at the cold temperatures encountered, the available starting torque was inadequate. The roll failures were probably connected somehow with the fact that converted gyros were used in these bombs.

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The last four drops unfortunately did not serve to provide definite proof that the anemometer had no detrimental effects on the aerodynamic behavior of AZONS since only one of the four bombs functioned properly. However, it seems reasonable to believe that the failures observed were not due to the anemometer but to malfunctioning of the equipment.

No more than the first five bombs were dug up at the time we left, to check the fuze functioning; however, they are presumably still available in the ground and can be dug up anytime if it seems desirable to do so.

The motion picture records of all the drops are available at this laboratory.

Very truly yours,

R. D. Wyckoff

JPM:CRK
cc: Dr. Eckhardt
Mr. Spencer
Capt. Evans

THIS PAGE IS DECLASSIFIED IAW EO 13526

[redacted]

S U B J E C T (BOMB)
BOARD AAF BASE UNIT (BOMBARDMENT)
PINECASTLE ARMY AIR FIELD
AAF TACTICAL CENTER

Orlando, Florida.
13 December 1944.

SUBJECT: Daily Report - Azon and Felix Projects at Pinecastle, Florida.

TO : Director, Air Technical Service Command, Engineering Division, Equipment Laboratory, Wright Field, Ohio. Attn: Special Weapons Branch, Capt. J. H. Ivans.

1. The following information on the activities at Pinecastle Army Air Field concerning Azon and Felix was obtained 8 to 12 December 1944.

2. VB-1 and VB-2. No tests have been conducted or yet officially proposed pending a scheduled meeting with members of the Air Forces to be held 15 December. It is believed that the objective of future VB-1 tests will be determination of a practical ceiling for mass drops. Previous tests have indicated satisfactory operation at 15,000 feet and unsatisfactory operation at 25,000 feet and testing will involve altitudes between these limits if tests are resumed.

3. From present available information all past plans for internal use of VB-2 in B-17 airplanes have not properly provided for the size of the bomb and have not considered alteration of the normal position of the bomb which is necessary and consequent changes necessary in the components of the equipment. As an example, since it is necessary to turn the tail from a level position in order to close the bomb bay doors, the normal 45° operation of the gyro should be changed.

4. If VB-2 can only be used externally, it is not considered practical for combat use by the Air Forces Board. The future program on these devices may be settled at the proposed meeting.

5. Felix Program (VB-6). The communications from the Air Technical Service Command concerning installation of warm-up circuits in heavy bombardment aircraft were received 11 and 12 December and communication with Lt. Col. Mastis was made immediately. Contrary to this information, it is found that desired installations in B-29 airplanes have not been made. Rather than inspection, information on proper circuits and material lists are requested.

6. It must be determined (1) if the installation is for test purposes only and (2) if it is for final use, if the Felix design to be used is that illustrated by samples now available or if new designs will change the requirements. A four-wire warmup similar to Azon would be suitable for test program.

7. Although proposed test program calls for use of B-29 airplanes as much as possible, N.D.R.C. personnel recently arrived expected to use

1884

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[redacted]

Daily Report - Azon and Felix Projects at Pinecastle, Florida, Cont'd.

B-17 aircraft almost entirely. Four B-29's are present at Pinecastle Army Air Field. It is undetermined whether all four are expected to be ready for use at one time and it is known that other projects are now underway employing them.

8. The range personnel from A.D.A.C. has been working at Ocala for approximately 10 days although this was not known at Pinecastle until 9 December.

John S. Capps
JOHN S. CAPPS,
1st Lt., Sig.Corps,

[redacted]

COPY 27

[redacted]

SECRET
By Authority of the President
AAF BD
15 DEC — BCW
Date — Initials

WRM/ERT/pt-(

14 December 1944.

Azon Bomb Requirements.

TO: Director, AAF Air Technical Service Command, Tactics Division.
Wright Field, Dayton, Ohio.
Attn: ISMST-7 AAF Board Liaison Officer
(Capt. Wyans, ATSC Special Weapons Branch)

1. It is requested that two hundred (200) 1000-lb Azon bomb tail assemblies complete, be shipped to Supervisor of Supply, 8th Sub-Depot, Orlando, Florida, for Army Air Forces Board, attention: Major E. C. Vorlan (Ret), Headquarters Commandant, AAF Board, for use in future tests in AAF Board Project No. 4[illegible], "Test of Azon Type High Altitude Bombs", as soon as possible.

2. A conference was held at the AAF Board on 13 December 1944, and the AAF Board, NDRC, and tactical testing agencies were represented. It was the general consensus of opinion that approximately three hundred fifty (350) Azon [illegible] of this type will be required before this project is completed. Additional [illegible] will be requested when future requirements are known.

For the President:

Wm. W. Moyer
Colonel, Air Corps

1st Ind 2-1

MX-225

MX-225

[redacted]

Y-10656

COPY

128

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL: TSEPL-314

Confidential

HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND
Lt. D.M. Baltimore:mep
Ext. 3-5316
Wright Field, Dayton, Ohio
15 December 1944

Requirements for Mechanically Armed Flare for High Angle Bomb, Project MX-225.

Commanding General,
Army Air Forces,
Washington 25, D.C.

Attention: Air Ordnance Officer,
AC/AS M & S.

1. Reference is made to a letter from this Command, Subject: Requirements for Special Flare for High Angle Bomb, Project MX-225, dated 14 December 1943. As a result of action taken at the time of the reference letter, an electrically armed flare was developed and accepted for use with this project. Such an electrically armed flare has been always viewed with misgivings, however, especially by crews flying bombers onto whose bomb loads these flares have been attached.

2. Two accidents occurred recently in which the flares were ignited because the bombs hung up and jammed in the bomb bay. Although the accidents resulted, fortunately, in only minor damage, it is strongly felt that the mechanically armed flare should be developed as rapidly as possible for use with the present project as well as future projects.

3. It is therefore requested that the Chief of Ordnance be asked to design a suitable mechanically armed flare in accordance with paragraph 6 of the reference letter and to coordinate the development with this command under the same conditions as in the reference letter.

For the Director:

G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

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[redacted]

MX-225
CENTRAL FILES

AAFMC-100-WF-5-20-42-2 M.H.

Y-117383

35

MATERIEL COMMAND ROUTING AND RECORD SHEET

INSTRUCTIONS: 1. Use full addresses for sender and addressees to facilitate routing.
2. Draw line across page after each comment.
3. Use whole sheet, both sides.
4. If addressed to two or more offices, first office receiving will readdress to next office on list.
5. See Office Memorandum 10-1 for full instructions.

Subject: Request for CTI Close-out. [redacted]

Comment Number | To: TSTEX | From: TSENG (TSEPL-314) | Date 20 December 1944
Dict. By Lt. W. H. Hess
Phone No. 3-5316

1.

1. Reference is made to CTI-1350 dated 5 June 1943. The action required therein has been completed as outlined below:

a. A high angle bomb controllable in azimuth, designated as VB-1 has been developed, tested, accepted, and standardized.

b. Contracts were negotiated by the Army Air Forces with Union Switch & Signal Company for a quantity of VB-1 units, type A-1. Portions of the quantities contracted for were manufactured, and the equipment used in combat. The VB-1 contracts were terminated approximately 1 October 1944.

2. It is, therefore, requested that subject CTI-1350 dated 5 June 1943 be closed out, since the provisions therein have been complied with.

MX-225

130

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[redacted]

MX-225 Y-119884

MC-360-WF-10-27-43-75M (Start comments on other side at this end)

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMIN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

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CONFIDENTIAL
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ATSC

Capt.J.H.Ober,
ATSTAX:lmg: Ext. 5-6147

6 January 1945

High Angle Controllable Bomb
in Azimuth.

Commanding General, Army Air Forces,
Office, Assistant Chief of Air Staff,
Materiel and Services,
Washington 25, D. C.

ATTN: Chief, Materiel Division.

1. Reference is made to your letter of 1 June 1943, subject: High Angle Controllable Bomb in Azimuth, as a result of which this Command issued CTI-1350, dated 5 June 1943, subject as above.

2. Inasmuch as the action required by the above referenced letter has been completed, CTI-1350 is to be considered closed.

For the Director:

J. H. OBER,
Captain, Air Corps,
Office, Chief of Administration.

cc: Procurement Division BCO-1
Engineering Division ECO-2
Supply Division SCO-3
Maintenance Division MCO-1A4

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RESTRICTED

Contrails & Memoranda
20-79

HQ OFFICE INSTRUCTION)
NO. 20-79)

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON, 1 JANUARY 1945

ORGANIZATION

Assignment of Guided Missiles Responsibilities
within the AAF

1. Scope and Purpose. Recent changes in emphasis in the guided missiles program make it advisable to consider guided missiles as a type of aircraft insofar as assigning the responsibilities to individual offices is concerned. This Instruction places the responsibilities for guided missiles in this Headquarters in the same channels now applicable to aircraft and aircraft equipment.

2. Definition. Guided missiles are to be considered as all missiles controlled in direction after launching by equipment in or remote from the missile.

3. Assignment of Responsibilities. Effective immediately, offices of this Headquarters are charged with responsibilities in connection with the guided missiles program as defined in AAF Regulations 20-1 and 20-46, and amendments thereto, with the following exception:

a. The Air Communications Officer is charged with completing the work through the stage of test introduction into theaters of those guided missiles projects which he already has under way which fall into the following category:

(1) Guided missiles which do not require any propulsion units, whether ram-jet, rocket, or more conventional means, and which have an electronics system of flight control.

Headquarters offices responsible for specific fields of guided missiles will assign guided missiles responsibilities to commands, air forces, and independent activities under the command of the Commanding General, AAF in accordance with the general plan of responsibilities outlined in AAF Regulation 20-1 and amendments thereto.

By command of General ARNOLD:

HEADQUARTERS ARMY AIR FORCES
OFFICIAL
WAR DEPARTMENT

BARNEY M. GILES
Lieutenant General, United States Army
Deputy Commander, Army Air Forces and
Chief of Air Staff

(AFR 11-30)

C5-5468, AF

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131

[redacted]

Capt.J.H.Evans:mep
Ext. 3-5316

TSEFL-314

13 January 1945

Tail Fuse for VB-1.

MX-225

Commanding General,
Army Air Forces,
Washington 25, D.C.

Attention: AC/AS M & S, Materiel Division,
Engineering Branch, Major J. F. Vogel.

1. The development of the tail fuse for the VB-1 (Azon) is now complete. This item carries the type designation of T-75 and is an anemometer type air-stream arming tail fuse. It comprises a cylinder 1 1/2 inches deep which mounts between the bomb and the tail assembly on the present mounting bolt and is designed to be fitted on all the VB-1 units now on hand.

2. In order to determine the production quantity for this tail fuse so that it can be made available for all the existing VB-1 units, it is requested that the location and quantity of all VB-1 units on hand in the United States and theatres of operation be forwarded to this office.

For the Director:

G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

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MX-225

(AFR 11-30)

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AAFMC-190-WF-5-20-42-2 Mil.

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A. S. C.
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[redacted]

AAF 470.9 (15 Dec 44) 1st Ind. AFDAO-4

Headquarters, Army Air Forces, Washington 25, D. C.

To: Director, Air Technical Service Command, Wright Field, Dayton, Ohio. Attention: TSEPL-3I4.

21 FEB 1945

1. The Office of the Chief of Ordnance has been verbally requested to investigate means of mechanically arming and igniting subject flares in accordance with your request. 9 JAN 1945

2. While military characteristics for subject fuze are stated in paragraph 6 of the referenced letter, it is requested that a re-statement of the characteristics should be made and forwarded to this Headquarters after coordination through the Ordnance Section, Area B (TSORD-1), for the following reasons:

a. Attention is directed to recent changes in the flares in use on VB-1, whereby all existing stocks of T6, T7, and T8 guide flares are to be replaced by T6E1, T7E1, and T8E1 flares, respectively. Production of these latter flares in sufficient quantity to provide for all VB-1 units, production of which has been discontinued, and for 3,000 VB-3 units, will be completed approximately 20 January 1945. It is therefore to be borne in mind that any change in the flares themselves as an effect of modification for mechanically arming and igniting them, will involve modification of all issued flares.

b. Since production of these flares will be completed before any definite decision may be made in regard to means of mechanical ignition, as is specified in the characteristics contained in the cited paragraph 6, it appears that electrical ignition of the flares is advisable, with an arming device actuated by air travel.

c. A more definite statement as to delay time prior to ignition of the flares is desired, preferably in terms of air travel in feet.

d. It is to be noted that limitations as to space will have a marked effect upon the design of a mechanical means of ignition, thereby contributing to the difficulties attendant upon a requirement for mechanical ignition.

3. Captain Vandenberg of the Ordnance Section (TSORD-1) has discussed basic letter with representatives of this Headquarters and the Office of the Chief of Ordnance, and additional details may be obtained from him.

By Command of General ARNOLD:

Basic 12/15/44

J. M. GRUITCH
Lt. Col., Ord. Dept.
Chief, Tech. Dev. Br.
AFDAO

[redacted]

V-117383 133

E. E. Mathewson Corp. 31

SECRET

Assembly of Azon Tail Units

Asst C/AS, M&S, Engineering Division

Asst C/AS, OCR, Requirements Division

Lt Col Fix/dr/2656

1

1. It is understood that various components for Azon tail units are in storage at a factory in sufficient quantity that 1000 complete assemblies could be secured. In view of the tentative requirement stated by the CBI theater, it is requested that these components be assembled into complete units ready for shipment so that they will be immediately available when the firm request from the theater giving shipping instructions is received.

S. F. GIFFIN
Colonel, G. S. C.

Bomb Br_____

M&E Sec _____

AFREQ/m_____

[redacted]

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4A

VB-1 (AZON) 1000 LB HIGH ANGLE AZIMUTH CONTROLLED BOMB

Progress and Availability

1. Very favorable reports have been received on the use of the VB-1 in the 10th AF. Of a total of 167 bombs dropped, there were 14 direct hits, 1 probable hit and 2 doubtfuls on bridges, the widest of which was 13 1/2 feet. Approximately 2% of the total bombs dropped mal-functioned.

2. The 10th AF plans to equip a complete group of B-24 aircraft for Azon and expects to also fit a P-38 "Droop Snoot" squadron to carry 2 VB-1's per aircraft.

3. Recent inventories of theater stocks reveal that the MTC has a total of 3,167 complete VB-1 tails which are available for redistribution. 600 have already been loaded for shipment to the CBI. The ETC reports 4,607 complete tail units but does not desire to release them for redistribution at the present time. The 360 complete units in stock in the continental United States have been allotted to ATSC for tests, primarily Spazon. The 300 units shipped from continental stock to the CBI theater early in November should arrive in mid February 1945.

4. During the end of November and in December, 18 Spazon bombs were dropped at Wendover, Utah. Of these bombs, 17 spun for the predetermined spin periods and stabilized and operated as a standard VB-1 to the end of the drop. During the spin period the bombs were observed, visually and by moving pictures and azimuth slit camera pictures, to have maintained an unusually tight formation, and the distance between bombs was estimated at [illegible] feet. The dispersion after the bombs stopped spinning was of such value as to indicate the normal Azon dispersion can be reduced by one-half or better.

a. The following tests are planned as soon as changes described in (b) below are completed:

(1) Drop tests at Wendover Field, Wendover, Utah about 1 February to test a new Spazon mechanism.

(2) Pass drop tests at Orlando Florida, in connection with project T-2822, "Moving Pattern in Azimuth" to determine effect of Spazon on this type of drop technique. The new Spazon mechanism will be used if it proves successful.

[redacted]

Sheet 1 of 2 23 January 1945 4A

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(AFR 11-30)

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[redacted]

VB-1 (AZON) 1000 LB HIGH ANGLE GRAVITY CONTROLLED BOMB (CONT.)

b. The mechanical time clock used in the original Razon was physically not reliable in its action and timing. A radio-controlled Razon has been developed, by which the first given control will cause the bombs to stabilize. In this manner all the bombs will be stabilized at exactly the same time since they are no longer operated on independent time clocks, but act at one signal. The versatility of the Razon is further improved because the operator can either stabilize the bombs and control them, or let them spin all the way to the target.

c. No production of Razon will be initiated until results of the February tests are known. Units for the tests are being fabricated by T2C.

5. A new improved flare has been developed for Azon and Razon. A total of 15,000 has been procured. Of this total 4,500 are T-4B1 (red), 6,500 are T-7B1 (white) and 4000 are T-8B1 (Green) flares.

6. Engineering is complete on the T-75 tail fuse and procurement is being initiated, CCC pending a more accurate determination of the production quantities required.

[redacted]

5 1887

[redacted]

VB-1 (AZON) 1000 LB HIGH ANGLE AZIMUTH CONTROLLED BOMB

Status and Availability:

1. The total completed is 14,071 plus 8748 extra Gyros, 5828 extra servos and 31,642 extra batteries.

2. On the "Spazon", tests at Wendover were started on 15 November 1944. A flare accident delayed the project until 25 November 1944. Due to rack failures to release on electrical impulse a mission was run carrying two Spazon bombs. The bombs were dropped by salvo. Results were considered successful, and an AAF Board test has been requested.

[redacted]

6 / 188

SECRET

4B

VB-2 (AZON) 2000 LB HIGH ANGLE AZIMUTH CONTROLLED BOMB

Progress and Availability

1. Necessary equipment is currently on hand at Orlando, Florida for service and evaluation tests by the AAF Board. Tests will utilize the new short-type guide flares designed for use with this missile. No estimate of the date of beginning of these drop tests can be offered since higher priority projects are necessarily given precedence over the middle priority of the VB-2 program. Some difficulty has been experienced with B-17 bomb bay clearance on this missile.

2. No production procurement versions of the VB-2 have been received pending the results of the Orlando tests. Although no tools have been made, development is complete and it has been estimated that the VB-2 could be in production within 90 days.

3. The CBI theater has evidenced interest in obtaining 300 VB-2 per month but no firm requirement has been established. This interest in the VB-2 may result in placing increased priority on this project to expedite service and evaluation tests.

[redacted]

28 January 1945 4B

C5-6380, AF

[redacted]

ASSISTANT CHIEF OF AIR STAFF, MATERIEL AND SERVICES
MATERIEL DIVISION

SECRET

By Authority of
The Commanding Gen.
Army Air Forces

28 Jan 1945 F.B.
Date Initials

PROGRESS REPORT

AAF

" GUIDED MISSILES DEVELOPMENT STATUS AND AVAILABILITY "

1. The attached sheets list progress on the items included in the subject summary.

2. It is recommended that only the following pages be removed from the previous summaries sent to your office:

a. Index of 18 December, 1944 - pages 1 and 2
b. Distribution List of 18 December 1944.

3. It is further recommended that the attached pages be placed in the summary in accordance with the new index. The first sheets of the following sections have been added to this report because of the error in printing them on the back of other section reports in the 18 December Progress Report: 1B, 1C, 1E, 2A, 2C, 3B, 3D, 3F, 3H, 3K, 4A, 4C, 4H.

4. No progress report has been included on the following missiles: XBC-1, 2 & 3, GB-1, GT-1, GB-4 GB-7C, GB-8, GB-9, GB-10, VB-5, VB-7, VB-8, VB-9, Towed Glider Bombs.

135

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135

28 January 1945 G5-6380, AF

IMMEDIATE ACTION

[redacted]

By Authority of
The Commanding General
Army Air Forces
AFDMA-2F/4
1 February 1945
Date Initials

IN REPLY REFER TO 413.44 VB

WAR DEPARTMENT

Subject: Assembly of Equipment for VB-1 (Azon) Installation in B-24 Aircraft

To: Director
AAF Air Technical Service Command
Wright Field, Dayton, Ohio
Attention: TSTEX

1. The India-Burma Theater has furnished this headquarters with a requirement of 50 aircraft installations for the operation of VB-1 (Azon) bombs. It is therefore requested that immediate action be taken.

a. To assemble the necessary equipment to completely equip 65 each B-24 aircraft for operation of VB-1 (Azon) bombs. This will provide for 50 installations and 15 spares sets.

b. To assembly the necessary spares, tool and test equipment for use with the above equipment.

c. To provide 100% spare antennas for the above sets of equipment.

2. Separate action is being taken to authorize the release of the controlled communication equipment required for the above sets of equipment.

3. A 1A priority is hereby assigned to this project.

4. It is requested that this office be immediately notified of the approximate date when the above equipment will be available for shipment.

By command of General ARNOLD:

D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engineering Branch, Mat Div
Office, Asst Chief of Air Staff
Materiel and Services

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(AFD [redacted]

X-31675

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Q. M. G. Form 586 (Old Form 492)
Approved December 1, 1922

IMMEDIATE ACTION

1050

7

[redacted]

7 FEB 1945

MEMORANDUM FOR: Budget and Fiscal Office
Army Air Forces

SUBJECT: Fiscal Year 1945 and 1946 Fund Requirements for Project 180, Guided Missiles

X45241 Radio Control Beam

1. A request has been received for an estimate of fund requirements, other than research and development, for guided missiles for the Fiscal Years 1945 and 1946.

2. The field of guided missiles is comparatively new and is still in the development stage. While there is a definite need for new types of weapons to fill certain types of missions, requirements for particular types have not yet been established as the relative merits of the various types cannot be definitely determined until further research has been made.

3. From general consideration of the projects underway and taking into account their relative progress in development and apparent merits, it would appear that approximately $100 million would be required to cover contracts (other than experimental contracts) which may be let during the Fiscal Year 1945. On the basis of information presently available, it is also estimated that approximately $150 million will be required for the Fiscal Year 1946. The estimate of $100 million for Fiscal Year 1945 includes approximately $18 million procurements made to date from Army Air Forces funds.

4. These estimates will be sufficient to cover procurement of approximately the following:

	Fiscal Year 1945	Fiscal Year 1946
VB-1, 2, 3 & 4	7,000	18,000
JB-2	8,000	12,000
VB-6	1,500	2,000

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7 FEB 1945

[redacted]

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OFFICE SYMBOL	1 AFDMA-2	2	3	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER						
INTERNAL OFFICE COORDINATION						

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The estimated cost breakdown is approximately as follows:

	Fiscal Year 1945	Fiscal Year 1946
VB-1, 2, 3, & 4 including 400 transmitters in 1945 and 500 in 1946	$17,000,000	$18,000,000
JB-2 including 15 control stations to be purchased in 1945 and 35 in 1946	70,000,000	110,000,000
VB-6	1,000,000	7,500,000
	$82,000,000	$135,500,000
Procurements to date (AAF funds only)	18,000,000	
Allowance for other Projects under consideration		34,500,000
	[illegible]	$[illegible]

5. The estimates above include the estimated cost of Air Forces and Signal Corps equipment with regard to VB-1, 2, 3 & 4's and VB-6's. At present standard bombs are being used and presumably there would be no additional requirement for procurement for these items. With regard to JB-2's the estimates do not include any amount for warheads and propellants (Ordnance items) and for launching ramps (Engineer item) or for organizational equipment for personnel. For 1945, included in the amount of $82 million, still to be procured is approximately $10 million for Signal Corps equipment applicable to VB-1, 2, 3 & 4's and JB-2's. It is understood that all items for the VB-6's, excluding the bomb, are and will continue to be procured by the Army Air Forces.

6. In writing up the justification, careful consideration should be given to the classification of the material used, as information regarding guided missiles projects carry high classification.

(Signed) JOHN C. MOORE
Colonel, Air Corps

E. M. POWERS
Brigadier General, USA
Deputy, AC/AS, M & S

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[redacted]

OFFICE SYMBOL	1	2 AFDEO	3 AFAMS 2A	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER	[illegible]	[illegible]	JCMoore			
INTERNAL OFFICE COORDINATION						

16—90242-1 U. S. GOVERNMENT PRINTING OFFICE

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[APPROX. 10 FEB. 1945]

MEMORANDUM FOR RECORD

SUBJECT: Meeting of Division 5, N.D.R.C.

1. Meeting was convened on 1430, 8 February 1945, National Academy of Sciences, by the new Chief of Division 5, N.D.R.C., Mr. Hugh Spencer. This meeting followed a closed morning session at which the policy to be followed by Division 5 for the duration of its existence. Since there are no provisions for continuing NDRC into the post war era. Division 5 intends to:

a. complete present development programs but undertake no new complete project.
b. furnish control components as requested by the services.
c. act as advisors to the services.

This program of future action will be presented to the J.A.C. panel of the Joint Chiefs of Staff for concurrence.

2. Dr. Hugh Dryden - Washington Project - explained the activities of this group were chiefly concerned with the GAT Glide Bomb project. Work has concentrated on increasing maneuverability. Present estimates are that 30 to 40% hits can be obtained on targets such as merchant ships. Test research has been stopped by the diversion of test personnel to man several squadrons to send overseas with GAT for operational theater tests.

3. Dr. Greenfield - Pittsburgh Project - told of the activities on the VB-1, VB-2, VB-3, VB-4 program. He told of the highly successful [illegible] results with VB-1, the continuing [illegible] tests on the new tail fins developed for the VB-1. Studies are [illegible] to shorten the VB-2. NAF Navy will start drop tests soon on the VB-3. The evaluation of the Whole Shroud on the VB-3 is expected to provide a device with accuracy of within 30 ft. in range; with 30 to 40 ft. in range possible with slighting improvements; azimuth accuracy practically same as VB-1.

4. Dr. Hartz - Philadelphia project - principal activity is the development of "Spino television" for the [illegible] project. Tests are expected in February or March. They expect to receive six equipments by 28 February and four more by 20 April. 150 units are on order for the Army. The range in the Philadelphia test was good at 10 miles with 6 watts output.

5. Dr. Boyce - Douglas Project - All [illegible] tests are conducted with "directional control." Azimuth control is good; range control is not satisfactory but improving. Of the next 30 [illegible] tests, 25 are expected to be conducted with Ideo equipment.

6. Dr. Boyce - Felix Project - Many manufacturing bugs still continue but they are slowly being eliminated. The device has definite limitations for successful application and should not be oversold. Dr. Denis explained

-1-

Copy for Col. Brown

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that Felix seems to select one target in a complex target and stick to it. Future test program is: a. Single bombs on single targets, b. Several simultaneous bombs on one target, c. Several dropped simultaneously on complex targets, d. Tests through overcast with radar sighting. Production engineering is almost complete but drop tests will continue and target evaluation by photo reconnaissance and the heat seeker unit will continue.

7. Other interesting comments included on explanation that one heavier bomb was superior to two lighter bombs in causing "spreading collapse" on certain structural targets. This information was from a civilian member of General Sanfords Joint Target Group, Joint Chiefs of Staff. Mr. Spencer also reiterated the coming need for "secure" radio control systems.

JOHN F. VOGEL
Major, Air Corps
(AFDMA-2G)
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AAFMC-[illegible]-M

[redacted]

P-1

ARMY AIR FORCES

AIR TECHNICAL MATERIEL COMMAND SERVICE COMMAND

ENGINEERING DIVISION

MEMORANDUM REPORT ON

Lt. J. S. Capps/mep
Ext. 35516

SUBJECT: Azon Project MX-500.

Date 13 February 1945

OFFICE M-[illegible]-314

Contract or Order No.

SERIAL No. [illegible]-673-52

Expenditure Order No. 673-52

A. PURPOSE:

1. To report on a trip to Eglin Field Army Air Base, Florida from [illegible] November to 6 February in which time steps were taken to determine modification necessary to expand the possible use of VB-2 (2,000 lb Azon).

B. PERTINENT DATA:

1. Personnel present were:

N. D. R. C.	Air Technical Service Command
Mr. Glenn Palmer	Captain J. H. Evans
Mr. [illegible] Wollan	Lt. J. S. Capps

2. Measurements were made to determine the number of VB-2 bombs of the original design that could be loaded in the conventional manner in various airplanes.

3. Changes were made in a few samples of VB-2 by Air Technical Service Command personnel with the cooperation of National Defense Research Committee personnel sufficient to permit its use in a B-17 airplane. (See Appendix 1). The bombs could then be loaded in a conventional manner except that the back plate with a flare attached was mounted last and separately. Those B-17's using the mechanical salvo system require that the revised sample be tilted 5° from the level position. This discrepancy can be made up in adjustment of the gyro contacts but necessitates the preparation of "left hand" gyros and "right hand" gyros for use in corresponding bomb bays.

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Memorandum Report Number TSEPL-3-673-52
13 February 1945

4. One sample was dropped from a B-17 airplane from 15,000 feet to determine the effect of the changes on controllability.

5. One sample was made up complete with a sample fuze and anemometer crudely fabricated to comply with known requirements for space. It was found that the fuze must be of such dimensions that the center of the arming shaft is between 1 11/16 and 1 15/16 inches from the seating face of the locking ring when the ring is within limits of adjustment. The end of the fuze must not extend more than 3/4 inches beyond the rear end of the bomb itself.

6. Six more YB-2 units were taken to the Orlando sub-depot for the same modification and 32 were taken to Gulf Research Laboratories in Pittsburgh, Pennsylvania for a more complete modification to make them suitable for test samples. Certain changes were discussed from the standpoint of their practical use in the field. (See Appendix 2).

7. Tests with the modified units are to be resumed in the near future and all difficulties in loading of the final design and in its use are to be determined before production of the units is begun.

C. CONCLUSIONS:

1. That the dimensions of the original design are such that none can be loaded in a B-17, two in the rear bomb bay of a B-24 none in the front bomb bay, one in a B-25 and eight in a B-29.

2. That the overall dimensions and arrangement of parts can be changed enought to permit loading of the YB-2 in either bomb bay of a B-24 or a B-17 after the bomb itself is in place.

3. That the first drop of the new design indicated no appreciable change in controllability of the bomb due to the proposed changes in dimensions.

4. That the proposed changes will still permit the use of a tail fuze and an anemometer for arming purposes.

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MX-590

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Memorandum Report Number TSEPL-3-673-52
13 February 1945

D. RECOMMENDATIONS

None -- Data merely submitted.

Distribution:
AC/AS M & S (5 copies)
Equal. Br. Tech Data Lab. (TSEAL-6D)
Service Engineering Sect. (TSEE-411)
Div.5, NDRC, MIT, Cambridge, Mass.
Sect. 5.2, NDRC, Union Switch & Sig. Co. Pittsburgh
Attn: Dr. L. C. Grondahl.

Prepared by
John S. CAPTS, 1st Lt. S.C.

Approved by
G. V. HOLLOWAY, Colonel, A.C.
Chief, Equipment Laboratory.

Approved by
H. Y. SMITH, Lt.Colonel, A.C.
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

[redacted]

Concurrence:
[redacted]

MX-590

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Memorandum Report Number TSEM-3-673-52
13 February 1945

APPENDIX 1.

The following changes were made in the first sample of the modified tail:

On the back plate

a. The back cover plate was removed and a hole approximately 5 3/4 inches in diameter was cut in the center.
b. A steel cup, 2 1/2 inches deep 5 5/8 inches internal diameter with a slot 3/4 inches wide for the flare plug was welded in the hole in the back plate so that it was inserted into the end of the housing 1 1/2 inches.
c. The bare terminals onthe top of the servo-mechanism were relocated to avoid contact with the flare cup when the back plate was attached.
d. The flare arming relay was removed. (This may be replaced with a Tung-Sol relay of the type used in VB-1 or two Ting-Sol relays in cascade).

At the front

a. Internal reinforcing plates for the corners of the body were removed. (These may be relocated further down inside the body as desired.)
b. The leading edges of the four fins were cut square from a point 2 in. from the leading edge of the corner posts of the body.
c. The forward edges of the body were cut back 1 3/4 inches and the flanges were reformed for securing the tail to the collar.
d. The four corners of the body were bevelled from the front edge of the joint with the fins to a point 2 inches back along the inside edge.

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Memorandum Report Number TSEPL-3-673-52
13 February 1945

APPENDIX 2.

The following additional changes are being considered in the modification by Gulf Research Laboratories:

On the back plate

a. The flare can may be inserted in the back plate another 3/8 in.
b. The back plate may be secured by quick-acting fasteners instead of 12 individual screws.

At the front

a. In order to prevent the collar from sliding too far up the end of the bomb, the diameter of which is not held to close tolerances, some form of stop may be employed inside the collar and the skirt made of thinner metal, slotted to fit every bomb.

b. Some new bracket will be necessary to support the anemometer on the collar and the body of the tail will have to be cut accordingly.

c. The body may be cut back only 1 3/8 inches instead of 1 3/4 inches if the flare can is inserted 3/8 inches farther. This may be desirable to avoid having to alter the receiver mounting bracket to accommodate the arming shaft.

[redacted]

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Suspense 25 Feb 1945 **SECRET** #11

Assembly of Azon Tail Units

AC/AS, Operations, Commitments and Requirements
Munitions and Missiles Unit — 13 Feb 45

AC/AS, Materiel and Services — Major Vogel/mjr/6901 — 2

1. The stocks of VB-1 components and materials which ATSC had ordered shipped to storage or salvaged have been frozen for a period of 30 days. However, in view of late discoveries as regards the availability of some VB-1 components, orders have not been issued to assemble additional tail assemblies as requested in Comment 1 above.

2. The best records available to this office (as of 1 Dec 44) indicated the following components were supplied over and above those required for the 14,071 VB-1's assembled:

Gyros - - - - - - - -	8,748
Servo Units - - - - -	5,828
Batteries - - - - - -	31,642
AN/CRR-2 (Radio Receiver)	8,529

A report of 1 Oct 1944, indicated the following AN/CRR-2's delivered by specific manufacturers.

Emerson- - - - - - -	16,666
General Electric - -	8,000
Total Delivered	25,005

3. The inclosed copy of a memo for record on a conference on receivers for VB-1 held on 10 Feb contains additional availability information.

4. With the exception of the radio receivers and tail assembly which houses the components, the necessary components are available for approximately 5000 additional VB-1 assemblies.

5. Request that the requirements for additional VB-1 be reviewed and restated. Should such a statement of requirements be considered as interim requirement until VB-3 is available or as supplementing VB-3. This latter statement is required to determine if more AN/CRR-2's should be produced even though not entirely satisfactory or wait for the later production of the AN/CRR-7.

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Cy of IDW 13 Feb

M. G. DUBELLEY
Colonel, Air Corps
Chief, Engr. Dr. Mt. Div.

Copies To: [redacted]
Lt. Bickham
Mr. Todd

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Azon
Lgcc. Proj. R. Group Div. - 2-(1 of 4)
ACO

#4

HEADQUARTERS ARMY AIR F[redacted]
INDIA BURMA THEATER
APO 671

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17 Feb 1945

AIR 471.6

SUBJECT: Guided Missiles.

TO: Commanding General, Fourteenth Air Force, APO 627.

INFO: Commanding General, Army Air Forces, Washington, D. C.
Commanding General, United States Forces, India-Burma Theater, APO 885
Commanding General, United States Forces, China Theater, APO 879
Commanding General, United States Forces, China Theater, Rear Echelon, APO 627.

1. With further reference to our radio CBX 2414, APO, 31 January 1945, and in accordance with your letter 471.6 dated 2 February 1945, we are submitting information pertaining to Azon (azimuth control only) bombs, based on operations in this theater.

2. The Azon (VB-1) consists of a special tail attached to the 1000 lb. general purpose bomb. The tail assembly contains a radio receiver, two gyros, a small storage battery, rudders and ailerons, the necessary mechanism for operation the latter, and a flare. When the bomb has dropped a out 4000 feet the flare ignites, permitting observation of the flight path of the bomb. By operation of a small left-right control lever on the transmitter in the aircraft, the bombardier controls the flight path of the bomb, keeping it on a path coincident with the direction of his line of sight to the target until the moment of impact.

3. Control of the bomb is possible in azimuth only, therefore Azon is best employed against long, narrow targets, such as bridges, railroads and roads. The greater the amount of control the bomb is subjected to after leaving the aircraft, the shorter its range becomes.

4. The best results have been obtained with single bombs individually controlled. If more than one bomb is in flight at the same time, it is very difficult for the bombardier to distinguish which is his own particular missile. Further, it is desirable that after the bomb is released the aircraft continue in the direction of the bombing run so that deviations in the azimuth may be observed and corrected readily. This procedure results in aircraft remaining in the target area longer than normally, exposed to enemy defenses. However, the overall result in terms of target damage results in considerably less time under fire, than in the more usual procedures.

5. The average bombing altitude has been about 10,000 feet. Release from lower altitudes is possible but the height of flare ignition and the control period desired are limiting factors. The chances of success are slight if the undercast is more than five-tenths. Enemy counter-measures in the form of electronic jamming on the transmitter frequency and smoke pots in the target area must be anticipated, although such interference has not been met in this theater.

6. Azon (VB-2), similar to VB-1 in all technical respects, consists of a 2000 lb. bomb which, being a heavier bomb, does not respond as readily to control. [redacted]

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Spec Proj Br Engrg Dec (2/44) 45- [redacted]

3.

7. The following three films; Azon, Razon and Guided Missiles, are being sent to your Headquarters immediately by air shipment.

8. The following data indicates the success of Azon employment in this Theater:

Date	VB-1 Bombs Expended	Destroyed
27 Dec	12	Pyinmana Bridge (330 ft.)
30 Dec	25	Okshitpin (250 ft.) Nyaungchidauk (310 ft.) Nyaungchidauk By-pass (310 ft.) Taungup Bridge (350 ft.)
3 Jan	14	RR Bridge #120 (300 ft.) #121 (150 ft.)
2 Feb	16	Jumbhorn RR Bridge (360 ft.)
7 Feb	36	RR Bridge #120 (300 ft.) RR Bridge #121 (150 ft.) #83 (150 ft.) #97 (210 ft.) #68 (140 ft.)

For the Commanding General:

H. M. Schwab,
Lt. Col., T. G. D.
Adjutant General

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(AFR 11-30)

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File VB-2 file

SQUADRON H BOMB (H)
903RD AAF BASE UNIT (BOMBARDMENT)
PINECASTLE ARMY AIR FIELD
AAF TACTICAL CENTER

19 February 1945

SUBJECT: VB-2 Tests at Pinecastle Florida

TO : Director, Air Technical Service Command, Engineering Division, Equipment Laboratory, Wright Field, Ohio.(Attn: Special Weapons Branch, Capt. J. H. Evans)

1. The following information has been obtained on tests conducted at Pinecastle Army Air Base on the VB-2 between 6 February and 16 February, 1945.

2. Two VB-2's which were modified at Pinecastle in the same manner as that which was taken to Pittsburgh were dropped from 15,000 ft. One was given right control for the entire drop after the first 12 seconds and the other was given left control in the same manner. Three 100 lb. spotters were dropped with each to give a reference position and these fell short of the Azons approximately 1,800 ft. The bomb given right control went 1,800 ft. to the right and the left bomb went 1,160 ft. to the left. This deflection is considered to be considerably less than expected from the bombs before modification but the modified bombs were stable and these results were felt to be encouraging.

3. Six VB-2's were modified at the Orlando sub-depot in the same manner as the others and were dropped individually. The first was dropped for a road intersection from 20,000 ft. and good control was noted but considerable range error made the results hard to interpret. The second was dropped in the same manner but the bomb was observed to spin from the time it left the racks and control was not effective, the bomb falling far beyond and to the left of the aiming point. Two bombs were dropped from 22,000 ft. against a road and these controlled well, falling 50 and 200 ft. to the right respectively. The last two were dropped from 20,000 ft. against the same target, again controlling but falling 150 to 200 ft. to the right.

4. The last four bombs all crossed over the road close to the aiming point which was an intersection and there is some question if the bombardier attempted further control after this point was passed since the films indicated a continuation of the last control beyond the target road. This was not checked and may be incorrect in which case the errors recorded may be attributed entirely to the fact that this design bomb is mare unwieldy.

5. Further tests on the VB-2 are awaiting the modified units from Pittsburgh. These are expected within the next ten days and it is hoped that final tests can be made with the new design fuzes.

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John J. Capps

[redacted] JOHN J. CAPPS
1st Lt. C
Sig. C

X-51084

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"Requirements for Mechanically Armed Flare for High Angle Bomb, Project MX-225."

2nd Ind. TSEWL-3IL/WHH/mep

HQ AAF ATSC Wright Field, Dayton, Ohio, 21 FEB 1945

TO: Commanding General, Army Air Forces, Washington 25, D.C.
Attention: Air Ordnance Officer, AC/AS M & S.

1. Reference is made to paragraphs 2a and 2b of the preceding 1st Indorsement. It is realized that the quantities of T6E1, T7E1, and T8E1 produced already would present a complex problem if attempts were made to modify them. However, guide flares produced in the future could incorporate a mechanical means of ignition.

2. It is therefore requested that some means of providing mechanical ignition with mechanical arming be given continued attention.

3. As requested in paragraph 2 preceding 1st Indorsement (in which it is believed the word "fuse" is intended to be "flare") the characteristics of such mechanically armed and mechanically ignited flare are partially listed below:

a. Candle power - 1,000,000 cp.

b. Maximum dimensions of flare only, not including arming device, should not exceed an amount of space equal to a cylinder of diameter 9 1/2 inches and height 5 1/2 inches.

c. General shape - Any shape but not exceeding dimensions in b above.

d. Maximum altitude for ignition - 30,000 feet MSL.

e. Distinctive colors - As many as feasible.

f. Type ignition - Mechanical.

g. Delay before ignition - Will be dependent upon the design or designs of flares w th arming device considered by Ordnance. Should be approximately 5 to 7 seconds or about 2000 to 2500 feet of air travel. This delay should be incorporated in the arming mechanism, preferably an adjustable one, and ignition should be almost instantaneous after arming.

h. Minimum burning time - 50 seconds.

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copy of basic already in record files, attached is copy of 1st Ind. mg

CENTRAL FILES

CRITICAL USE ONLY (AFR 11-30) Y-117363

COM. GEN.
TECH. EXC.
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PROD. CONT.
I. P. S.
A. S. C.
TECH. DATA
CIV. PERS.
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OTHERS

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2nd Ind. TO: CG,AAF, Wash. D. C.
Attention: Air Ordnance Officer, AC/AS M & S.
"Requirements for Mechanically Armed Flare for High Angle Bomb, Project MX-225". 21 FEB 1945

4. Further specific characteristics are dependent upon the various types of air arming devices that are available or that might be considered for development for use with the above mechanically ignited flares; further information regarding the general physical characteristics which would probably be incorporated by the Ordnance Department in such arming device would be great assistance to this office.

5. For use in the period during which such mechanically armed and mechanically ignited flares would be under development and for use with the considerable quantities of T6E1, T7E1, and T8E1 flares that have already been or shortly will be manufactured, a type of electrical ignition for use with an arming device actuated by air travel would be advisable, as suggested in paragraph 2b in preceding 1st Indorsement. This could be accomplished by a device incorporated into the present flare ignition circuit and thus provide a safety factor in addition to the present Tung-sol switches. Personnel of this office have experimented with the use of a micro-switch mounted on a modified guide bracket for the T75E1 fuze. This modification was recently brought to the attention of Major Hopkins and Mr. Fagan of the Office, Chief of Ordnance, by Captain R. H. Vandenberg of the Aviation Ordnance Engineering Office, Air Technical Service Command.

6. It is requested that a project be initiated to develop a device which can be incorporated into the flare arming circuit in the form of an additional electrical safety switch. This device should preferably be mounted on a modified guide bracket of the presently developed T75E1 fuze and should provide for approximately 400 feet of air travel before the flare circuit is positively closed. The use of a micro-switch operated by the arming pin of the T75E1 fuze is offered as a suggestion. It is desirable however that the device developed be of such compactness as to enable it to be installed within the confines of the fuze recess in the base plug of the 1000 pound AN-M65 and within the cup-shaped part of the tail plug threaded for the tail fin retaining nut for the AN M-66 2000 pound bomb without extending to the rear of the fuze. If the device is not of such compactness, it could conceivably utilize 180° of space on the side of the fuze opposite the arming mechanism stem but in any case should not extend beyond the space limitations determined by the rear extremity of the fuze. Drawings of VB-3 are in the possession of Major J. R. Hopkins, Ammunition Development Division, Office, Chief of Ordnance.

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2nd Ind. TO: CG, AAF, Wash. D.C.
Attn: Air Ordnance Officer, AC/AS M & S.
"Requirements for Mechanically Armed Flare for High Angle Bomb, Project MX-225." 21 FEB 1945

7. It is requested that action be initiated to develop the device discussed in paragraphs 5 and 6 above in sufficient time that it may be utilized on production of VB-3 tail assemblies. An amount of 3150 VB-3 tail assemblies are to be produced on the following schedule:

a. 20 units by 1 April 1945.

b. 130 additional units by 15 May 1945.

c. 225 additional during July 1945.

d. 500 additional during August 1945.

e. 1000 units per month thereafter.

It is requested that detailed information relative to the development of the above requested air arming electrical switching device be furnished as soon as possible in order that it can be determined when to begin including additional wiring and plugs necessary in VB-3 tail assemblies.

8. This correspondence has been coordinated with the Aviation Ordnance Engineering Section (TSORD-1) of this command.

For the Director:

S P Stewart
for G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

[redacted]

Y-117383

CONFIDENTIAL

NATIONAL DEFENSE RESEARCH COMMITTEE
Building 23
Mass. Institute of Technology
Cambridge 39, Mass.

March 1, 1945

MEMORANDUM FROM: Division 5 Headquarters

TO: Division Personnel and Liaison Officers

The following material is quoted from a letter of Mr. T. J. O'Donnell who recently returned from a tour of duty as Technical Observer in the Burma theater in connection with the Azon project:

"I left Miami December 3, 1944 with Major W. Dorice of Fort Dix Army Air Base, after waiting a week for a shipment of test equipment which was to accompany us to the theater. We reported to H. Q. India-Burma Theater December 8 and were sent to H. Q. Eastern Air Command December 9. There we were taken in tow by Mr. F. D. Lamont, civilian Technical Consultant to Col. Knowlen, Air Communications Officer, A.A.F. I.B. Theater. Mr. Lamont was of considerable help and enabled us to get started much sooner than we might otherwise.

We found that the AZON project had been assigned to the 7th Bombardment Group, the only heavy bomb group in the 10th Air Force. The chain of command between the 7th Group and Eastern Air Command runs in parallel channels thru H. Q. 10th A. F. for administrative functions and Strategic Air Force for operations. We had no occasion to deal with H. Q. 10th A. F. Strategic Air Force is a combined U.S.A.A.F. - R.A.F. affair commanded by A/C Millerch.

We explained our gadget, discussed its possibilities, and showed films of AZON and RAZON drops to everyone in Eastern Air Command interested, including Brig. Gen. Bedeko, chief of operations, the heads of the communications, armament, ordnance and intelligence sections and their minions and to A/C Millerch and Col. Lynd, his chief of operations in Strategic Air Force. A/C Millerch was enthusiastically receptive to the idea of using AZON, which was fortunate, since he was in a position to assign missions and targets to 7th Bomb Group.

The Eastern Air Command targets were mainly on the Jap lines of communications - a rail line from Rangoon through Mandalay to Lashio, with several short spur lines supplying the north Burma front; a rail line north from Rangoon to Prome and a road running west and north from Prome to the Arakan front; and the famous Burma-Thailand railway, running from Bangkok to Moulmein and then to Rangoon. Because of Allied naval interference with Jap shipping,

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the major portion of their supplies had to be routed east of the Malay peninsula to Bangkok. Hence, the Burma-Thailand railway was of highest strategic importance. Destruction of bridges, of course, was the most effective means of cutting communications and bridges constituted the majority of targets. They had been attacked by fighters, mediums and heavies at altitudes ranging from six or seven thousand down to three-hundred feet--the latter altitude being most effective but very dangerous, especially for the heavy bombers. We were worried by the fact that few of the bridges were as long as 500 feet and as a result were hightly conservative in our predictions of the possible effectiveness of AZON.

On December 17, immediately after the arrival of our test equipment, we left for the 7th Bomb Group. Here the reception was cold and the prospect discouraging. The group had been previously assigned other "long hair" projects which had never been followed through beyond their initial disappointing efforts. It was quite apparent that AZON had to get a successful start to have any chance of proving itself.

An AZON maintenance team of an officer and 10 men, and 10 air crews with AZON-equipped B-24's had been trained at the Fort Dix Special Weapons Training School and sent to the theater in August, 1944. When we arrived, no AZON missions had been assigned. Only three AZON ships were on the field, three having been lost, and four were being used on the gas haul in China. The air crews were scattered among four squadrons and none were in China. The maintenance team was intact but had no equipment except the sketchy minimum we brought with us. Transportation was on a hitch-hiking basis, since we naturally had lower transportation priority than such essential departments as the chaplain, the Red Cross and Special Service. Power supplies were inadequate. Tools were not obtainable.

It was decided to concentrate AZON in one squadron, the 493rd, and to bring the AZON aircraft back from China. However, it took considerable argument and some harsh words to get enough AZON-trained crews for even the first missions.

Group operations believed it was quite practicable to make several passes at each target because of the light opposition usually encountered in Burma. This allowed the ideal utilization of AZON bombing-- each ship dropping and steering one bomb per pass. The formations consisted of flights of six ships of two elements of three each in close trail. In general, there were fewer than six AZON ships in the formation. The remaining places were taken by standard ships which salvoed on the first pass and thereafter simply

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went along to maintain the formation. The lead bombardier sighted for course and rate. Each other bombardier "killed" his own rate.

For the first mission, December 27,-- a relatively short one requiring no bomb bay tanks,-- 8 bombs were carried in each of three AZON ships, four AZON and four standard M-65. The target was a 3-span steel railway bridge, 380 feet long, at Pyinmana on the line between Rangoon and Mandalay. The first pass was made at the tracks 7 or 8 miles from the bridge for practice. Three passes were made at the bridge, with one AZON and one standard bomb dropped on each pass, all at 9300 feet. The center span of the bridge was destroyed and another span damaged with the expenditure of 9 AZONS. The standard bombs all missed. The bridge had been attacked various times over a period of two years without damage.

On the second mission, December 30, one bridge was assigned with two alternates. All three were attacked and in addition, a fourth bridge which had been attacked unsuccessfully by another squadron the same day. All targets were road bridges on the supply line to the Arakan front. All four were destroyed by AZON with a total expenditure of 20 bombs dropped from 4 ships at 10,000 feet. The targets were a 225-foot steel road bridge at Nyaungchidank on the Taungup-Prome road, a 75 foot wooden bridge 500 feet away, used as a by-pass for the main bridge, a 200 foot steel bridge at Okshitpin and a 400 foot steel and concrete bridge at Taungup.

All the succeeding missions were flown against bridges on the rail line between Bangkok and Moulmein, the bridges usually being known only by a number.

On the third mission, January 1, four ships carrying four AZONS each attacked three bridges at 10,500 feet. The weather was bad with 4-10ths to 10-10ths cloud cover. One bridge was definitely knocked down. The other two were rated as possible but doubtful.

On the fourth mission, January 3, three ships carrying 6 AZONS each at 8000 feet attacked two bridges and a section of tracks. One bridges was knocked out, the other probably damaged, and three direct hits were made on the tracks.

On the fifth mission, January 8, 6 ships carrying 6 AZONS each attacked 4 bridges at 10,000 feet. Three bridge were knocked out and one left undamaged.

On the sixth mission, January 9, three bridges were attacked by three ships carrying four AZONS each, at 10,500 feet. Two were knocked out and the third undamaged.

 [redacted]

On the seventh mission, January 11, two bridges were attacked by five ships carrying five AZONS each, at 10,500 feet. Both bridges were destroyed. Some anti-aircraft was encountered on this mission, but no damage was done to the ships.

On these 7 missions, a total of 154 AZONS were dropped. Fourteen bridges were listed as knocked out with full confirmation obtained from either photographs or from crew observation from flights near the target after the smoke had cleared. In addition, one bridge was considered "probable" and two as "possible but doubtful". Of the 154 bombs, about 35 were wasted for various reasons— the majority being salvoed because of engine trouble, a few being released late because of rack malfunctions, and a few wasted by personnel failure. Other bombs were "wasted" in the sense that more hits were obtained than were necessary to destroy some of the targets. The overall economy of AZON bombing on these seven missions is somewhat startling. At least 35 of the AZONS were either direct hits or close enough to damage the targets. This does not include bombs that fell over or short of the bridges and damaged roads or trackage. Conservatively, we can say that one out of five AZONS gave a damaging hit. I do not have available the figures on standard bombing of bridges in the I. B. theater, but I should say that one damaging hit out of fifty bombs would be an over-optimistic guess. On this basis, conservative for AZON, optimistic for standard bombing, AZON is ten times as effective against bridges as standard bombing or one AZON squadron is equivalent to two and a half standard groups.

The success of the first two missions aroused great enthusiasm not only in the group but also in the theater. Non-AZON crews began to feel that they were having to use inferior weapons. The fact that the entire installation in the airplane weighs only 100 lbs., has no effect on the use of the ship for standard bombing, and will not have to be modified for RAZONS, was a strong argument for equipping the whole theater. At the moment, the supply problem and the troop basis are retarding factors and equipment has been authorized only for the rest of the 7th Bomb Group.

Major Donies and I were asked to try to expedite the shipment of equipment in order to permit some bombing before the monsoon which is expected to start in May. The shipment is to include one Fort Dix maintenance team of an officer and 25 men, their test equipment and tools, and modification kits for 50 B-24's. The theater has also requested 700 VB-1's and 300 VB-2's per month. It appears unlikely now that production will be started on VB-2 unless the requirements are raised considerably. Increased requirements might result

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[redacted]

from the 14th Air Force and 20th Bomber Command, both of which are interested in AZON, but have not yet requested it.

I have no new recommendations to make as a result of this trip, but would like to reiterate some of the old ones. The crying need is for a better radio receiver. It is to be hoped that the one under development for RAZON will fill the bill. More radio frequencies would be desirable with at least one more as the absolute minimum, since a flight of six ships is the smallest desirable combat element. Better photography, especially the use of movie cameras on all combat operations, is highly recommended. Most important in my opinion, is the old idea of creating an autonomous special weapons unit of at least group status complete with trained personnel, air and ground.

* * * * * * *

The work of the air crews and ground maintenance team trained at Fort Dix was first class. It is to be hoped that replacement air crews for the 7th Group be given a short course at Fort Dix before being sent overseas."

This letter from Mr. O'Donnell which was addressed to Dr. Eckhardt, his superior at Gulf Research and Development Company, is so complete that I could not refrain from sending it to you substantially in its entirety.

Very truly yours,

Hugh H. Spencer

Hugh H. Spencer
Chief, Division 5, NDRC.

[redacted]

10

[redacted]

Secret by authority of
CG AAF
26 FEB 1945
Initials

Col Travelli/724
Mrtn 24 Feb 45
Room 4E 120

2 MAR 1945

MEMORANDUM FOR ASSISTANT CHIEF OF AIR STAFF, MATERIEL AND SERVICES:

Subject: Controlled Missile Program

1. Under the provisions of the directive to this office from the Deputy Chief of Air Staff dated 28 December 1944, subject: "Controlled Missiles," a preliminary survey of the controlled missiles field has been made. The first conclusions that became apparent were that the development effort has been handicapped and that it has not been as productive as possible because of the lack of statement of military characteristics and requirements. This office has a study in progress here, and in addition has established a project with the Army Air Forces Board to recommend the required military characteristics for all missiles pertinent to this program. These characteristics will be forwarded as soon as possible.

2. In the meantime there are certain fundamental concepts which we hold towards which development should be pointed, if the results are to be tactically useful. These are summarized briefly as follows:

a. Guided missiles must be suitable for all-weather uses, and must be particularly suitable for use in bad weather when normal bombing cannot be accomplished.

b. Controlled missiles if they are to be carried must be designed so that they can be carried internally in the aircraft.

c. Controls should be of target seeking nature when possible, or when control is exerted from the aircraft, it should be such that the airplane can take normal evasive action, preferably staying at least 25 miles from the target.

d. The missile should be suitable for multiple release and control.

3. With these concepts in mind the individual projects have been analyzed with the following tentative conclusions:

a. Glide bombs. As long as glide bombs must be carried externally on aircraft, even the most perfected weapons would have only limited application. Every effort should be made to develop missiles having glide bomb characteristics that can be carried internally and when launched have speed sufficient to make them a very much harder target to hit from the ground than they are at the present time. The development of target seekers against land or water bourne targets must continue, but because of the factors above, the following comments on each project are made:

OFFICE SYMBOL	1 AFRDW	2 AFRDW	3 AFCCR	4 ACC-	5	6
SIGNATURE OF RESPONSIBLE OFFICER	[illegible]	[illegible]	McKee	[illegible]	[illegible]	
INTERNAL OFFICE COORDINATION	[illegible]	[illegible]	Hill	[illegible]		

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(2) GB-1 (Preset GB-1 with Torpedo) - No tactical requirement beyond the project already established.

(3) GB-4 (Television) - No tactical requirement.

(4) GB-5A (Light Contrast Seeker) - No tactical requirement.

(5) GB-5C (Light Contrast Seeker) - No tactical requirement.

(6) GB-5D (GB-13) (Flare Seeker) - No tactical requirement. The use visualized by O.S.S. does not appear sufficient to this office to warrant the special effort required to put this item in tactical operations.

(7) GB-6 - Of definite interest tactically if it can be developed with folding wings and the control system perfected.

(8) GB-7A (Radar Seeker) - No tactical requirement.

(9) GB-7B (Radar Seeker) - Possible tactical requirement if completely developed.

(10) GB-7C (Enemy Radar Seeker) - No tactical requirement.

(11) GB-8 (Visually Guided) - No tactical requirement.

(12) GB-9 (Ground Skimmer) - No tactical requirement.

(13) GB-10 (Television in Nose) - No tactical requirement.

b. Vertical Bombs.

(1) VB-1 (Azon, Azimuth Control, 1000 lb) - This should be continued in development to complete the Spason phase.

(2) VB-2 (2000 lb Azon) - Tactical use expected.

(3) VB-3 (Razon, Azimuth and Range Control, 1000 lb) - Tactical use expected.

(4) VB-4 (Razon 2000 lb) - Tactical use expected but definitely on a lower priority than VB-3.

(5) VB-5 (Light Seeker, 1000 lb) - No tactical requirement.

(6) VB-6 (Felix, Heat Seeker) - This should be completed in development as rapidly as possible.

(7) VB-7 (Television, 1000 lb) - Possible tactical usage when suitable television is available.

(8) VB-8 (Television, 2000 lb) - Possible tactical usage when suitable television is available but on lower priority than VB-7.

[redacted]

OFFICE SYMBOL	1	2	3	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER						
INTERNAL OFFICE COORDINATION						

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(9) VB-9, 10, 11, and 12 (ROC, Med. Angle) - The merit of the ROC principle appears to offer tactical applications, however, it is believed that the effort should be concentrated on one item. It is believed that VB-10 offers best tactical possibilities and should receive the emphasis in the development. Major emphasis should be placed on incorporating the ROC principle into a design that can be carried internally.

c. Power guided missiles other than jet bombs - There are no tactical requirements for the XBQ-1, XBQ-2, XBQ-3, XBQ-4 or XBQ-5. Any need for this type weapon can be filled by using war weary airplanes.

d. Glider bombers - There are no tactical requirements for the usage of stripping worn out airplanes and using them as towed gliders.

e. Jet Bombs

(1) The JB-2 and the JB-1A should be continued in development with emphasis placed on the following phases:

(a) Improving the launching methods.

(b) Accuracy and control to the limit of range.

(c) Increase distance of flight.

(d) Carry, launch, and control from airplanes.

(2) JB-3 - Development should continue on an air-to-air missile.

(3) JB-4 - No tactical requirement.

(4) JB-5 - Development should continue.

(5) JB-6 - Development should continue.

(6) JB-7 - Development should continue.

(7) JB-8 - Development should continue.

(8) JB-9 - No tactical requirement.

4. It is realized that the research and development problems on the guided missile program are a matter of principal interest to your office and the above statements are submitted without the intention of dictating in research matters, but to provide a guide for research so that the present effort can be concentrated on items that can be made useful in this war.

OFFICE SYMBOL	1	2	3	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER				WILLIAM F. McKEE		
INTERNAL OFFICE COORDINATION				[redacted] Brigadier General, Asst. Chief of Air Staff, Operations, Commitments and Requirements	U.S.A.	

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Western Hem 360.2 Research
2 F AAF 4

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AFBFO-B

8 March 1945

MEMORANDUM FOR BUDGET OFFICER FOR THE WAR DEPARTMENT:
(Attention: Lt. Colonel McConahay)

x452.1 radio control planes

SUBJECT: Research and Development for Control Missiles

1. In accordance with telephone request of a few days ago with reference to the amount of funds set up in the Research and Development Program, Fiscal Year 1946, for the research and development of guided missiles, the following data is submitted:

a.	Fundamental Research	None
b.	Development	$ 4,503,000
c.	For National Defense Research Committee	None
d.	Research Board for National Security	$ 50,000

2. While no direct coordination has been made with the Navy Department as to the amount of funds included in the Fiscal Year 1946 Estimates for subject purpose, coordination of specific projects has been constantly maintained with the Bureau of Aeronautics, Navy Department.

FOR THE COMMANDING GENERAL, ARMY AIR FORCES:

L. W. MILLER
Brigadier General, U. S. Army
Chief, Budget and Fiscal Office

360.2 Research

HQ. AAF
- 8 MAR 1945
AFO MAIL SECTION

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TOB/vc 6128

OFFICE SYMBOL	1. AFBFO-B	2.	3.	4.	5.
GRADE AND SURNAME OF COORDINATING OFFICERS		[redacted]			

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16—29042-2 U. S. GOVERNMENT PRINTING OFFICE

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[redacted]

TSEPL-314/JHR/mep

9 MAR 1945

TSEPL-314

Reallocation of VB-1 Tail Assemblies.

Commanding General,
Army Air Forces,
Washington 25, D.C.

Attention: AC/AS M & S, Materiel Division,
Engineering Branch, Major J. F. Vogel.

1. Confirming telephone request by Major Vogel of AC/AS M & S on 6 March 1945, it was requested that two hundred (200) each of the VB-1 tail assemblies which have been allocated for tests to Air Technical Service Command be reallocated for training at Fort Dix, New Jersey.

2. Three hundred sixty of subject assemblies have been allocated to this office for experimental and service tests of Spazon. To date 20 units have been expended. Of the 340 remaining it is anticipated that 200 will be required for Air Technical Service Command tests up to 15 April 1945; therefore, 140 tail units may be reallocated to Fort Dix for training.

3. It is understood that 140 units will be available to this office on or about 15 April to replace those units allocated for training at this time.

FOR THE DIRECTOR:

G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Subdivision,
Engineering Division.

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MX-225 X-64318

AAFMC-190-WF-5-20-42-2 MIL

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PROD. CONT.
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A. S. C.
TECH. DATA
CIV. PERS.
OTHERS
147

Azon
Spec. Proj. Div., Equip. Div. 8
ACO

46

SUBJECT: Guided Missiles. (Hq. AAF. IBT, APO 671, 25 February 45).

14 AF 452-1 **COPY** 1st [redacted] 10 March 1945 **COPY**

HEADQUARTERS FOURTEENTH AIR FORCE, APO 627, C/O POSTMASTER, N. Y., N. Y.

TO: Commanding General, Headquarters AAF, India-Burma Theater, A. P. O. 671.

1. Reference your letter 471.6 dated 25 February 1945, your attention is invited to our radio No CAK 6874 dated 5 March 1945, wherein our comments for AZON equipped aircraft were outlined for your information and requested action.

2. We are herein reiterating the fact that we will require three of our replacement aircraft to be modified with complete AZON installation.

a. Further we requested permission to send to your theater two officers and five enlisted men on Temporary Duty to undergo training in the operation and maintenance of AZON equipment.

b. We requested that when aircraft are modified with AZON installation that 130 AZON tails for 1,000 pound bombs be transported to China for test requirements.

3. We extend to your our appreciation and thanks for your assistance in this matter and feel sure that the extra effort required on the part of your personnel in the development of this program will result in successful operations with this equipment against the Japanese by the Fourteenth Air Force.

4. After completion of test operations in China with Azon equipped B-24s we will furnish you with our further requirements for these special installations.

C. L. CHENNAULT,
Maj. Gen., U. S. A.,
Commanding.

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ATSC Form No. 10-508 (3 Jan 45)
(Old, TSC Form No. 43)

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10 March 1945
NGE:ejt:3-9019

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUSTMENT DIV.
OTHER

Procurement Division (TSNPG341)

HQ AAF, ATSC, Wright Field, Dayton, Ohio

Commanding General
Hqs., Army Air Forces
Washington 25, D. C.

Attention: AC/AS, W&E
Engineering Branch

Wash. spec. mail pouch

J. Brown Maj AC
for: A. [illegible]
Colonel, Air Corps
Actg. Chief, Production Section

1-3-45 . . . . . ATSC AGC TI-2003, ADDENDUM 22, DATED 7 MARCH 1945:

PROCUREMENT BEING INITIATED FOR ONE THOUSAND (1000) VB-1 AZON BOMB [illegible]
FIVE HUNDRED (500) IN JUNE 1945 AND FIVE HUNDRED (500) IN JULY 1945. PRELIMINARY
INVESTIGATION REVEALS THAT TWENTY FIVE HUNDRED (2500) TO THREE THOUSAND (3000) ADDITIONAL
UNITS CAN BE PRODUCED FROM AVAILABLE COMPONENTS WITH A MINIMUM PROCUREMENT OF
ADDITIONAL MATERIALS. THIS ADDITIONAL QUANTITY COULD BE SCHEDULED AT THE RATE OF FIVE
HUNDRED (500) PER MONTH BEGINNING AUGUST 1945. SPARES REQUIREMENTS HAVE BEEN CONSIDERED
IN THIS PROGRAM. REPLACEMENT PROCUREMENT FOR SERVO MOTORS AND GYRO ASSEMBLIES FOR
VB-5 RAZON PROCUREMENT WILL BE NECESSARY. REQUEST INFORMATION AS TO ORIGIN AND
QUANTITIES OF PLANES REQUIRED FOR USE ON THE VB-1 AZON TAIL ASSEMBLIES NOW BEING
PROCURED. ORDNANCE SECTION, AIR TECHNICAL SERVICE COMMAND, ADVISES RED, GREEN AND
WHITE PLANES ARE AVAILABLE. HOWEVER, IT IS UNDERSTOOD THAT THE GREEN PLANES ARE
NOT DESIRABLE.

CC:
TCCLP
TSPEA
TSBUY1 - Mr. Lonnelly

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[redacted]

A-6859

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WF, Area B-1-1-45-600M

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Major H.F.Mullins
Part:TSTEX:5-7126

ARMY AIR FORCES
Headquarters
AIR TECHNICAL SERVICE COMMAND

TECHNICAL INSTRUCTIONS

Wright Field Dayton, Ohio
3 March 1945

INITIALS
H.F.M

Serial No: TI-2003, ADDENDUM NO. 22

Subject: Procurement of VB-1 Azon Assemblies

To: Procurement Division

1. Problem Presented:

a. To procure immediately 1000 additional VB-1 assemblies utilizing components and materials presently available.

b. To determine the practicability of procurement beyond the 1000 units referred to in paragraph 1.a. above, by utilizing existing components taking into account that it may be necessary to initiate replacement procurement of these components for VB-3 Razon.

2. Factual Data:

a. Procurement of radio receivers for the 1000 VB-1 Azon assemblies for which procurement is directed herein will be directed by the Office, Assistant Chief of Air Staff, Materiel and Services. These radio receivers for subject equipment will probably be AN/CRW-7.

b. Spare requirements should be taken into consideration in the studies directed herein.

c. The Office, Assistant Chief of Air Staff desires that procurement of additional components except radio receivers and tail assembly shells for VB-1's not be recommended at this time.

d. The production schedule on the procurement of 1000 units directed herein, and also on any production beyond the 1000 units which may be recommended in accordance with this directive, is to be forwarded to the Office, Assistant Chief of Air Staff, Materiel and Services.

e. Reference is made to CTI-1350, Addenda No. 1, 3, 5 and 7 which directed procurement of a total of 110,600 Azon tail assemblies VB-1, and to CTI-1350, Addendum No. 9 which directed immediate cancellation of all future production of Azon tail assemblies, VB-1, except radio equipment.

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(AFR 11-30)

X-58635-

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Serial No.: TL-2003, ADDENDUM NO. 22

Subject: Procurement of VB-1 Azon Assemblies

To: Procurement Division

3. Authority:

a. Commanding General, Army Air Forces by teletype WAR-44504, dated 27 February 1945 from Chief Engineering Division, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Procurement Division take the necessary action to procure 1000 additional VB-1 assemblies utilizing components and materials presently available and determine the practicability of procuring beyond this 1000 units by utilizing existing components, taking into account that it may be necessary to initiate replacement procurement of these components for VB-3 Razon, and forward this information together with the production schedule for the 1000 units for which procurement is directed herein as well as the production schedule for any production recommended beyond this 1000, to the Office, Assistant Chief of Air Staff, Materiel and Services, through this office.

By Command of Lt. General KNUDSEN:

W. F. Wallens Maj AC

T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Engineering Division
Maintenance Division
Supply Division

[redacted]

X-58635-[redacted]

O-Azon-95.317
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HEADQUARTERS ARMY AIR FORCES
Office, Asst. Chief of Air Staff, Materiel and Services

Inter-Desk Memorandum

39 Ord

MEMORANDUM FOR RECORD AND ~~[illegible]~~

DATE 12 March 1945

1. Mr. Spencer NDRC
2. Lt. Colonel Fix, AC/AS, OCR

Conversations of 9 March indicate that AAF board tests on new 2000 lb Azon bomb are favorable. The only two failures of 20 dropped have been due to antenna failure in the carrying airplane. OC&R are requesting a prompt report when AAF Board tests are complete in order that procurement request can be initiated.

O.K.
E.B.

FROM V.A.B.

[redacted]

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OPERATIONS ANALYSIS REPORT

SECRET
By Authority of the Commanding General Army Air Forces 4/2/45 ACS
Date: Initials:

Issuing Unit: Operations Analysis Section IBT

Title: AZON (VB-1) IN INDIA-BURMA THEATER

Date: 21 March 1945

Identification: Report dated 21 March 1945 Copy No.

Note: Operations Analysis Sections (designated in some theaters as Operational Research Sections) have been established in a number of Air Force Commands pursuant to a memorandum from CG AAF to All Air Force Commanders, dated 24 October 1942, approving this activity.

This is a report of one such Section. Information as to Operations Analysis Sections and Reports can be obtained from Operations Analysis Division, Management Control, Headquarters, Army Air Forces, Washington, D. C.

This report has been issued by an Operations Analysis Section. It represents the views and conclusions of the authors and is distributed for your information. It does not necessarily represent the views of either Hq, AAF or the Hq. through which it was issued.

C5-8457,AF

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HEADQUARTERS ARMY AIR FORCES
INDIA BURMA THEATER
APO 671

SECRET
Auth: CG AAF IBT
Initials:
Date: 22/3/45

Cl. No. AOA-ST9
Copy No.

Operations Analysis Section
21 March 1945

AZON (VB-1) IN INDIA-BURMA THEATER

A. UNITS INVOLVED

1. To date the only operational experience with Azon (VB-1) in India-Burma Theater has been within the 7th Bombardment Group (H). Administratively this Group is part of Tenth Air Force but it is under the operational control of Strategic Air Force within the Theater. Because of the paucity of the type target that is usually considered the primary objective of heavy bombers, Strategic Air Force has been operating against lines of communication as high priority targets, with the purpose of cutting Burma off from the supplies that have been coming in from Thailand and Malaya. Railways, particularly the vulnerable points along the rights of way, are under constant attack in this program, superseded in priority only by special counter air force and anti-shipping strikes.

2. The Azon-equipped B-24s assigned to the 7th Bomb Group were kept together in one squadron for several reasons. In the first place, maintenance of the special equipment (see Section D below) is facilitated; there are insufficient men and testing equipment in the maintenance crew assigned to provide the same service at the separate fields that they can at the one field. In the second place, operational procedures are greatly simplified: all Azon briefing is done in one squadron and double briefings within the four squadrons are thereby avoided, and all other special functions and duties deriving from the use of Azon are similarly localized. Third, training matters are also simplified, and finally, there are strong morale reasons in favor of this concentration.

3. The result of having all the Azon-equipped aircraft within one squadron is to increase the capabilities of that squadron without in any way handicapping it insofar as the other types of duty are concerned. In other words, the 493d Squadron, which is the one that contains all the Azon-equipped B-24s of the 7th Bomb Group, functions just as the three other squadrons of the Group do except when the occasion for flying an Azon mission arises.

B. USE OF EQUIPMENT

1. The targets to which Azon is best suited satisfy two conditions with regard to shape:

a. The target should be long (because of the lack of control over range in the dropping) and narrow (to ensure destruction across the width with one hit and to make full use of the deflection control possible with Azon).

b. The line of the target should be straight and continued for a considerable length on one side of the portion that is to be attacked (so that the plane can be brought on the proper course for the bomb run).

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[redacted]

Azon bombing has been done on targets which are on curves, but the results are not as good as when the above condition b. is satisfied. The bridges on roads and railway lines are the only targets that have been attacked with Azon; the length of bridge averages to 250 feet.

2. The technique employed for dropping Azon bombs is summarized in the following quotation from a report by the Group Bombardier, 7th Bomb Group:

> "Best bombing altitudes have been found to be 8,000 to 10,000 feet. This allows sufficient time for the bombardiers to put in their corrections, yet is not so high that range error is too great, due to personal error and ballistic error due to bombs not spinning.
>
> Individual releases are always made, as it has been found that train releases are not successful. Each bomb takes a different amount of control, therefore the bombardier must concentrate on one bomb, guiding it into the target. The difference is too great for a target as narrow as a bridge.
>
> The following method of bombing has given the most satisfactory results and is used where the possibility of interception is slight:
>
> (a) A first initial point is assigned, at which point each plane goes in trail, taking up a thirty second interval. At the second initial point, each plane turns in on his own run. A pattern is made around the target, each plane sighting for his own range and deflection, dropping one bomb on each run.
>
> (b) Where interception is probable, six-ship formations are flown--two three-ship elements, javelin down. The formation makes a pattern around the target, each plane dropping one bomb on each run. It is not possible to drop from larger formations at the present time, since only six frequencies are available.
>
> At altitudes of 8,000 to 10,000 feet, five mils of trail are added to the standard 1000 lb. GP bombing tables. Any corrections applied cause the bomb to hit short. Five mils take care of the average correction applied on each bomb.
>
> It is to be emphasized that good standard synchronization is essential for successful use of Azon equipment. Much better results are obtained where experienced lead bombardiers are used, as it is necessary that the plane be correctly lined up on the bridge and range and deflection are killed as well as possible."

3. The bombs are fuzed in the nose only, pending the arrival of T75 fuzes which are adapted for tail fuzing these special bombs (ordinary tail fuzes cannot be used in Azon bombs because of interference of the fuze arming device and the Azon tail assembly). The nose fuzes used are the M103, M139, and M140, set at 0.1, 0.01 and 0.025 seconds respectively. The occurrence of duds is very erratic, on one occasion 12 out of the 24 bombs dropped not going off. Over

[redacted]

the period under study, duds have comprised 6% of all Azon bombs dropped. If the T75 operates as well as the current ones this can be expected to be reduced to about 1½%.

4. Azon bombs have been dropped in trains of up to 4 bombs. This practice has been discarded after trial because of the difficulty of controlling the stick. This difficulty seems to be due to the variation in the bombs' ballistics: one bomb taking more correction and another less than the bomb being watched by the bombardier. Such dispersion can be overcome in this Theater by the repeated run tactics; elsewhere some other tactics being necessary, dropping Azon in train might be adopted, but the measure of control, and therefore the accuracy, cannot be as great as with single release.

5. The importance of having good drops without regard to the control that may be exercised has its basis in the lack of range control (some range can be killed by alternate use of right and left control, but it is usually too late by the time it becomes obvious that the bomb is going to carry over), and in the parallax which will develop between bomb and target if the plane is appreciably off course. Parallax will prevent accurate use of the control available. The value of the repeated run lies in the resulting familiarization of the bombing team with the particular conditions with which they have to cope.

6. Another technique has been developed for the attack of targets which are protected by anti-aircraft fire serious enough to interfere with the completion of six runs by each plane. Against such targets the planes are loaded with 3 Azon bombs and 3 standard bombs of the same weight. Each plane makes 3 passes, dropping one Azon and one standard bomb on each run. (The quality of the photographs taken on such missions has not been such that the relative accuracy of the standard and Azon bombs can be determined; presumably hits have been scored by both types, which is a reflection of the excellence of the dropping without regard for the control that may have been exerted.) In some instances, planes of other squadrons within the Group have been loaded with clustered 20-lb. fragmentation bombs which are dropped on and about the gun emplacements, neutralizing the positions for the length of time necessary for the Azon planes to make their runs. Group officers feel that air or ground opposition appreciably heavier than what has been encountered in this Theater would seriously interfere with the repeated run tactics that have been satisfactorily employed here.

7. After enemy opposition, the most serious interference with Azon bombing is undercast. If this is as dense as 3/10 or denser, the flight of the bombs cannot be followed closely enough to permit of proper control. Failures of Azon equipment have occurred about 3% of the time; about half of these are flare malfunctions, and the remainder are failures of the bomb to take right or left control. The question was specifically raised as to whether or not surface wind blowing the smoke trail to one side or the other made the control more difficult; apparently no difficulty is caused by surface winds.

C. ACCURACY

1. The following is quoted from the Group Bombardier's "Report on Employment of Azon Bombs":

[redacted]

"During the period December 27, 1944, through March 3, 1945, this Group has expended 459 1000-lb. Azon bombs, resulting in the destruction of 27 bridges. During this period, an average range error of 201 feet and an average deflection error of 131 feet has been maintained. Ten to fifteen per cent of the bombs dropped have been direct hits, the bridges averaging approximately 250 feet in length."

2. The uncertainty concerning the exact number of direct hits is attributable to the difficulty of differentiating between near misses and direct hits in the photographs of the strikes taken. The accuracy figures given above do not include those bombs which, although Azon-equipped, were dropped as standard bombs, nor do they include the gross errors resulting from excessive undercast or malfunctions of equipment; in short, they cover only the operational errors.

D. MAINTENANCE

1. One of the most significant factors in making the operational use of Azon equipment effective is proper maintenance, according to the experience of 7th Bomb Group. Maintenance standards there are kept as high as possible considering the number of men available with the proper training. There are 10 enlisted men and one officer with the 493d Bomb Squadron assigned to maintaining and checking Azon units and equipment. Below (see Section D.5.) the recommendations of the Azon maintenance officer as to the number of men that could be effectively used on this work are given; 25 men are considered about the right number to keep one Azon squadron properly maintained at all times. Naturally, the maintenance problem is eased somewhat if not all the targets for the squadron are to be attacked with Azon. It is because of this that the officer and crew with the 493d Squadron have been able to maintain as high a standard of maintenance as they have.

2. The following steps are routine in the installation of each Azon unit:

a. Unpacking. Because of the difference in functional suitability of the Emerson and the G.I. receivers, it has become necessary to unpack every tail assembly from the crate in which it is shipped in order to select those assemblies equipped with G.I. receivers. The assemblies equipped with Emerson receivers are used as a reserve in the event that the supply of G.I. receivers falls behind the demand for Azon tails.

b. Taking Tail Assembly Apart. Once unpacked the collar is removed from the tail; the gyro and the receiver are also.

c. Checking of Tail Structure. The fins, controls and general framework of the tail is checked, particular attention being paid to the wiring, the servo mechanism, and the mechanical coupling of the moving parts. (Note: In about 3% of the assemblies the pins coupling the rudders or the ailerons to the control mechanism have been sheared. Such tails are discarded. Another fault that is frequently found in this inspection is the spreading of the points of the flare arming relays, occurring about 7% of the time. Both these flaws have been reported by the maintenance officer in UR-FA-BEC-45-36 dated 15 March 1945.)

[redacted]

d. Tuning and Checking Receivers. The receivers are tuned to the bands transmitted by the equipment mounted in the various planes. As a rule about half the receivers need some sort of major maintenance. When it becomes necessary to use the Emerson receiver because the supply of G.I. receivers is inadequate, all sets are subject to major maintenance consisting principally of changes in wiring to increase their sensitivity.

e. Mounting the Receiver. Once the receiver has been checked and the necessary repairs made, it is mounted in the tail assembly and given another check. In about two-thirds of the cases it is found that the set loses sensitivity on being mounted in the tail assembly. In order to achieve the sensitivity of the set as tested in its dismounted condition, the grounding of the tail antenna has to be changed.

f. Testing of Gyro. Each gyro is tested for balance, precession and uncaging. Each gyro is also checked to insure that it will rotate properly through the 45-degree rotation of axis of the bomb after it falls free of the bomb racks.

g. Mounting the Gyro. After testing, the gyro is mounted in the tail assembly.

h. Flare Procedure. After each flare is unpacked, the contacts of the sockets have to be scraped clean of the wax used to prevent corrosion during shipment and storage, and the flare is then ready for mounting on the back plate.

i. Batteries. The batteries are filled and charged at this point. It is not absolutely necessary to charge a battery because it should have the proper potential shortly after filling. However, it has been found that the batteries have more muscle if they are charged for a few hours prior to their installation in the tail. The batteries are mounted in the tail assembly the last thing before the planes are loaded.

On the average, the jobs listed above require 5 man hours per bomb. In some circumstances a longer time is necessary. The most troublesome lots of tails are those whose indicator cards (included inside the packing) showed that moisture has penetrated to within the case. Troubles that arise are those due to fungus and corrosion although it frequently happens that a unit whose indicator card shows wet will give less trouble than one whose card shows dry.

The aim toward which this type of maintenance should be directed, according to the Azon maintenance officer at 7th Bomb Group, is the association of one man with one of the particular jobs all the time. In view of the number of men available in the 7th Bomb Group and the number of tasks to be performed, this is not possible there.

3. The following steps are routine in the checking of transmitting equipment in the aircraft:

a. Check of Transmitter Frequencies. Transmitter frequencies are measured by a signal generator and the values thus obtained are used in tuning the receivers.

b. Inspection of Warm-up Circuits. This is simply a check of the wiring to each bomb station that will carry an Azon bomb.

c. Cleaning Antennas. This has been found necessary to insure optimum control.

The work of checking the ship takes on the average one man hour for each ship before each mission. It is, however, a two man job.

4. Loading of Plane. The procedure followed in loading Azon bombs into the B-24 aircraft comprises the following steps:

a. The bomb, without tail assembly and without fuzing, is hung on the rack by the armament crew.

b. The Azon crew mounts the tail collar on each bomb after it has been slung from the racks and the collar is trued up so that the two studs used for aligning of the tail assembly are vertically one above the other.

c. The Azon crew mounts the tail assembly on the collar insuring that it is level athwartships.

d. The assembly having been checked after all parts are in place is again checked after it has been mounted on the bomb in the plane.

This job comprises an effort of about one man hour per bomb. When the men have become well acquainted with the disposition of space in the B-24 bomb bay, it is possible to put one man to work on each bomb. Therefore, the total time consumed should be one hour per ship.

5. The maximum rate to which the 10 men of the 493d Squadron have been able to work is 25 bombs prepared and mounted in 2 days. The officer in charge of the Azon maintenance crew feels that a crew the size of the one he has could not service a full Azon squadron at maximum rate, as stated above, continually. The most outstanding deficiencies in the crew T/O as established for the 493d is that it lacks first, a clerk, and second, a power plant specialist. It is also felt that 10 to 12 radio mechanics should be assigned to a full time squadron, half of these mechanics being capable of performing the kind of maintenance that is carried on at depots. The remainder of the crew (between 10 and 12) should be instrument mechanics.

E. OVERALL RESULTS

1. Aside from giving the bomb group as a whole a means of more certainly being able to cope with a particular type of target, the presence and operation of the Azon-equipped planes has had other effects. One of the most significant is that the bombing accuracy of the group as a whole has improved because the bombardiers of the non-Azon squadrons have accepted the challenge to prove that they unaidded can do as well as those bombardiers who have this mechanical assistance. It is also true that the existence of an Azon-equipped squadron within the 7th Bomb Group has in no way limited the activity of the group.

[redacted]

F. FUTURE PLANS FOR AZON IN INDIA-BURMA THEATER

1. Because of the sucess with which the Azon technique has been adapted to the targets and conditions of India-Burma Theater, plans are being implemented for the use of Azon on other type planes. It has been decided to try out Azon equipment in P-38s which will operate as droopsnoot squadrons, the bombardier in the droopsnoot maintaining control of the flight of the bombs in the other planes. Whether or not such a combined technique will prove successful in improving the accuracy of small compact patterns remains to be seen. B-25s of the 12th Bomb Group (M) are also being considered for Azon equipment.

/s/ David Mayer

DAVID MAYER, Chief
Operations Analysis Section

C5-8457,AF

[redacted]

SECRET

14

ARMY AIR FORCES
Headquarters
AIR TECHNICAL SERVICE COMMAND

SECRET
AUTH: DIR., ATSC
INITIALS
DATE

TECHNICAL INSTRUCTIONS

Serial No.: TI-7003, Addendum No. 27

Subject: Test Equipment for Azon Program, 5th Special Weapons Detachment

To: Supply Division

1. Problem Presented:

a. To ship the following items of equipment to the India-Burma Theater:

1. Signal Equipment:

2 Signal Generators - 804-A or equivalent
2 Audio Oscillators - HP or Jackson
3 Williamsters, 10 or 15 V.A.D.C. panel type
3 Volt meters 0 to 30 V.D.C. panel type
2 volt ohmeters or multi-testers any type
2 Ammeters 0 to 10 or 0 to 15 amp DC panel type
1 Tube tester - any type
1 Voltmeter 0 to 150 V...C. panel type

1 U.H.F. receiver with speaker for 110 V...C. operation Hall crafter S.X. 27 or equivalent
1 Field telephone set EE-8
18 Female receptacles for 115 V...C. American type
12 Male plugs or 150 V...C. American type
12 Mogul light sockets for 150 V...C.
12 Power switches, house wiring type
4 D.P.D.T. power switch boxes 50 amp. 110 V.
24 Spare fuses for above
2 D.P.D.T. power switch boxes 50 amp. 110 V.
12 Spare fuses for above
24 Toggle switches B 5 A
48 Spares for each plug in AZON tail assembly
6 Spares for each plug in transmitter, dynamotor and control box
18 Spare antenna installations complete
12 Spares for each fuse in AZON installation
500 Feet coaxial cable RG-31/U(WC 549) or RG 8/U
500 Feet aircraft wire AN-20
500 Feet aircraft wire AN-18
200 Feet aircraft wire AN-8
1 Headset
1 Battery charger 6 amp 36 V (Tungar or Rectigon)
100 Battery clips Mueller #24
50 Battery clips Mueller #10
50 Battery clips Mueller "Pee Wee"
50 Alligator clips assorted sizes

X-101919-A-

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Serial No.: TI-2003, Addendum No. 27

Subject: Test Equipment for Azon Program, 5th Special Weapons Detachment

To: Supply Division

50 Pilot lamps type 30 D
50 Radio tubes 12 SN 7
50 Radio tubes 9003
50 Radio tubes 9002
24 Radio tubes 815
20 lb. rosin core solder
2 Rheostats 8 ohm 100 watt
6 Resistors 4 ohm 25 watt
10 TS-154/GRN-2

2. Power Supply:

2 Gasoline driven generators 110V, A.C. 2.5 to 5 KVA
2 Gasoline driven generators 28 V.D.C. 100 amp
3 Aircraft batteries 24 V
6 Battery hydrometers
36 Flashlight cells

3. Special AZON Equipment:

2 Final test panels
2 gyro test stands

4. Tools:

1 Tool Kit TE-46
8 Tool Kit TE-48
6 Crew chief tool kits
1 electric drill 110 V.A.C. 1/2 inch
1 electric drill 24 V.D.C. 1/2 inch
1 Carpenters tool kit
2 Sets watch makers screw drivers
1 Hacksaw with 12 blades
36 Small insulated tuning screw drivers with metal tip
2 Sets fractional drill bits 1/16" to 1/2"
12 Padlocks with keys.
100 Sheets sand paper 5 fine
100 Sheets sand paper medium
100 Sheets crocus cloth-medium
24 Lbs. friction tape 3/4"
10 rolls rubber tape
1 grease gun
3 Sets Allen wrenches
3 Claw hammers
3 Crow bars
1 Machinist combination

[redacted]

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SECRET [redacted]

Serial No. TI-2003, Addendum No. 27

Subject: Test Equipment for Azon Program
5th Special Weapons Detachment

To: Supply Division

2. Factual Data:

a. Action has been initiated by the Office, Assistant Chief of Air Staff, Material and Services, to send an additional Special Weapons Detachment consisting of one (1) officer and twenty-five (25) enlisted men to the India-Burma Theater in connection with Azon operations.

b. Basis for activation of this team is AG letter dated 21 December 1944, subject: "Constitution and Activation of Certain Army AirForces Special Weapons Detachments". Attention is invited to the special list of equipment (Signal), a part of the letter, which has been determined to be inadequate for the India-Burma Theater.

c. The Office, Assistant Chief of Air Staff, Material and Services, has requested that the above items be shipped in order that this team may properly perform its function. These items are to be shipped by water.

d. Care should be exercised to avoid a duplication in the supply of equipment which may possibly exist in the above list. Certain of the items are available for immediate shipment at Fort Dix, New Jersey. This matter should be coordinated by your Headquarters, through channels, with Lt. A. N. Hollyer, Fort Dix, New Jersey, telephone Ft. Dix 2000, extension 6231.

e. Since the unit is on movement orders with deadline date at the Port of Embarkation of 1 May 1945, it is requested that supply of the equipment be arranged to meet this date.

f. The India-Burma Theater should be queried as to the exact shipping instructions and markings.

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 9 April 1945, subject as above, from Chief, Communications Equipment Section, Office, Assistant Chief of Air Staff, M & S.

4. Action Desired:

a. That the Supply Division take immediate action to accomplish that which is outlined in problem presented in order to meet the deadline date of 1 May 1945.

By Command of Lt. General KNUDSEN:

Air Comm. Office
cc: Proc. Division
Eng. Division
Maint. Division
Tech. Liaison Office
Aircraft Test Control

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T. A. SLEE (H-30) X-101919-
Colonel, Air Corps
Chief of Administration

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44

VB-1

Procurement of Automatic Electric Company Type S Relay.

TSEPRLH-5 TSEPL-314 [redacted] 1

Attn: Mr. Stevison

1. In accordance with the conversation between Mr. Stevison and Lt. Baltimore the urgency of the need for the Automatic Electric Company Type S relay is hereby stated:

a. The relays are for use in the VB-1 (Azon) radio-controlled bomb. Combat operations have shown that it is desirable to drop these radio-controlled missiles in train in large numbers. The Army Air Forces Board accordingly set up a high priority project to make the train drops possible. It was discovered that only one practical way to accomplish the mission was available, and therefore the Engineering Division of Air Technical Service Command undertook the development in order to ready the missiles for return to combat use promptly. Without the type S relays, for which there is no known acceptable substitute, the modification of the missiles must be halted, and the combat effectiveness of the weapons will be reduced. It is extremely desirable that this weapon be returned to combat promptly.

2. Ninety (90) type S relays are required for immediate use. Starting one month after the date of delivery of the first 90 relays, 100 a week are required until the remaining 410 are delivered.

3. It is therefore requested that delivery of subject relays be expedited.

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S. R. STEWART
Colonel, Air Corps
Chief, Equipment Laboratory
Propulsion and Accessories Subdivision
Engineering Division

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ATSC Form No. 43
(16 Sep 44)

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COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS. & BASE SERV DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

T&E 1-314/JHB/mcn

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EXTRA COPY REQUIRED
VALUE OF PAPER CHECK ONE: PERMANENT [X] TEMPORARY [ ]

T&E 1-314 (T-2 EPL-314)

Reallocation of T-2 fuse bliss.

President
Army Air Forces Board
Orlando, Florida
Attention: Lt. Colonel, [illegible]

1. With the introduction of the AN/ARW-7 radio receiver in the T-2 fin assembly it is necessary that a considerable amount of noise suppression be incorporated in the tail assembly. The noise suppression mock-up is being completed at this station at the present time and it will be necessary to make drop tests of some of the T-2 equipments, incorporating the new receiver in order that the reliability of operation can be checked. This modification in no way affects the performance of the VB-2 unit, it merely involves the substitution of component equipment and therefore should be flight tested before release to combat.

2. It is requested that ten (10) sets of the VB-2 tail fin assemblies, either the shortened version or the original version be allocated and shipped to the Supply Officer, Wright Field, Dayton, Ohio, Attention: Department 54-7, for modification and drop tests.

FOR THE DIRECTOR:

[illegible] Capt. AC
for J. Y. SMITH
Colonel, Air Corps
Chief, Engineering Standards Section
Service Engineering Subdivision
Engineering Division

Capt. W. W. Burton

[redacted]

Copy Furnished:
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WF Form R-10-14-44-500M

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SPECIAL WEAPONS TEST UNIT
Wendover Army Air Field
Wendover, Utah

AJW/11

TSEPL-3111

1 May 1945

Director,
Air Technical Service Command,
Wright Field,
Dayton, Ohio.

Attention: Capt. J. H. Evans, TSEPL-314.

Since I was at Wright Field, we have talked over here at Wendover the problem of equipping Azon-Razon combat ships with 16 mm. movie cameras. One or two new ideas on the subject have been suggested in which I believe you may be interested. In addition to pointing out these suggestions, I would like to take this opportunity to put down on paper the reasons I believe that some of this type camera equipment should be used in combat and what I hope can be done to get the ball rolling as soon as possible. In general, it is the plan we discussed last week.

Several people have mentioned that they had understood that movie cameras were available for taking records of past Azon missions in the MTO, ETO and CBI and have wondered why no good records were obtained, (with the exception of one mission in the CBI). Although the equipping of all Azon aircraft with fixed movie cameras was suggested even in the case of the first Azon combat units, apparently other problems were more pressing at the time and these installations were not made. Instead, hand-held GSAP cameras, not well suited to the problem, were furnished each aircraft. Several factors contributed to the failure to obtain any results with this equipment.

a. The cameras were hand-held, in some cases equipped with telephoto lenses. The ship's crews were just not experienced enough to operate such cameras. The operator either did not see the bomb fall away and missed the drop, or he could not hold the bomb in the field of view when he did see it.

b. The film we obtained in the theatre was badly loaded and magazines jammed.

c. Developing facilities were almost impossible to find, and the few films we obtained were badly developed.

I mention these points to emphasize the fact that there is no use attempting to obtain movie records unless the equipment and personnel are provided to handle the problem from beginning to end. Installation of a fixed, automatically starting camera in each ship is

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necessary, but even this isn't enough. In the CBI, movies of the first Azon mission were ruined by poor development facilities and inexperienced personnel. Movies of the second mission had to be taken back to the U. S. for development. Lack of film made it impossible to photograph any more missions.

Since extra work is involved in obtaining these records, I would like to point out some of the information which can be obtained from them to justify this extra work.

a. With bridges or narrow line targets which are attacked with Azons, or point targets suitable for Razons, it is very important to know whether or not a direct hit was obtained. The smoke from the bomb explosion covers such a large area by the time a standard bomb strike photo is taken that it is impossible to determine whether the communication line was cut or only a near miss was achieved. Running at 16 or 32 frames per second, a movie camera records the impact point very accurately.

b. Movie records show up immediately such errors in tactics as an approach direction at such a large angle to the direction of the bridge or railroad that the bomb could not possibly be steered so as to insure a hit.

c. Movie records properly interpreted will keep a continual check on the number of bomb failures. The equipment suggested for initial combat use is provided with four small lights which record on the film the control applied by the bombardier. In a few minutes, questionable missions can be plotted and carefully studied.

d. These records also allow a continual check to be made on the skill of the bombardier. If developed and shown to the bombardier soon after a mission, they will teach him how to improve his steering.

e. When several aircraft release in formation, each man controlling his own bomb, each impact point can be identified with a particular aircraft and bombardier so that direct hits can be credited to individual bombardiers. This inspires greater care in control and pride in results.

f. When the movies have served their purpose in the theatre, they can be returned to the U. S. for detailed analysis. Information from these detailed analysis will be invaluable in determining the usefulness of the weapon and in improving tactics.

g. One of the most important purposes which the movies serve is to give theatre commanders, staff officers and interested Army personnel the results of hundreds of special missions in a clear form in a short time. By condensing and editing the movies, the results of a hundred attacks on special targets could be shown in half an hour.

[redacted]

h. The information mentioned above will be all the more valuable in the case of Razons which will soon be introduced in combat. Their use is slightly more complicated, and if a continual check is available, particularly on the first missions, correct use of the weapon can be more quickly learned.

Since the 7th Bomb Group of the 10th Air Force is the only group at present using Azons and since probability is high that it will initiate use of Razons, I suggest that a photographic unit be formed immediately to be made available to the 7th Bomb Group.

Based on experience we have had in using such camera equipment during Gulf tests and at Pinecastle, Florida, I would like to make some suggestions regarding the formation of such a photographic unit.

a. I believe it should be 100% independent, able to take and provide developed, titled, edited and briefly analyzed movies.

b. Since the 7th Bomb Group used B-24's, the camera installation which we worked out for the B-24 a week ago could be used. I will mention later one possible modification suggested by Tom O'Donnell.

c. I believe the first unit should be based on camera installations for about 30 ships. If it will expedite matters, Division 5, NDRC, will have made and furnish to the Army these camera installations.

d. In the first unit at least, the type cameras with lights indicating control applied should be used. If the use of the cameras became more general, this feature might become cumbersome, and could be left out.

e. All cameras, junction boxes, mounting brackets, small windows could be put together in this country for quick installation in the field.

f. The unit should be furnished with the following equipment to accompany them overseas:

(1) 30 modified GSAP cameras with lights and 35 mm. lenses, junction boxes, mounting brackets, release switches and all necessary small items to install cameras.

(2) 2 GSAP analyzing projectors; these must be of the type which can be operated frame by frame as well as motor driven and must be equipped with a frame counter.

(3) 2 Editors and viewers.

(4) 2 Titler and titling camera.

[redacted]

(5) Small continuous developing tank; although I have little information on the K-2 developing unit, it appears to be very suitable. Also, any developing solutions not readily procurable in the field should be provided.

(6) 2 Weston or GE exposure meters.

(7) 1 Alignment indicator.

(8) 50 50' reels
50 100' reels
25 400' reels

(9) 1,000 50' Super X loaded magazines.
At 16 frames/second, 3 releases from 15,000' could be made on each magazine.

(10) T.O.'s for use of all equipment.

(11) 12 17 mm. lenses for GSAP cameras.

(12) About 20% spare parts for all items subject to malfunctions.

g. It would seem that three enlisted men and an officer would be needed to handle the unit. One enlisted man probably would have to devote most of his time to maintaining the equipment; the other two for developing of films, titling, etc., and possibly a 2nd Lieutenant trained as a photo interpreter to be in charge of the unit, edit the films and briefly analyze and take data from them.

h. Excellent training would be provided if the unit could be formed as soon as possible at some place like Fort Dix. It could gain experience in handling the cameras and taking data from the films before it went overseas.

This summarizes my ideas on the subject. I don't know who would be given the task of organizing such a photographic unit, although the Tech. Data Lab. at Wright Field has been mentioned. I hope that if you agree that a unit of the type outlined would be of value, you might pass on some of my suggestions. I have talked to Major Vogel of M and S in Washington, and he agreed to give the matter some consideration.

The suggestion of Tom's that I wanted to pass on concerns the elimination of the bomb bay release switches for starting the cameras. It appears that all ships are equipped with an agostat relay in the nose which lights a red light in the tail of the airplane when the bombs fall away. The idea is to place the starting relay in the camera junction box in parallel with the tail release light. Every time a release is

made, the camera will be started. The agostat resets itself after bomb release so that if the time clock on the junction box were reset, the camera would start again on the next release. This system would eliminate all the bomb bay starting switches, and the six delay relays in the box. I think it is very definitely worth considering.

Abner J. Wollan

ABNER J. WOLLAN,
Technical Aide,
Section 5.2, NDRC.

cc: L. O. Grandahl

[redacted]

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P-1

ARMY AIR FORCES
MATERIEL COMMAND

AIR TECHNICAL SERVICE COMMAND

MEMORANDUM REPORT ON

[redacted]

TSEPL-311/JHE/sep

Date 5 May 1945

SUBJECT: Vertical Controllable Bomb Type VB-1 (Azon).

OFFICE TSEPL-311

Contract or Order No.

SERIAL No. TSEPL-3-675-16-A-1

Expenditure Order No. 675-21

A. PURPOSE:

1. To summarize the development of the Vertical Controllable Bomb Type VB-1 (Azon).

B. FACTUAL DATA:

2. The following agencies were directly responsible for the development of the VB-1 bomb.

a. Special Weapons Branch, Engineering Division, Air Technical Service Command, Major J. H. Evans, Project Officer.

b. Section 5.2 of National Defense Research Committee, Dr. E. H. Grondahl, Chief.

c. Gulf Research & Development Company, contractor to N.D.R.C., Mr. A. D. Nyckoff.

3. The purpose of this development was to design a bomb that could be controlled from the carrying aircraft after drop away to correct for the inherent sighting errors common to the best known practices at that time.

4. The project as originally set up intended that a bomb be developed which would be controllable in both range and azimuth from the carrying aircraft. It naturally followed in this development that an attempt be made to control the bomb first in one axis only, azimuth being the chosen coordinate. Thus evolved the Vertical Controllable Bomb Type VB-1 which consists of a 1,000 pound general purpose bomb to which is attached, in place of the standard tail fin, a special Controllable Bomb Tail Fin Type A-1 with movable surfaces to control the trajectory in azimuth only.

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Memorandum Report No. TSEPL-3-673-16-A-4
5 May 1945

[redacted]

Within the assembly housing are contained gyro stabilizing equipment, servo motor mechanism for the operation of the control surfaces, and radio receiver apparatus. In operation this device is visually tracked from a control airplane and observed errors in azimuth corrected by means of radio signals transmitted therefrom. AAF photographs 1/6327, 159403, 159406, 159407 and 167318 are available in Technical Data Laboratory, Engineering Division, Air Technical Service Command.

5. History.

a. A history of this project has been compiled by the Historical Office, Air Technical Service Command, Wright Field dated August 1944.

b. For bibliography see Appendix 1.

C. CONCLUSIONS:

6. That the development of the Vertical Controllable Bomb Type VB-1 (Azon) is complete. (Entered into Standard Classification 21 April 1945)

7. That the Vertical Controllable Bomb Type VB-1 (Azon) is satisfactory for combat use.

D. RECOMMENDATIONS:

8. It is recommended that the following action be taken by the organization designated below:

(a) Engineering Division, Air Technical Service Command, Equipment Laboratory.

(1) That Expenditure Order Number 673-21 be closed out, (Action Initiated)

This Memorandum Report Closes out E. O. No. 673-21

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Technical Data Laboratory
TSDAL-60
Special Weapons Branch
TSEPL-311
Engineering Planning & Control
TSEPL-311

Prepared by
J. H. (illegible), Major, Air Corps

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C. O. FRENCH, Jr., Lt. Col. A.C.
Chief, Special Weapons Branch

Approved by
S. H. STEWART, Colonel, A.C.
Chief, Equipment Laboratory
Propulsion and Accessories Subdivisor
Engineering Division

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PART I

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