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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

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X-745-3
Part II

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CASE HISTORY

of

CONTROLLED MISSILES - VERTICAL BOMBS
PART II - RAZON

Part II of the Controlled Missiles, Vertical Bombs Project is a study of the VB-3 and VB-4 (Razon) which were developed by NDRC under army project AC-36.

The VB-3 consists of a 1000 pound general purpose bomb to which is attached, in place of the standard tail fin, to a special tail fin assembly with movable surfaces to control the trajectory in both range and azimuth. Within the tail assembly housing are contained gyro-stabilizing equipment, servo-motor mechanism for the operation of the control surfaces and radio receiver apparatus. This missile is steered, while in flight, through bombsight adaptation (CRAB I) designed by Franklin Institute. The VB-4 is a 2000 pound version of the VB-3; it contains similar components, however, the tail assemblies are not interchangeable.

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. A.T.S.C.
Initials: C.M.T.
Date: 11 JUNE 1945

CASE HISTORY

of

CONTROLLED MISSILES PROJECTS
PART III - RAZON

Part III of the Controlled Missiles Project is a study of the VB-3 and VB-4 (Razon), which were developed by NDRC under army project AC-36.

The VB-3 consists of a 1000 pound general purpose bomb to which is attached, in place of the standard tail fin, a special tail fin assembly with movable surfaces to control the trajectory in both range and azimuth. Within the tail assembly housing are contained gyro-stabilizing equipment, servo-motor mechanism for the operation of the control surfaces and radio receiver apparatus. This missile is steered, while in flight, through bombsight adaptation (CRAB I) designed by Franklin Institute. The VB-4 is a 2000 pound version of the VB-3; it contains similar components, however, the tail assemblies are not interchangeable.

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Compiled by
Historical Office
Air Technical Service Command
Wright Field
May 1945

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Summary

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SUMMARY OF THE RAZON PROJECT

The Razon project was initiated in April 1942 as a cooperative development project of the National Defense Research Committee and the Air Corps. At this time it was intended that means should be perfected for control of vertical bombs with respect to both range and azimuth. But technical difficulties were encountered which, for approximately a year, discouraged attempts to incorporate two-axis control in the same bomb. The result was that Azon (a bomb which can be controlled in azimuth only) received the lion's share of attention, and it was not till 1 June 1943 that the Materiel Division, Washington, instructed the Technical Executive, Wright Field, that work on Azon was not to interfere with "the development and successful conclusion" of bombing equipment capable of being guided on two axes. *(2)

Between 23 June and 7 July 1943, six bombs, controllable in both range and azimuth and furnished by the Gulf Research and Development Company, Pittsburgh, Pennsylvania, were tested with unsatisfactory results due to radio failures. These bombs were at first designated "Raaz," but "Razon" soon became a more common name, Although in November 1943 Maj. Gen. B.M. Giles, Chief of Air Staff, directed "active cooperation and expedition" of projects concerning guided missiles in order to put them into combat as quickly as possible, the Report on AAF Guided Missiles Program for April 1944 stated that Razon was still experimental because of spins encountered when both range and azimuth controls were applied. (5) The British Royal Aircraft Establishment was interested in Razon, and the Germans had incorporated its principles in their FX-1400, a bomb which was effectively controlled but which had been discarded because it had to be carried externally. (6,8) (13)

Up to this point the National Defense Research Committee had directed most of the experimental work on the guided missiles program. In June 1944, at its own request, the Materiel Command, Wright Field, was authorized to assist NDRC in conducting tests. Capt. J.H. Evans was appointed Project Engineer for VB-3 (Razon control added to 1000-pound bomb) and VB-4 (Razon control added to 2000-pound bomb). Testing took place at Tonopah Army Air Field, Nevada, from 4 August to 9 September 1944, during which 19 Razon bombs were dropped from a B-17 at an altitude of 15,000 feet. An adaptation of an M-Series bombsight, designed by Franklin Institute, Philadelphia, Pennsylvania, was used. Conclusions were that the VB-3 showed "promise of becoming an invaluable weapon against special targets," but that it was not yet ready for combat use. The Project Engineer recommended that changes necessary for mass production should be made so that sufficient units could be on hand for final acceptance tests. NDRC placed a tooling contract for 150 Razon (10,11, 12) (17) (16)

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

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assemblies with the Union Switch and Signal Company, Pittsburgh, Pennsylvania, and expected deliveries completed by the end of January 1945. Twenty more were to be produced by the Gulf Research and Development Company for tests in November 1944. However, the Navy expressed a desire for 300 Razon tails, and it was felt that, (18) because of rapidly accelerated interest in the project, service tests should be expedited. On 28 October Brig. Gen. H.M. McClelland, Air Communications Officer, authorized Maj. Gen. O.P. Echols, Assistant Chief of Air Staff, Materiel and Services, to procure 3000 Razon bombs, to be delivered to the Twentieth Air Force, which had re- (20,21) (26,27, quested that number. So far, no quantity production requirement had 28,31, been stated, but the Air Technical Service Command was directed to 33,51) assign funds not to exceed $1,000,000 to NDRC for obtaining 1000 Razon tails and to procure directly 2000 more. The Chief Signal (29) Officer, Washington, was informed of an urgent need for 3300 radio receivers of the type used in this equipment.

Although service tests were being anticipated at an early date, (30) in November 1944 Razon development was still considered incomplete, and modified designs were prepared. However, tests at Wendover (40,42) Field, Utah, indicated that the old design was more stable than the modified versions. The best position of the shroud had not been (40,44, determined, and it was recommended that NDRC continue development 46,52) work. Fuzes, arming devices, and antennae had not reached the (43,79) stage of final decision. Also, it was necessary to devise a method of reducing noise made by the gyro and servo motor.

Since the only large requirement for Razon equipment for test purposes was from the Twentieth Air Force, a study of Razon instal- (39) lation in the B-29 was recommended. Test kits, electronic equip- (45) ment, and tools were to be procured for B-29 units. A training program for VB-3 ground and air crews was planned at Fort Dix, (41,50, New Jersey, for which purpose twenty Razon tail assemblies were to 62) be furnished from the NDRC pre-production order.

A conference of military and civilian personnel interested in Razon was held on 19 January 1945. The Azon production program had been discontinued, but it was hoped that a quantity of surplus Azon components could be salvaged for Razon production. It was reported that the securing of radio receivers from the Signal Corps had (53) proved to be a bottleneck, for which reason Razon tails would not be available before April.

By 28 January the Union Switch and Signal Company had begun (56) tooling, although the final design was not expected before 15 February. A monthly output of 2000-3000 VB-3's was considered possible, an estimate which was modified 2 February, when the Union Switch and Signal Company reported that beginning 1 July, five Razons could be delivered each day, followed by 500 in August, and

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(57) 1000 per month thereafter. Twenty hand-made units would be delivered at Fort Dix by the middle of May. No definite requirement could be established at this time, but Brig. Gen. E.M. Powers, Deputy Assistant Chief of Air Staff, Materiel and Services, informed the AAF Budget and Fiscal Office that during the fiscal year 1945, $17,000,000 would be needed for procurement of 7500 VB-1, 2, 3, and 4 units; and

(58) that during the fiscal year 1946, an estimated 18,000 units would cost $18,000,000.

Further tests of VB-3 bombs of Mark Ia and Mark IV types at Wendover Field showed that both types were satisfactory, although Mark IV with an octagonal shroud was preferred because of greater maneuverability. Range errors were attributed to inadequate ballistic data. Again, in April 1945, very satisfactory results were obtained from dropping 18 VB-3's, and further ballistic tests were scheduled. Evidence indicated that one aircraft equipped with VB-3 had the same effect on the target as two aircraft dropping standard bombs. Razon's mean error was 150 feet in range and 16 feet in azimuth, considerably less than the 580 and 384 foot errors obtained from standard 1000-pound bombs dropped at the same time. Targets suitable for attack with Razon were bridges, causeways, roads, railway lines, power plants, coke ovens, blower houses, rectifier buildings, electronic industry buildings, ships, and gun positions.

(59) (74) (81) (82)

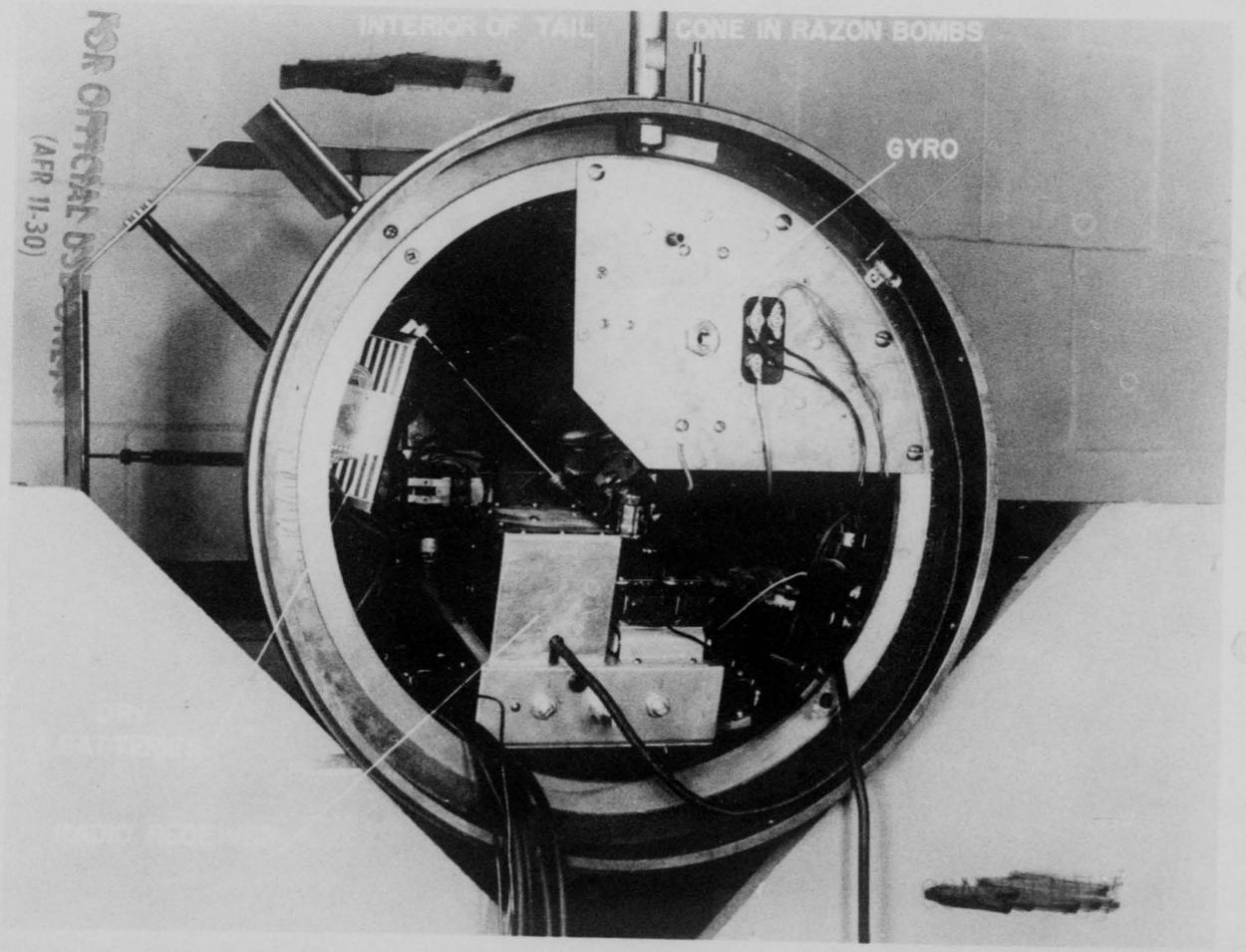
The first estimated price of a VB-3 unit was $1000, later cut to $750. In March 1945, the Union Switch and Signal Company estimated that VB-3's could be produced in quantity for from $450 to $500 per unit. In the spring of 1945, however, the stage of quantity procurement had not been reached. On 2 April the Air Technical Service Command was again directed to expedite the order for 2000 Razon units, which was planned to follow the NDRC order for 1000.

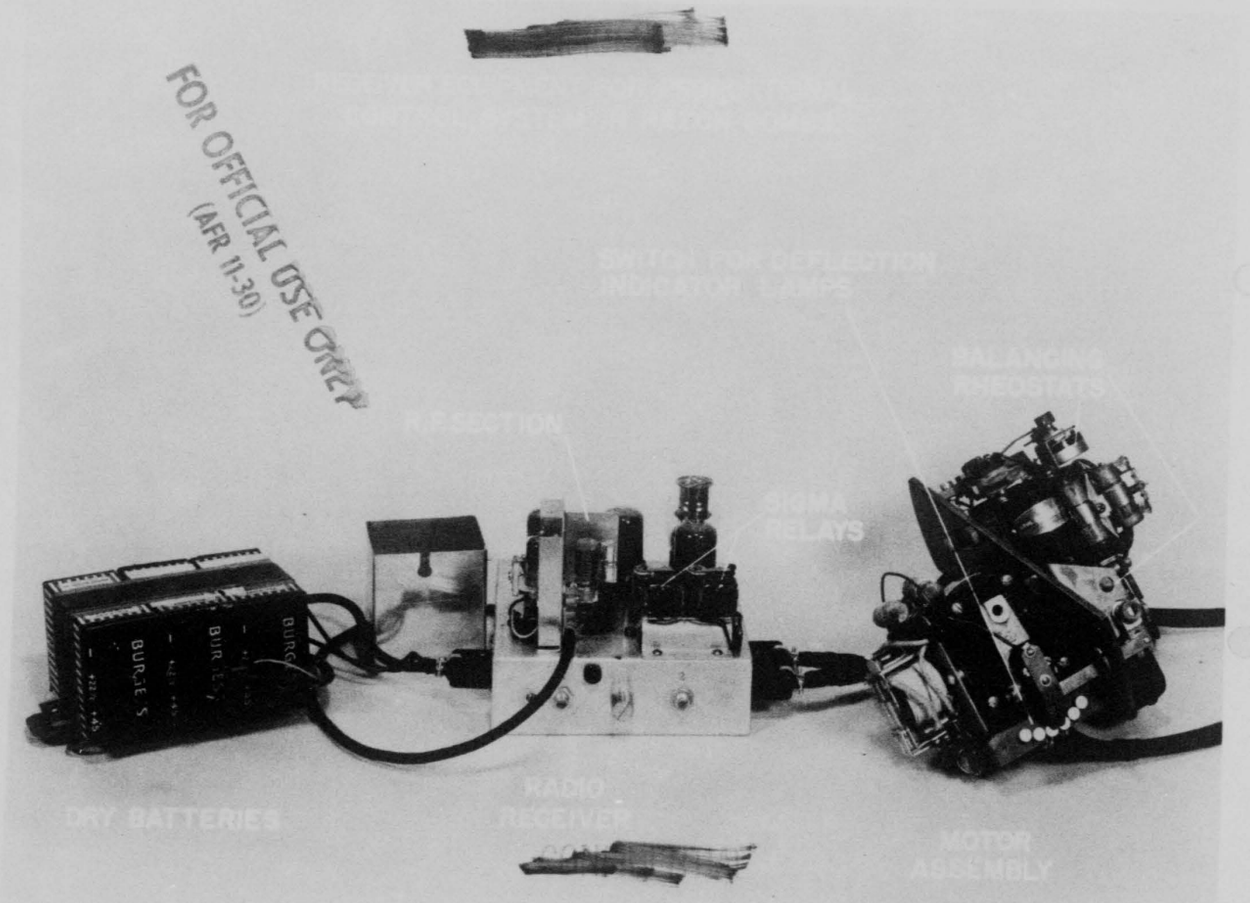
(70) (72)

The VB-4, the 2000-pound Razon bomb, was still in the mock-up stage in the spring of 1945, since development of the larger unit was not scheduled until VB-3 had been perfected.

(16,48, 56)

Photographs





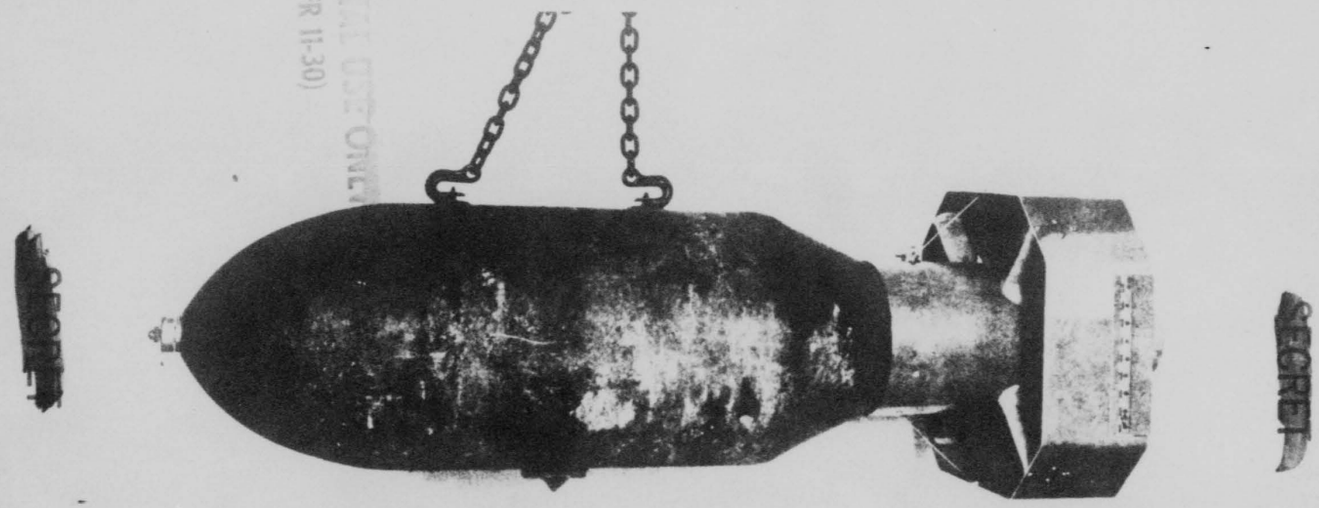


FIG. 10 - VB-3 TAIL ASSEMBLY MOUNTED ON 1000-LB. AN-M-65 GP BOMB

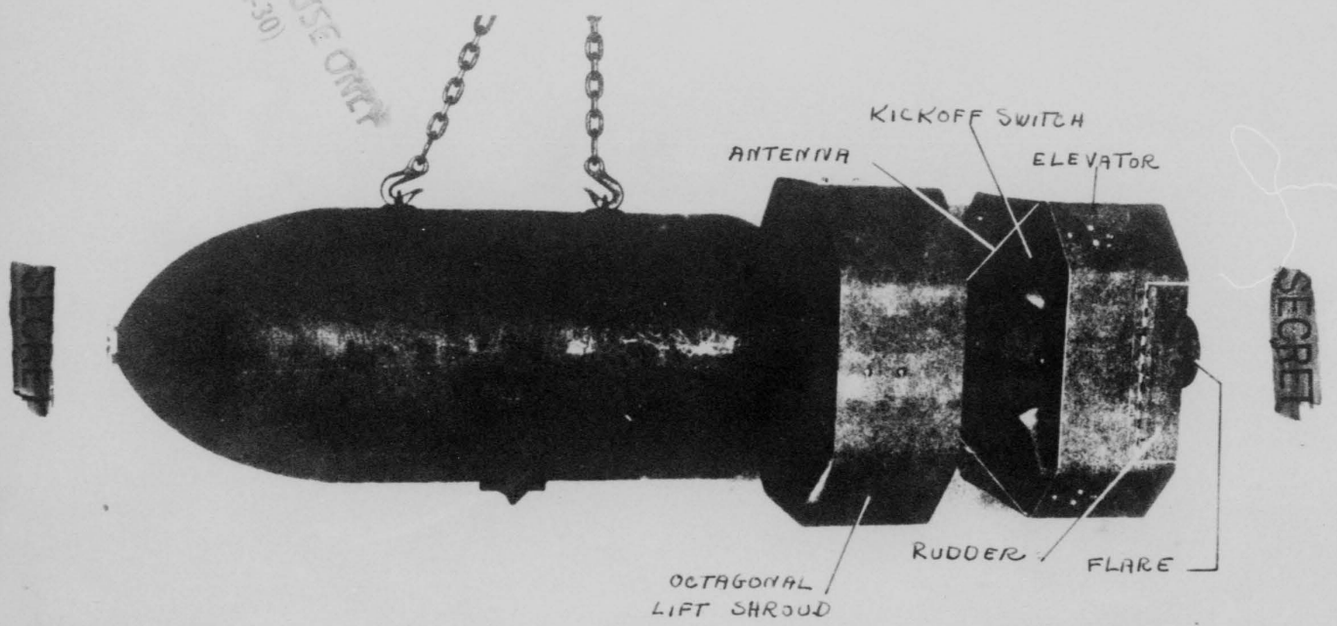


FIG. 2 - VH-3 TAIL ASSEMBLY - MARK IV MODEL - MOUNTED ON 1000-LB. AN-M-65 GP BOMB

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Auth: DIR. A.T.S.C.
Initials: C.M.T.
Date: 11 JUNE 1945

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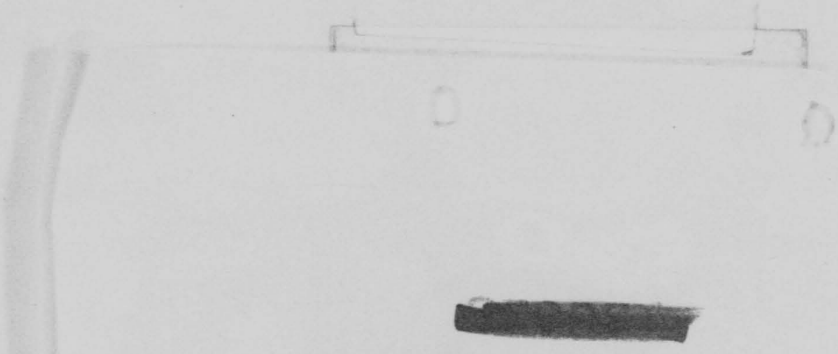
PART II



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1. (C) Memo Rpt. ENG-M-54-673-16-K, 11 March 1943 (File: Central Files)

The Razon project was initiated in April 1942 as a co-operative development project of the National Defense Research Committee and the Air Corps. Attempts were first made to control the missile in both range and azimuth but early failures resulted in altering the program to perfect control in azimuth only (see case history Controlled Missiles, Part I - Azon). With the approach toward standardization of VB-1 (Azon), interest in VB-3 (Razon) was again revived. In Feb. 1943, two special Razon bombs and ten Azon bombs were tested at Eglin Field, Fla. in the presence of Mat. Center, NDRC, and Gulf Research & Development Co. representatives. Those tests indicated that the special bombs were very stable in axis of spin, but attempts at applying control were not successful.

2. (S) Ltr. 1 June 1943
Fr: Brig. Gen. B.W. Chidlaw, Chief, Mat. Div., OAC/AS, M&D, Wash.
To: CG, Mat. Com., WF
Attn: Tech. Exec.
(File: Central Files)

Chief, Mat. Div. (Wash.), informed Tech. Exec., Mat. Com. (WF), that the Azon project was not to interfere with "the development and successful conclusion of the radar or television controlled versions with two-axis control." (See attached CTI-1350 dated 5 June 1943.)

3. (S) Ltr. 14 June 1943
Fr: L.H. Ridenour, Asst. Dir. (Radiation Lab., MIT, Cambridge, Mass.)
To: Dr. K.T. Compton, Pres., MIT, Cambridge, Mass.
(File: M&S)

Asst. Dir., Radiation Lab., notified Pres., Mass. Inst. of Tech., that NDRC Div. 5 had developed a high angle controllable bomb which was considered quite promising, and a development to adapt that bomb to control in range as well as azimuth was contemplated. The latter bomb was not to use radar homing devices, however, "because it falls at so steep an angle that target discrimination cannot be secured."

4. (C) Ltr. 21 Sept. 1943
Fr: Gulf Research & Devel. Co., Pittsburgh, Pa.
To: Capt. J.H. Evans, Special Weapons Br. (Equip. Lab.) WF
(File: Central Files)

Special Weapons Br., Equip. Lab. (WF), was advised that, if Gulf Research & Devel. Co. construction program proceeded as planned, six dual-control bombs would be completed by 11 Oct. and shipped to Eglin Field for scheduled drop tests. It was believed four or five days would be required for the drops (direct sight method) due to weather conditions and the fact that that type bomb was more of a job than those with one-axis control.

5. (C) Memo Rpt. ENG-54-673-16-M, 23 Sept. 1943
(File: M&S)

Mat. Com., NDRC, and Gulf Research & Devel. Co. representatives visited Eglin Field from 23 June to 7 July 1943 and viewed a series of tests held for the purpose of checking the performance of apparatus and roll stabilization of bombs when dropped at 45°. Six of the twelve Gulf bombs, equipped with cylindrical lift

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shrouds and octagonal tail shrouds, were direct sighted and controlled in both range and azimuth; they were designated "Razz" (later as Razon). Results of those tests were contained in Appendix II attached. It was concluded that the unsatisfactory results were due, in most cases, to radio failures.

6. (S) Ltr. 16 Nov. 1943
Fr: Maj. Gen. B.M. Giles, C/AS, Wash.
To: AC/AS, M&D, Wash.
(File: M&S)

C/AS (Wash.) stated that guided missiles were urgently needed, therefore, AC/AS, M&D, was "authorized and directed to pursue the active coordination and expedition of all guided missiles development and research projects established under the broad directive of the Air Comm. Officer and to press them to the earliest possible availability for Service use."

7. (S) Rpt. on Status of the Guided Missiles Program
20 Dec. 1943
(File: M&S)

Col. Wright (Office, Air Comm. Officer, Wash.) reported that NDRC development on both the 1000 pound and 2000 pound Razon bombs was continuing. He also stated that no procurement other than that on NDRC contract was anticipated at that time.

8. (S) Rpt. on AAF Guided Missiles Program
15 April 1944
(File: M&S)

Report on Guided Missiles Program dated 15 April 1944 included units in production (200 or over) and those ordered in experimental quantities (less than 200). Both the 1000 pound and 2000 pound Razons fell in the latter group. Because of spins encountered when both range and azimuth controls were applied, Razon was still considered experimental. It was believed Razon would prove more valuable if a range determination device or procedure was developed.

9. (C) Ltr. 28 April 1944
Fr; Brig. Gen. F.O. Carroll, Chief, Eng. Div., WF
To: Sec. 5.5, NDRC, MIT, Cambridge, Mass.
Attn: Dr. J.C. Boyce
(File: Research Proj. Br., Eng. Div.)

NDRC was advised of Mat. Com. interest in the Razon (VB-3) development. It was suggested that Razon tests be conducted at Tonopah Army Air Field, Tonopah, Nev., because that location had been selected as guided missiles proving ground after tests of bombs with flares had proved unsatisfactory at WF.

10. (S) Ltr. 12 May 1944
Fr: Brig. Gen. F.O. Carroll, Chief, Eng. Div., WF
To: CG, AAF, Wash.
Attn: Devel. Eng. Br.
(File: Research Proj. Br., Eng. Div.)

Eng. Div. (WF) sent list of guided missiles being developed by NDRC to Devel. Eng. Br. (Wash.). It was explained that every possible assistance to expedite the development had been given by Eng. Div. although it had done so without directive, except in case of VB-1, therefore, Eng. Div. asked that authority be granted to collaborate with NDRC in the guided missiles program and that the extent of its participation in the matter be explicitly stated.

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11. (S) R&R-1, 21 June 1944
Fr: Brig. Gen. H.M. McClelland, Air Comm. Officer (Wash.)
To: C/AS (Wash.)
(File: M&S)

Air Comm. Officer summarized the various guided missiles under development and production. Included in his list were: (1) Razon 1000 pound bomb (VB-3) in development stage and sponsored by NDRC; it was remotely controlled, by radio, in range and azimuth; parallax caused some trouble but the Norden bombsight was to be modified to correct that. (2) Razon 2000 pound bomb (VB-4) also was an NDRC development; similar to VB-3 except a larger bomb was used.

12. (S) Ltr. 26 June 1944
Fr: Col. R.C. Wilson, Chief, Devel. Eng. Br., Mat. Div., OAC/AS, M&D, Wash.
To: CG, Mat. Com., WF
Attn: Tech. Exec.
(File: Central Files)

Devel. Eng. Br. directed that Mat. Com. collaborate with NDRC, insofar as NDRC desired, in conducting tests on guided missiles. Proj. officers, responsible for following and reporting monthly to Hq., AAF, the progress made by NDRC, securing necessary assistance of Mat. Com., Prod. Div. and ARL, and taking all possible action to place experimental model into production without undue delay, were to be assigned to listed NDRC projects. By attached letter, Eng. Div. said Capt. J.H. Evans had been appointed project officer for VB-2, VB-3, VB-4, VB-7 and VB-8; Lt. Col. A. Nyman for VB-6, VB-10 and VB-11; the VB-5 project had been abandoned.

13. (S) Ltr. 16 Aug. 1944
Fr: 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, briefly reviewed the important facts of his recent trip to England. While there he discussed with interested AAF and British officials various controlled missiles (including Razon), dirigible bombs and German bombs. It appeared that the British were very much interested in Razon because of its dual control; the sight being used with Razon was os special interest to Royal Aircraft Establishment. The German version of Razon, the FX-1400, was carefully designed and effectively controlled, but was probably discarded because the bombs had to be carried externally thus decreasing both speed and maneuverability and increasing the vulnerability of the plane.

14. (C) TT 17 Aug. 1944
Fr: CO, Tonopah Army Air Base, Tonopah, Nev.
To: CG, Mat. Com., WF
Attn: Chief, Special Weapons Br. (Equip. Lab.)
(File: Central Files)

CO at Tonopah asked WF to authorize a flight to Kirtland Field, N.M. for purpose of securing a split vision eyepiece for use on bombsight to record Razon drops. All Razon drops were postponed until the eyepiece was obtained.

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15. (S) Memo 7 Sept. 1944
Fr: Lt. Gen. B.M. Giles, C/AS, Wash.
To: Under Secy. War, Wash.
Thru: Asst. Secy. War (Air)
(File: M&S)

C/AS forwarded military characteristics for remotely controlled guided missiles, which AAF had adopted, to Under Secy. War. The characteristics included mission, nature of missile, type of control, launching, range and altitude. It was then proposed that Mat. Com. continue development of guided missiles, that WF continue as developmental center, that Mat. Com. make all experimental procurements, and that field tests be made jointly with Mat. Com., Signal Corps and Ordnance.

16. (S) Monthly Rpt. on Exp. Guided Missiles Program
3 Oct. 1944
(File: Research Proj. Br., Eng. Div.)

The monthly status report on experimental guided missiles program indicated that the Razon procurement was less than 200 units. In Sept. tests at Tonopah proved the VB-3 pre-production model was satisfactory so the necessary changes for mass production were to be incorporated in that model and final acceptance tests made; design work on VB-4 was progressing but it was still "on the drawing board."

17. (C) Memo Rpt. TSELA-4C-673-16-Y, 26 Oct. 1944
(File: Research Proj. Br., Eng. Div.)

During the period from 4 Aug. to 9 Sept. 1944, at Tonopah, nineteen Razon bombs were dropped from a B-17 flying at altitude of 15,000 feet; results of eleven of the nineteen drops were contained in Appendix I to this report but it was emphasized that the scores obtained in combat would probably not be so good. After the tests, it was concluded that Franklin Institute's adaptation of bombsight was satisfactory; that, as a tactical weapon against special targets, Razon was very promising; and, that Razon was in final stage of development but not ready yet for combat use. Continuation of Razon development by Sec. 5.2 of NDRC was recommended.

18. (C) Ltr. 26 Oct. 1944
Fr: Col. R.C. Wilson, Actg. Chief, Eng. Br., Mat. Div., OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
Attn: Office, Chief of Adm.
(File: Central Files)

Eng. Br. wrote ATSC that the Navy and NDRC representatives had met on 19 Oct. 1944 and discussed the following matters: (1) NDRC had placed tooling contract for 150 Razon assemblies with Union Switch & Signal Co. and expected deliveries to be completed by last of Jan. 1945. (2) NDRC would test 50 of the units and distribute 50 each to Navy and Army. (3) Gulf Research & Devel. Co. would have 20 Razon tails with fuses ready for drop tests in Nov. [1944].

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(4) BuOrd wanted 300 Razon tails (developed by Army), therefore, the quickest way to get them was for Navy to transfer funds to Army and then the Army would transfer funds to extend NDRC's production of 150 to 450. Since NDRC believed Razon was ready for service tests, ATSC was requested to recommend initiation of project for those tests by AAF Board; also, number of Razon tails required for the tests. By 1st Ind. dated 20 Nov. 1944, Eng. Div. stated that 1000 items would be procured on NDRC contracts while AAF prepared specifications for a larger quantity. It recommended that 100 units be used by AAF Board in service and tactical evaluation tests. It was anticipated that Razon production would start about 15 Dec. 1944 since the article was already in final stage of completion.

19. (C) Ltr. 27 Oct. 1944
Fr: Col. T.A. Sims, Chief of Adm., ATSC, WF
To: Chief, Eng. Div., WF
(File: Research Proj. Br., Eng. Div.)

Chief of Adm. (WF) quoted memorandum from Dep. C/S which made: (1) The AAF responsible for research and development of all guided and homing missiles dropped or launched from aircraft. (2) The AAF responsible for those guided or homing missiles launched from ground but dependent on lift by aerodynamic forces; the AGF would assist AAF, when necessary, in regard to military characteristics of those missiles. (3) The ASF responsible for those guided or homing missiles launched from ground but dependent on momentum of missile; AGF charged with designation of military characteristics, with assistance from AAF when necessary. The necessity for an active program to develop usable guided missiles, incorporating radar, television, infra-red, or mechanical control systems, was emphasized. Eng. Div. was told the development of guided missiles or controls, which would prove valuable to AAF, was unlimited and unrestricted.

20. (C) Memo 27 Oct. 1944
Fr: Maj. Gen. O.P. Echols, AC/AS, M&S, Wash.
To: Air Comm. Officer [Wash.]
(File: M&S)

AC/AS, M&S, requested Air. Comm. Officer's directive to proceed with the procurement of 3000 Razons. This request was made in order that ATSC would have instructions in time to keep up the continuous delivery of components.

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21. (S) Memo 28 Oct. 1944
Fr: Brig. Gen. H.M. McClelland, Air Comm. Officer, Wash.
To: Maj. Gen. O.P. Echols (AC/AS, M&S, Wash.)
(File: M&S)

Air Comm. Officer told Gen. Echols to instruct ATSC to procure the 3000 Razon bombs and components, as requested by Dep. C/S, Combat Operations, Twentieth Air Force. Gen. Echols added a note to the Memo, which was forwarded to Mat. Div., saying WF was to be notified of the requirement.

22. (C) IOM 30 Oct. 1944
Fr: Capt. J.H. Evans, (Vertical Bomb Unit, Spec. Weapons Br.) Equip. Lab., Eng. Div., WF
(File: Special Weapons Br., Equip. Lab.)

Capt. Evans, Special Weapons Br., reported on the conference held at Gulf Research & Devel. Co. on 26 Oct. 1944, when the VB-3 was the main topic under discussion. Although Aug. tests indicated the VB-3 was very promising as a precision bombing weapon, the range control was not satisfactory, therefore, further tests on a modified version with increased control were scheduled for Nov. It was concluded that the Razon development should be continued, that serious consideration should be given to use of mechanically armed tail fuses for vertical bombs since Navy refused to accept electrically armed fuses, and that redesign of Razon for production should start at once.

23. (C) Ltr. 30 Oct. 1944
Fr: Gulf Research & Devel. Co., Pittsburgh, Pa.
To: Capt. J.H. Evans, Special Weapons Br., Equip. Lab., WF
(File: Central Files)

Equip. Lab. was advised of the requirement of twenty-four flares (white preferred) for VB-3 tests at Wendover. Previous flare failures during VB-2 drops had been encountered and Gulf was a little afraid that reliable flares would not be available from stock at Wendover. It was hoped that satisfactory flares would be obtained from same lot as those used on scheduled Spazon tests, providing the results of those drops were satisfactory. Since there was only a limited number of VB-3 bombs, Gulf felt none should be lost on account of flare trouble.

24. (U) E.O. #673-51, 4 Nov. 1944
(File: Special Weapons Br., Equip. Lab.)

E.O. #673-51 dated 4 Nov. 1944 was issued to cover close liaison with NDRC in the Razon development and the experimental tests of that equipment. NDRC was to finance most of the development costs but ATSC was expected to take care of expenses for AAF advisory assistance and government equipment needed to expedite the development; other funds to cover experimental tests and transition of the missile from experimental to production status would be necessary also; no outside purchases would be made.

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25. (C) R&R-1, 8 Nov. 1944
Fr: Maj. H.F. Marshall, Proc. Div. Coordinator for Guided Missiles Program, WF
To: Facilities Eng. Br., Res. Control Sec., WF
Attn: Mr. Opitz
(File: Special Weapons Br., Equip. Lab.)

Res. Control Sec. (WF) was informed by Proc. Div. Coordinator for Guided Missiles Program that no production requirement for Razons existed at that time, and that a requirement for more than 2000 a month was unlikely; however, it was believed that when the requirement was established, the production rate of 2000 per month would be expected to begin almost at once. It was thought the Razon requirement would be established within three months.

26. (S) Memo 10 Nov. 1944
Fr: Brig. Gen. D. Wilson, AC/AS, OC&R, Wash.
To: C/AS, Wash.
(File: M&S)

AC/AS, OC&R, gave a brief description of the VB-3 and results of recent tests at Tonopah. Because of the increased accuracy of Razon bombs over uncontrolled bombs, under the same conditions, Twentieth Air Force requested 3000 for use in that Theater. The VB-4 was a 2000 pound version of the VB-3 and functioned in the same manner; it was still in the experimental stage and design work was suspended until results of VB-3 tests were available. No quantity requirement for VB-3 had been established but would be after operational suitability of the missile was obtained; the VB-4 procurement would be made only after the VB-3 proved satisfactory. It was recommended that procurement of 3000 Razon tails be initiated at once.

27. (C) Ltr. 11 Nov. 1944
Fr: Col. J.F. Phillips, Chief, Mat. Div., OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
Attn: Office, Chief of Adm.
(File: Central Files)

Mat. Div. directed ATSC to assign funds to NDRC for early procurement of 1000 Razon tails needed for various tests, and to procure 2000 additional Razon tails for same purpose. Necessary spares would be furnished by ATSC, radio receivers would be GFE from Signal Corps, and cancelled Azon tail procurement would provide some components and material for Razon. ATSC was also to forward delivery schedule and list of necessary test equipment and tools for the procurement to Mat. Div.

28. (C) Ltr. 11 Nov. 1944
Fr: Col. J.F. Phillips, AAF Liaison Officer with NDRC, Wash.
To: Col. Osborne, War Dept. Liaison Officer for NDRC, Wash.
(File: Research Proj. Br., Eng. Div.)

WDLO for NDRC was informed of requirement of 1000 Razon tails for 1000 pound bombs; the procurement was to be through NDRC in addition to pre-production procurement, and the equipment was for tests of AAF Board and Navy, and for theater service tests. AAF would secure the necessary radio receivers from Signal Corps and ordnance items from Ordnance. Upon receipt of NDRC's cost estimate, ATSC would make formal allocation of funds, and furnish delivery instructions for the Razon equipments. It was requested that deliveries be expedited because the missiles were needed for operational uses.

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29. (S) Ltr. 14 Nov. 1944
Fr: Col. D.W. Benner, Chief, Air Service Div., OAC/AS, M&S, Wash.
To: Chief Signal Officer, Wash.
Attn: Req. Div.
(File: M&S)

Chief Signal Officer (Wash.) was informed of the urgent need for 3300 AN/CRW-7 radio receivers for use with the VB-3 tails. The radio receivers were to be GFE to Razon tails, so coordination between Signal Office and ATSC to insure concurrent deliveries was requested.

30. (S) Memo 14 Nov. 1944
Fr: Lt. Col. V.A. Stace (OAC/AS, M&S, Wash.)
To: Lt. Col. W.P. Allis (Asst. War Dept. Liaison Officer for NDRC, Wash.)
(File: M&S)

The Razon development was incomplete at the time of this writing. Tests of a modified design were scheduled sometime in Nov., but it was felt still further changes would be necessary. Since NDRC was developing the bomb, it was not advisable for ATSC to place a production order, but rather NDRC should procure enough tails for AAF Board, Navy and service tests; later, ATSC would continue that procurement. The radio and ordnance items, for use on Razons, were to be obtained through Signal Corps and Ordnance and furnished as GFE to NDRC.

31. (C) TI-2003, Add. 4, 17 Nov. 1944
Fr: Col. T.A. Sims, Chief of Adm., ATSC, WF
To: Proc., Eng. and Supply Divisions (WF)
(File: Research Proj. Br., Eng. Div.)

TI-2003, Add. 4, dated 17 Nov. 1944 directed, with authority from CG, AAF, the procurement of 3000 Razon (VB-3) tails for 1000 pound bombs. The following action of the various divisions was desired: (1) Eng. Div.--develop the Razon tails in cooperation with NDRC, and furnish information for determining tools and testing equipment for the tails to Supply Div. (2) Proc. Div.--assign funds to NDRC for procurement of 1000 Razon tails, procure 2000 additional tails as soon as Eng. Div. supplied the drawings and engineering data, arrange for delivery of Signal Corps radio receivers to contractor for use in Razon tails, determine, with Supply Div. help, quantity of spares required, arrange for the packaging and shipment of 2000 VB-3's overseas, and send delivery schedule of 3000 Razon tails to AC/AS, M&S. (3) Supply Div.--assist Proc. Div. in procuring spares for Razon tails, assist in determining tools and test equipment needed for Razon tails, and initiate procurement action. (4) Main. Div.--assist Supply Div. in determining the tools and test equipment for the tails, and issue Technical Instructions.

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32. (C) Ltr. 20 Nov. 1944
Fr: Col. J.F. Phillips, Chief, Mat. Div., OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
Attn: Office, Chief of Adm.
(File: Research Proj. Br., Eng. Div.)

Mat. Div. wrote that it was probable that development and testing of Razon tails would reach a point, before NDRC procurement order was completed, where it would be preferable for ATSC to continue the procurement. The transfer would be arranged by ATSC with NDRC.

33. (C) Ltr. 20 Nov. 1944
Fr: Irvin Stewart, Exec. Secy., OSRD (Wash.)
To: WDLO for NDRC, Eq., ASF, Wash.
(File: Research Proj. Br., Eng. Div.)

Office of Scientific Research and Devel. (Wash.) agreed to the requested extension of project AC-36. It would issue a letter of intent in the amount of $1,000,000 to Union Switch & Signal Co. for 1000 Razon tail assemblies. Then, if AAF production order, including the 1000 units, was written as anticipated, the OSRD letter of intent would be withdrawn. Unless a contract for the Razon tails was negotiated by 15 Jan. 1945, AAF would be expected to transfer $1,000,000 to OSRD in order that obligated funds could be released for regular OSRD activities. That amount would be retransferred to the Army when a production contract was issued and OSRD's letter of intent withdrawn.

34. (C) Ltr. 22 Nov. 1944
Fr: 1st Lt. W.H. Hess, Special Weapons Test Unit, Wendover Field, Utah
To: Dir., ATSC, WF
Attn: Capt. J.H. Evans
(File: Special Weapons Br., Equip. Lab.)

ATSC was notified of receipt at Wendover Field, Utah, of ten Razon units with shroud moved forward of that in previous models. Drop tests were delayed a few days while Razon components were checked.

35. (C) IOM 23 Nov. 1944
Fr: W.E. Donnelly, Asst. to Chief, Proc. Div., WF
To: Aero. Equip. Sub-Sec., Prod. Sec., Proc. Div., WF
(File: Central Files)

A recent directive called for procurement of 1000 VB-3's from NDRC, plus production of 2000 from Eng. Div. specifications and drawings. The procurement of 2000 was awaiting production data; although action had been initiated through WDLO for NDRC for the procurement of 1000, a formal purchase order would not be placed with NDRC until Proc. Div. issued the AFF's. The Navy was to get 300 of the VB-3's, and their order to cover the procurement was being initiated.

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36. (C) Ltr. 28 Nov. 1944
Fr: 1st Lt. W.H. Hess,
Special Weapons Test Unit,
Wendover Field, Utah
To: Dir., ATSC, WF
Attn: Capt. J.H. Evans,
Equip. Lab., Eng. Div.
(File: Special Weapons Br.,
Equip. Lab.)

Lt. Hess reported from Wendover Field that the Razon mission scheduled for Sat. (25 Nov. 1944) had been cancelled due to trouble encountered the day before with Azon equipment. He stated that if reliable data was expected from initial tests, Razon bombs should not be dropped in salvo. In order that those bombs would not be expended without obtaining definite results, it was suggested that Razon missions be postponed until rack failure to release electrically had been corrected.

37. (C) Ltr. 28 Nov. 1944
Fr: 1st Lt. W.H. Hess,
Special Weapons Test Unit,
Wendover Field, Utah
To: Dir., ATSC, WF
Attn: Capt. J.H. Evans,
Equip. Lab., Eng. Div.
(File: Special Weapons Br.,
Equip. Lab.)

ATSC was notified that one mission of Razon bombs on 28 Nov. had to be suspended because of bombsight stabilizer failure; later the same day, two more bomb runs were made. One bomb did not respond to control, so no evaluation of stability was made; the other gyrated so upon application of control that the range and azimuth errors were meaningless. The trouble seemed to be in location of the shroud, so further tests with shroud moved rearward two inches were to be conducted as soon as the weather was favorable.

38. (C) Ltr. 30 Nov. 1944
Fr: Col. D.C. Doubleday,
Chief, Eng. Br., Mat. Div.,
OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
Attn: Office, Chief of Adm.
(File: M&S)

Eng. Br. informed Chief of Adm. that ATSC was to take over procurement of 1000 Razon equipments as soon as testing and development had progressed enough that a production contract could be placed. Steps to take over a part of the NDRC procurement were to be taken by ATSC at the earliest practicable date.

39. (S) R&R-1, 1 Dec. 1944
Fr: Col. S.A. Mundell, Chief,
Equip. Div., Office, Air
Comm. Officer, Wash.
To: Lt. Col. DuBose, Dep. C/S
for Combat Operations, Twentieth Air Force and Lt. Col. V.A.
Stace, Guided Missiles Unit,
Equip. Sec., Mat. Div., M&S,
Wash.
(File: M&S)

Chief, Equip. Div., Office of Air Comm. Officer, stated that the Razon requirement established by Twentieth Air Force was for test purposes to determine the extent of its use in that area. A study of Razon installation in B-29 was recommended, but it was not to interfere with more urgent B-29 problems since Razon was not expected to be in production until latter part of Jan. 1945.

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40. (C) Memo Rpt. TSEPL-3-673-46, 14 Dec. 1944
(File: Research Proj. Br., Eng. Div.)

Representatives of ATSC, Naval Air Station at Traverse City, Mich., and Gulf Research & Devel. Co. witnessed tests of Razon which were conducted 6 Nov. through 8 Dec. 1944 at Wendover Field. Conclusions reached were: (1) Neither the VB-3 Mark II nor the modified VB-3 Mark II exhibited enough stability during drops. (2) Earlier designs showed greater stability than those tested, thereby proving a final design with shroud still nearer the tail unit was necessary. It was then recommended that Sec. 5.2 of NDRC continue development work on Razon until it was completed.

41. (C) Ltr. 15 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: Research Proj. Br., Eng. Div.)

Inasmuch as delivery of production Razon tails would not begin until latter part of Jan., Eng. Div. was directed to secure twenty complete tail units from NDRC pre-production order, and forward them to Fort Dix, N.J., for training purposes. One unit for inspection and information was to be sent to Fort Dix as soon as possible.

42. (S) Progress Rpt.
18 Dec. 1944
(File: M&S)

After six drops using the new increased maneuverability design Razon (VB-3), it was decided to go back to the old design which was more stable in both yaw and pitch. Estimated delivery schedule was given for the 1150 items from NDRC, and it was believed the rate could be increased to 1000 per month after April. The radio receiver was expected to be a "bottleneck item" and it was quite possible that delay in deliveries would also be caused by fuse difficulties. No development or production of the VB-4, which wouldn't reach the drawing board until Jan., was contemplated until it was determined whether the possible bomb load was acceptable to the services.

43. (U) R&R-1, 19 Dec. 1944
Fr: Lt. Col. G.L. Haller, Chief, Special Proj. Lab., Radio & Radar Sec., Eng. Div., WF
To: Equip. Lab. (WF)
(File: Special Weapons Br., Equip. Lab.)

Radio & Radar Sec., Eng. Div. (WF), informed Equip. Lab. that in order to insure reliable operation of radio control equipment, it would be necessary to reduce gyro and servo noise. By Comment #2, Equip. Lab. replied that servos and gyros would be furnished them for noise studies. NDRC's request for complete Razon tail assembly for noise study would be complied with as soon as the latest modified model VB-3 was available.

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44. (C) Ltr. 23 Dec. 1944
Fr: Union Switch & Signal Co., Swissvale, Pa.
To: CG, ATSC, WF
Attn: Capt. J.H. Evans
(File: Special Weapons Br., Equip. Lab.)

Gulf Research & Devel. Co. had suggested that the octagonal lift shroud be used on 150 VB-3's on the NDRC development contract. Union Switch & Signal Co. said they must know type of fuse to be employed and dimension of Ord. Dept. arming device before they could go ahead with the VB-3; also, it was necessary that information concerning final antenna design be expedited if developed Razons were to be produced in Jan. or Feb. 1945.

45. (S) Ltr. 27 Dec. 1944
Fr: Col. D.C. Doubleday, Chief, Eng. Br., Mat. Div., OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
(File: Central Files)

Eng. Br. notified ATSC of requirement for Razons to be tested by Twentieth Air Force. It was requested (1) that a mockup and test of Razon in B-29 be made, (2) that ten service test kits be procured in order to have enough B-29 aircraft equipment for the tests, (3) that necessary tools and test equipment be obtained for the service test kits and for the 3300 Razon bombs under procurement, and (4) that quantity and type of electronic equipment for the kits and tests be determined and reported to Eng. Br. The mockup and tests referred to above were not to interfere with other B-29 problems, since Razon production would not be started until last of Jan. (TI-2029, Add. 20, dated 2 Jan. 1945, initiated action in accordance with above letter.)

46. (C) R&R-1, 30 Dec. 1944
Fr: Col. G.V. Holloman, Chief, Equip. Lab., Propulsion & Access. Sec., Eng. Div., WF
To: Ord. Sec., WF
Attn: Capt. R.H. Vandenberg
(File: Special Weapons Br., Equip. Lab.)

Ord. Sec. (WF) was asked to initiate project for a suitable tail fuse, similar to the T-75, to meet existing requirement of fuse for VB-3. Ord. Sec. answered that requirements for the above-mentioned tail fuse had been submitted to Air Ord. Office (Wash.).

47. (R) Hq. Office Instruction #20-79, 1 Jan. 1945
Fr: Lt. Gen. B.M. Giles, Dep. Com. of 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 responsibility 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

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that the Air Comm. Officer was charged with completion of work, through test introduction into the theaters, on those guided missiles projects having electronic systems of flight control but not requiring propulsion units, which have already been started.

48. (S) Ltr. 5 Jan. 1945
Fr: Col. D.C. Doubleday, Chief, Eng. Br., Mat. Div., OAC/AS, M&S, Wash.
To: Dir., ATSC, WF
Attn: Eng. Div.
(File: Research Proj. Br., Eng. Div.)

Eng. Div. was asked to comment on use of Razon with 4000 pound bomb. By 1st Ind. dated 5 Feb. 1945, Eng. Div. replied that the above project should not be initiated, unless specifically requested, until Razon with 1000 pound bomb was perfected.

49. (C) Ltr. 11 Jan. 1945
Fr: Lt. Col. H.Y. Smith, Chief, Eng. Standards Sec., Eng. Div., WF
To: Dr. L.O. Grondahl, Chief, Sec. 5.2, NDRC, Union Switch & Signal Co., Pittsburgh, Pa.
(File: Central Files)

Eng. Div. requested Union Switch & Signal Co. to furnish various photographic views of the Razon tail assembly mounted to a AN-M-65 general purpose bomb case or mockup. The photographs were needed in the preparation of production specifications. (The photographs were sent to Eng. Div. by Gulf Research & Devel. Co., at Dr. Grondahl's request, on 30 Jan.)

50. (C) Ltr. 12 Jan. 1945
Fr: Lt. Col. H.Y. Smith, Chief, Eng. Standards Sec., Eng. Div., WF
To: Dr. L.O. Grondahl, Chief, Sec. 5.2. NDRC, Union Switch & Signal Co., Pittsburgh, Pa.
(File: Research Proj. Br., Eng. Div.)

Union Switch & Signal Co. was asked to notify ATSC when the twenty Razon tail assemblies, especially the one for inspection and information, would be available to Fort Dix. By attached letter dated 18 Jan. 1945, Union Switch & Signal Co. replied that the complete Razon units would not be available until the middle of March.

51. (S) Ltr. 13 Jan. 1945
Fr: Col. H.A. Shepard, Actg. Chief, Prod. Sec., WF
To: C.O., Eastern Dist., ATSC, New York, N.Y.
Attn: Prod. Exec.
(File: Central Files)

Prod. Sec. (WF) wrote Eastern Dist. (New York) giving the important facts concerning the Razon procurement and production progras. It was stated that NDRC letter of intent for 1000 production units had been issued to Union Switch & Signal Co. but, when engineering and development had progressed sufficiently to permit design standardization, AAF would take over that procurement plus that of another 2000. Special Weapons Br. had been instructed to cooperate with NDRC on the design development and

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also to furnish drawings and data to Proc. Div., which was to decide on delivery schedule of the 1000 units and the possible follow-on schedule. A number of directional control gyros, from cancellation of Azon procurement, were in possession of Union Switch & Signal Co. and would be used in the first 1000 Razons. (It was later reported by Prod. Control Sec. that a definite delivery schedule was impossible until experimental and research work was finished, but an attempt would be made to secure an estimated schedule.)

52. (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 T6, T7 and T8 guide flares in use on VB-1 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 finished by last of Jan. 1945; (2) flare production would be completed before a decision on mechanically 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.

53. (S) IDM 22 Jan. 1945
Fr: JFV (Maj. J.F. Vogel)
For: Record
(File: M&S)

A conference was held on 19 Jan. 1945, at which time future procurement of Azon and Razon bombs was discussed. In regard to Razon, the following points were brought out: (1) Dr. Boyce was convinced one bombardier could satisfactorily control the missile, (2) the control box needed a few modifications, (3) drawings were expected to be completed in Feb., (4) April was earliest date when Razon tails would be available because of delay in getting radio receivers, (5) Union Switch & Signal Co. had not received ATSC order for 2000 tail units, (6) Dr. Boyce suggested installation of belly movie cameras, (7) Dr. Grondahl said anemometer for T-75 tail fuse was acceptable for Razon, (8) NDRC would forward parts of Razon equipment to Fort Dix for training purposes, and (9) NDRC was of the opinion that a standardized airplane warm-up circuit should be incorporated in both Razon and Felix.

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54. (C) Ltr. 24 Jan. 1945
Fr: 1st Lt. W.H. Hess, Razon Proj. Officer, Special Weapons Test Unit, Wendover Field, Utah
To: Dir., ATSC, WF
Attn: Capt. J.H. Evans
(File: Special Weapons Br., Equip. Lab.)

Razon Proj. Officer, then at Wendover Field, listed and briefly described the general features of the various types of VB-3 designs which had received consideration. The list included the Mark I, Mark I-a, Mark II, Mark II-a, Mark III and Mark IV. [For details, see document.]

55. (C) Ltr. 25 Jan. 1945
Fr: Lt. Col. H.Y. Smith, Chief, Eng. Standards Sec., Eng. Div., WF
To: Dr. L.O. Grondahl, Chief, Sec. 5.2, NDRC, Union Switch & Signal Co., Pittsburgh, Pa.
(File: Central Files)

Hoping that the assembly might be incorporated into the production Razon, Eng. Div. sent to Union Switch & Signal Co. a sample flare mounting bracket together with simple instructions for its installation. Union Switch & Signal Co. comments on construction of assembly and any suggestions were invited.

56. (S) Progress Rpt.
28 Jan. 1945
(File: M&S)

Modifications of the VB-3 were under way in an attempt to get an article with better maneuverability. New measurements of antenna impedance and radiation pattern would require two months work; the final design was expected to be established by 15 Feb. In the meantime, AAF specifications were being prepared in order to be ready for future production procurement. Tooling was already begun and Union Switch & Signal Co. thought about 2000 - 3000 production VB-3's per month was possible. No orders had been placed for the CRAB bombsights for the VB-3. The Tenth Air Force believed Razon would be very successful on certain targets in their territory. Action was being taken to procure tool and test equipment for ten service test kits and for 3300 VB-3's. The mockup of the VB-4 was incomplete and would remain so until the VB-3 design was frozen. The wooden mockup would probably be finished by first of March, and, after it was decided how many bombs could be accommodated in present bomb bays, the VB-4 tooling would begin.

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54. (C) Ltr. 24 Jan. 1945
Fr: 1st Lt. W.E. Hess,
Razon Proj. Officer,
Special Weapons Test Unit,
Wendover Field, Utah
To: Dir., AFSC, WF
Attn: Capt. J.H. Nvans
(File: Special Weapons Br.,
Equip. Lab.)

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Fr: Lt. Col. H.Y. Smith,
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Eng. Div., WF
To: Dr. L.O. Grondahl, Chief,
Sec. 5.2, NDRC, Union Switch
& Signal Co., Pittsburgh, Pa.
(File: Central Files)

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57. (C) Ltr. 2 Feb. 1945
Fr: Union Switch & Signal Co., Swissvale, Pa.
To: ATSC, Proc. Div., WF
Attn: Maj. H.F. Marshall
(File: Central Files)

In reply to recent inquiry from Prod. Div., Union Switch & Signal Co. made following promises regarding production Razons: (1) Provided engineering data was available by 20 Feb., twenty of the 150 test units, on order, could be delivered by 1 April and the remainder by middle of May. (2) Those test Razons would be hand-made, but economical production required tools which could be furnished by last of May. (3) Beginning 1 July, five Razons could be turned over for delivery each day; that number would be increased later in the month with approximate July deliveries being 225; 500 in Aug.; 1000 in Sept.; and 1000 each month thereafter for an indefinite period. Union Switch & Signal Co. thought a contract for at least 6000 Razons should be placed with them to justify that stepped-up production.

58. (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 new and required continued research in order to complete development. It was estimated that, other than research and development contracts, $100,000,000 was needed to cover guided missiles procurement during FY 1945, and, 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 would be set aside for procurement of VB-1, 2, 3 and 4's. The above figures cover both Air Force and Signal Corps equipment; bombs, being standard, would not require special procurement.

59. (C) Memo Rpt. TSRPL-3-673-46-A, 9 Feb. 1945
(File: Research Proj. Br., Eng. Div.)

During Jan., at Wendover Field, eight Razon units of the Mark I-a type and ten units of the two Mark IV types were dropped, along with 1000 pound GP bombs used as dummies, from an altitude of 15,000 feet. Gulf Research & Devel. Co., ATSC and BuOrd personnel, who witnessed the drops, concluded that (1) stability characteristics of all types were satisfactory, (2) the Mark IV with octagonal shroud was preferred because a greater deviation from initial trajectory could be obtained than with other types, (3) the T-75E1 tail fuse was suitable for Razon, and (4) insufficient ballistic data accounted for range errors. It was then recommended that NDRC

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incorporate Mark IV with octagonal shroud in the production Razon, also that Razon be released to ATSC before AAF Board evaluation and service tests; and, that Eng. Div. obtain necessary ballistic data on either the pre-production or production version before Razon was turned over to the AAF Board.

60. (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 was held on 8 Feb. 1945 in Wash. Although there were no provisions for NDRC's continuance after the war, Div. 5 expected to go ahead with those developments already begun, furnish control equipment to the services, and act in advisory capacity to the services. The activities of various groups in connection with NDRC projects were outlined by Drs. Dryden, Grondahl, Mertz and Boyce. The Pittsburgh Project, headed by Dr. Grondahl, included Razon (VB-3 and VB-4). The VB-3 with double shroud and sighting improvements was expected to have a range accuracy to within 30 - 40 feet and an azimuth accuracy about the same as that of the VB-1.

61. (C) Ltr. 14 Feb. 1945
Fr: Gulf Research & Devel. Co., Pittsburgh, Pa.
To: Capt. J.H. Evans, Special Weapons Br., Equip. Lab., WF
(File: Central Files)

Gulf Research & Devel. Co. notified Equip. Lab. that two sample Razon units had been shipped for permanent use of that Lab. Although the units were of final design, the several listed changes would be incorporated in the production model with little effect on external appearance or radio antenna performance. One of the units was to be turned over to ARL for development of antenna.

62. (C) Ltr. 14 Feb. 1945
Fr: Lt. Col. H.Y. Smith, Chief, Eng. Standards Sec., Eng. Div., WF
To: Dr. L.O. Grondahl, Chief, Sec. 5.2, NDRC, Union Switch & Signal Co., Pittsburgh, Pa.
(File: Research Proj. Br., Eng. Div.)

The urgent need for the first Razon tail for inspection and information purposes in connection with the ground and air crew training program was basis for Eng. Div. repeat request for expeditious delivery of that one to precede the other nineteen on order.

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63. (C) Ltr. 17 Feb. 1945
Fr: Lt. Col. H.Y. Smith, Chief, Eng. Standards Sec., Eng. Div., WF
To: CG, AAF, Wash.
Attn: Eng. Br., Mat. Div., AC/AS, M&S
(File: Research Proj. Br., Eng. Div.)

Eng. Div. informed Eng. Br. that the first Razon tail assembly would probably be shipped to Fort Dix the first part of April, and the remaining nineteen would be shipped from pre-production units within another month.

64. (S) Excerpt from Div. 5 13th BiMonthly Rpt. to NDRC 15 Feb. 1945
(File: Research Proj. Br., Eng. Div.)

BiMonthly report prepared by Div. 5 of NDRC gave a brief summary of the Pittsburgh Project (including Razon) up to 15 Dec. 1944, and the progress made from that date to 15 Feb. 1945. (Documents substantiating the information in the above report included in earlier part of case history.)

65. (C) Ltr. 17 Feb. 1945
Fr: Col. G.V. Holloman, Chief, Equip. Lab., Eng. Div., WF
To: C.O., Wendover Field, Wendover, Utah
Attn: Capt. M.A. Chiba, Special Weapons Test Unit
(File: Central Files)

Equip. Lab. stated that a series of tests for purpose of obtaining ballistic data on the Razon missile would be conducted at Wendover Field, starting the first of March and continuing for three or four weeks. Besides usual requirements, certain other requirements regarding planes, instruments, flares, inert bombs, vertical bomb range and wind directions were outlined.

66. (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 modifications of M51, T7E1 and T8E1 flares would present 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 for development of air arming device to be used with electrical ignition of flares in production VB-3 tail assemblies was contained in this Ind. Production of 3150 VB-3 assemblies was scheduled: 20 by 1 April, 130 more by 15 May, another 225 in July, 500 in Aug. and 1000 a month thereafter.

[redacted]

[redacted]

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

OC&R advised 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 stated that the missiles should (1) be suitable for use in all weather, especially bad weather; (2) be designed so plane could carry them internally; (3) be suitable for multiple release and control; and (4) incorporate target-seeking devices when possible. Both VB-3 and VB-4 bombs were required for tactical purposes, with VB-3 having the higher priority.

68. (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 the amount set up for research and development of guided missiles during FY 1946, as follows:

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

69. (C) Ltr. 21 March 1945
Fr: Col. F.H. Robey, Chief, Propulsion & Access. Sec., Eng. Div., WF
To: CG, AAF, Wash.
Attn: Mr. G. Boehm, Devel. Eng. Br., OAC/AS, M&S
(File: Central Files)

The CRAB I, originally developed by Franklin Institute with the idea of adapting M series bombsights for use of Razon bombs, was explained to Devel. Eng. Br. CRAB I consisted of "a small stationary full-silvered mirror which is inserted between the telescope objective lens and the target mirror in such a manner as to intercept a portion of the light from the target normally entering the telescope, and to substitute for this portion, light coming from the controllable bomb." ATSC had been instructed to procure ten CRAB I modification kits, and a contract was let for fifteen kits from Gen. Scientific Corp. (Chicago). Meanwhile, the L.N. Schwein Eng. Corp. (Los Angeles) had developed a modified CRAB I attachment with full sized half-silvered mirror which increased the auxiliary mirror's field and also lessened possibility of bomb image being lost by operator. It had been suggested that ATSC procure 100 CRAB I or modified CRAB I attachments, whichever was most satisfactory, to meet the urgent Razon requirement. ATSC initiated action to get some of the modified CRAB I kits, under procurement by NDRC, for comparative tests with the original CRAB I attachments.

[redacted]

70. (S) Ltr. 24 March 1945
Fr: Col. H.K. Shepard, Actg. Chief, Prod. Sec., Proc. Div., WF
To: CG, AAF, Wash. Attn: Maj. Vogel, OAC/AS, M&S
(File: Central Files)

In confirmation of recent telephone conversation, Prod. Sec. stated that Union Switch & Signal Co. estimated prices of Razons first at $1,000 per unit, then $750, and finally $450 to $500, if produced in quantity. A number of gyro assemblies, servo motors and batteries were on hand due to the termination of Azon contracts; each Razon assembly required one gyro, one servo, and four batteries; the Azon gyro, if modified, was satisfactory for use on Razon, but the Azon servo could not be used in Razon units.

71. (C) R&R-1, 26 March 1945
Fr: Col. D.C. Doubleday, Chief, Eng. Br., Mat. Div., Wash.
To: Air Comm. Officer, Special Proj. Sec.; AC/AS, M&S; and AC/AS, OC&R, Req. Div., Wash.
(File: M&S)

Chief, Eng. Br., informed Air Comm. Officer, OC&R, and M&S of the estimated VB-3 delivery dates beginning with 20 pre-production units in April, production deliveries would start with 225 in July and continue at rate of 500 per month. Additional orders would have to be placed prior to 1 Aug. if a production rate of 500 per month was to continue; for 1000 per month production, at least 7000 items would be required and the estimated schedule follows: 225 in July, 500 in Aug., 750 in Sept., 1000 each in Oct., Nov. and Dec. 1945, 1000 each in Jan. and Feb. and 525 in March 1946. Razon drop tests were set for April at Wendover, and AAF Board evaluation tests were to begin the latter part of May 1945; theater requirements would be determined after results of evaluation tests were available. Requirements were to be coordinated if Razon was to supplant Azon. By Comment #2, Air Comm. Officer stated no change in delivery schedule was recommended because no further production was contemplated until after the evaluation tests. Since OC&R was responsible for operational use of Razon and Azon, it was up to them to make recommendations for one supplanting the other. In Comment #3, Req. Div. stated no service requirement of Razon would be made until AAF Board found the missile satisfactory, and that requirements would be coordinated if tests indicated Razon could supplant Azon.

72. (C) TT 2 April 1945
Fr: Wash.
To: AFSC, WF
(File: Central Files)

Wash. advised WF that, in order that delivery of the 2000 Razon units could begin as soon as NDRC order for 1000 was completed, the AFSC order should have been placed by 1 April 1945. It appeared quite possible that the NDRC deliveries would be completed by 1 July, two months ahead of schedule.

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73. (C) R&R-1, 4 April 1945
Fr: Col. S.R. Stewart, Chief, Equip. Lab., Eng. Div., WF
To: Guided Missiles Unit, Prod. Sec., Proc. Div., WF
(File: Special Weapons Br., Equip. Lab.)

Equip. Lab. concurred in use of Union Switch & Signal Co. drawings as VB-3 procurement data pending availability of AAF drawings and specifications. The above action was believed necessary to avoid delay in obtaining materials for 3000 production VB-3's.

74. (S) Progress Rpt.
5 April 1945
(File: M&S)

Eighteen VB-3's, having two octagonal lift shrouds, were dropped at Wendover with very satisfactory results. A satisfactory antenna design to be used with AN/CRW-7 radio receiver in the VB-3 had also been established. It was found that the B-24 plane would accommodate six to eight VB-3 units. The VB-3 assembly, without bomb, cost $816.50; quantity production was expected to reduce that amount by $100. NDRC estimated delivery of its entire VB-3 order by 1 July, after which ATSC's order for 2000 would begin at rate of 500 per month. Twenty-five ballistic tests and ten or fifteen engineering service tests were scheduled to be made at Wendover beginning 15 April; AAF Board tests would begin about 1 June. Development of "Tallboy", a 12,000 pound semi-armor-piercing bomb controllable in both range and azimuth, was started by ATSC the latter part of Feb. The bomb was "designed for deep penetration of heavily fortified targets." Planes specially modified to carry "Tallboy" were the B-29 and the British Lancaster.

75. (C) Ltr. 7 April 1945
Fr: Maj. Gen. C.L. Chennault, CG [Fourteenth Air Force]
To: H.H. Spencer, NDRC, MIT, Cambridge, Mass.
(File: M&S)

Gen. Chennault, CG, Fourteenth Air Force, wrote NDRC that he was very much impressed by movies showing operation of VB-3. He stated that Azon had been used very successfully against Jap lines of communication, and it appeared that future bombings would be made from high altitudes. He expressed appreciation for NDRC's interest in the situation and asked to be kept posted on any new developments.

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76. (C) R&R-1, 7 April 1945
Fr: Col. S.R. Stewart, Chief, Equip. Lab., Propulsion & Access. Sub-Div., Eng. Div., WF
To: Ord. Sec., WF
Attn: Capt. R.H. Vandenberg
(File: Special Weapons Br., Equip. Lab.)

Ord. Sec. was asked to send a quantity of nose and tail fuses and flares to be used on twenty-five VB-3 units which were scheduled for tests soon after the ballistic data tests at Wendover were completed. It was estimated that the fuse and flare tests would begin approximately 23 April.

77. (U) Ltr. 9 April 1945
Fr: H.H. Spencer, Chief, Div. 5, NDRC
To: CAC/AS, M&S, Mat. Div., Research Liaison Sec., Wash.
Attn: Col. W.S. Brown
(File: Special Weapons Br., Equip. Lab.)

Div. 5 of NDRC advised Research Liaison Sec. (Wash.) that tests of pre-production VB-3's were scheduled to begin 25 April at Wendover Air Base. After the tests, a number of Razons would be turned over to AAF Board for evaluation.

78. (S) Ltr. 13 April 1945
Fr: H.H. Spencer, Chief, Div. 5, NDRC, MIT, Cambridge, Mass.
To: CG, AAF, Wash.
Attn: Lt. Col. V.A. Stace
(File: M&S)

Chief, Div. 5 of NDRC, informed Col. Stace that bombardiers could be expected to control the VB-3 with probable errors of about one mil in azimuth and ten mils in range. Tests had resulted in a better record than this, but it was felt the above figures were more reliable.

79. (C) R&R-1, 25 April 1945
Fr: Col. S.R. Stewart, Chief, Equip. Lab., Eng. Div., WF
To: Guided Missiles Unit, Prod. Sec., Proc. Div., WF
Attn: Capt. Dungan
(File: Special Weapons Br., Equip. Lab.)

Equip. Lab. requested that action be taken to procure enough noise suppression items for the VB-3's in order that production schedules could be met. Those 125 bombs still remaining on NDRC order were needed by AAF Board before 1 June so service and evaluation tests could be conducted. By Comment #2, dated 2 May, Capt. Dungan replied that Supply Div. was shipping the necessary items to Union Switch & Signal Co.

80. (U) Ltr. 2 May 1945
Fr: H.H. Spencer, Chief, Div. 5, NDRC
To: C.O., Special Weapons Unit, WF
Attn: Lt. Col. C.O. French
(File: Special Weapons Br., Equip. Lab.)

In order that defects in design of the VB-3 might be discovered and corrected, NDRC suggested that Special Weapons Br. thoroughly test the two pre-production models being sent them by Union Switch & Signal Co.

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81. (S) R&R-4, 5 May 1945
Fr: Col. J.N. Stone, Actg. Chief, Operational Plans Div., AC/AS, Plans, Wash.
To: Req. Div., AC/AS, OC&R and Joint Target Group, AC/AS, Intell., Wash.
(File: M&S)

Available evidence indicated that, because of the missile's reliability and accuracy, one aircraft bombing with the VB-3 had the same effect on the target as two aircraft bombings with standard bombs. Therefore, it was recommended that VB-3 requirement be established at once so all VHB, HB and MB bases could be provided with a quantity of those missiles.

82. (S) Ltr. 10 May 1945
Fr: H.H. Spencer, Chief, Div. 5, NDRC, Wash.
To: Dr. R.L. Stearns, Chief, Operations Analysis Sec., Twentieth Air Force, Wash.
(File: M&S)

Chief of Div. 5, NDRC, sent information concerning the VB-1, VB-3 and VB-6 guided missiles, which were available or would be soon for combat use. In regard to the VB-3 he said that the bomb had previously been controlled in range by one operator and in azimuth by another, but tests were being conducted to determine effect on accuracy when only one operator did the guiding. Tests had indicated the Razon's mean error was 150 feet in range and 16 feet in azimuth, which was considerably less than the 580 foot and 384 foot errors obtained with standard 1000 pound bombs dropped at same time from 15,000 feet. It was hoped that NDRC would finish the tests before last of May, after which AAF Board evaluation tests would begin. Delivery of the 3000 Razons, on order, would start sometime in July. In attached Memo, it was stated that targets suitable for attack with Razon were bridges, causeways, roads, railroad lines, power plants, coke ovens, blower houses, boiler houses, rectifier buildings, electronic industry buildings, ships and gun positions.

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WAR DEPARTMENT
AIR CORPS, MATERIEL DIVISION

MEMORANDUM REPORT ON

862
EMK:hle:54-235
1213

Date March 11, 1943

SUBJECT: Controllable High Angle Bomb

SECTION Equipment Laboratory

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

SERIAL No. EMC-A-54-673-16 K

MX-225

DATE
CHF. DIV.
TECH. EXC.
ADM. EXC.
C. O.
BUD. OFF.
EXP. ENG.
PROD. ENG.
CONTRACT
INSP.
MAINT. COMM.
I. P. S.
OTHERS

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	Gulf Research & Development Co.
Major T. L. Mayrath	Dr. J. P. Molnar
Lt. E. W. Moorman	Mr. R. D. Wyckoff
Major D. L. Anderson	Mr. T. B. Pepper
	Mr. C. A. Gustavson
Section 5.2, N.D.R.C.	Mr. L. D. Palmar
	Mr. A. B. Lindeberg
Mr. A. J. Wollan	

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

MX-225 (AFR 11-30)

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

4. The action 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. W. MORMAN, 2nd Lt., A.C.

C. V. HOLLOMAN, Colonel, A.C.
Equipment Laboratory,
Engineering Division.

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

[redacted]

MX-225

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 moments of the pivoting cylinder were too great to be overcome by the servo motor.

CASE HISTORY of CONTROLLED MISSILES PROJECTS
VB-3 (RAZON)

Wright Field

TO: Air Technical Service
Historical Officer, ~~XXXXXX~~ Command.

STATEMENT BY: (Name) Major John H. Evans
(Title) Chief, Vertical Bomb Unit,
Equipment Laboratory
Engineering Div.

HISTORY SUMMARY OF VB-3 (RAZON)

The VB-3 (Razon) was initiated as a cooperative development project of the National Defense Research Committee and the Air Corps in April 1942. Attempts were first made to control the missile in both range and azimuth, but early failures resulted in altering the program to perfect control in one axis only. Control in Azimuth only was chosen, and considerable tests were conducted using the missile in this way. With increased interest in this phase of the Razon development and as an expedient only, all efforts were concentrated in the perfection of this new missile which was called VB-1 (Azon). With the standardization of VB-1, interest in VB-3 was again enlivened and the development of a bombsight attachment to make possible control of the range component was initiated. The sight modification proved practicable and was immediately made part of the VB-3 development. The VB-3 missile was modified to give greater control, was service tested, and was evolved as a complete missile in June 1945.

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(Signature) John H. Evans
Maj A.C.

1 June 1945

[redacted]

WAR DEPARTMENT

HEADQUARTERS OF THE ARMY AIR FORCES

WASHINGTON

[redacted]

[redacted]

[redacted]

[redacted]

Incl.
Ltr to Maj. Gen. Williams

COPY

WAR DEPARTMENT
HEADQUARTERS, MATERIEL COMMAND

[redacted]

AUTH: C.O., 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 fuses 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 fuses 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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Serial No.: OTI-1350 [redacted] 6

Subject: High Angle Controllable Bomb in Azimuth.

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, Mateierl, 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]

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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. N. 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)

[redacted]

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Y

[illegible]

[illegible] 1[illegible]

Dr. K. T. Compton, President
[illegible] Institute of Technology
Room 3-[illegible]
Cambridge, Mass.

Dear Dr. Compton:

[illegible] will recall that at the meeting of Division 5 of the NDRC [illegible] the various radar homing projects [illegible] at the Radiation Laboratory. You suggested at that time that I write you a memorandum [illegible] to Dr. Bush, so that he could take action to straighten out the rather confused situation which has grown up regarding these projects. This is intended [illegible] letter.

[illegible] Radar Target-Seeking Devices

Two general types of radar homing equipment are now under development at the laboratory. The first [illegible] a radar receiver only and depends upon a radar set carried in an aircraft for illuminating the target during an attack. This is referred to as the [illegible] equipment. An order of 100 of these sets [illegible].C.C. is [illegible] being completed, and [illegible] small production order for 400 equipments of improved design has been divided between Zenith and the General Electric Company by the Navy. The Radiation Laboratory has been requested to act as consultant with regard to this contract and is actively engaged in doing what it can to help with all phases of the engineering which precedes production.

The second type of equipment which is being worked on at the laboratory is the so-called SHB equipment. This is a radar homing device whose target selector is identical with that used in the [illegible] equipment and whose receiver is very similar; however, a transmitter is incorporated also with the expendable radar equipment included in the [illegible]. Three different types of this equipment have been contemplated, two operating on the S-band and one on the X-band. Of the two operating on the S-band, the first uses the Lighthouse transmitter-receiver unit (L[illegible]) which forms the basis of the radar system for the SCR-7[illegible], which is now in procurement, plus the target selector and antenna units of the [illegible], which is now in production. This combination has already been satisfactorily test flown and appears to be suitable for application to glide bombs. It is probably not suitable for application to drones because it contains no provisions for automatic frequency control and probably could not stay in tune over long periods of time.

The second type of S-band SHB equipment is one exactly similar in principle to that just described, but employing a lightweight magnetron

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I. Program of the Bureau of Ordnance

The Bureau of Ordnance [illegible] Navy [illegible] [illegible] rather consider the program in this field. The first missile which is being developed is the so-called Pelican, which is an eight-foot scale model of the vehicle designed by Dr. Dryden to carry a 2000-pound bomb. [illegible] load of the target is about [illegible] pounds. About thirty experimental [illegible] of this vehicle employing radar homing [illegible] have so far been made, and the development of the entire missile is proceeding in a very promising way.

This has encouraged the Bureau of Ordnance to undertake a program of development looking toward the employment of larger models of the same Dryden glider and the use of [illegible] type of radar homing equipment. Commander [illegible] has stated that the Bureau of Ordnance holds the view that this may be as important as the development of the torpedo was to surface warfare.

As has already been indicated, the Bureau of Ordnance has suggested that the participation of the Radiation Laboratory in this program be limited to the RHB development for the Pelican project.

II. Program of the Bureau of Aeronautics

Partly under the Bureau of Aeronautics and partly under Naval Operations, a very considerable program is being carried on by the Navy in the development of assault drones. The homing means which are to be provided to bring these vehicles to their targets are foreseen now as being principally television and the frequency-modulated CW homing device being developed by R.C.A. and mentioned above. There seems to be general agreement on the part of those connected with this program that the pulse type of radar homing equipment such as is being developed at the Radiation Laboratory is not particularly suited for this application.

The Bureau of Aeronautics of the Navy Department also has a program for the development of glider bombs, towed vehicles which could be launched by loosing their tow, and could then home in on a target. I do not know what type of target-seeking mechanism is contemplated for these gliders, but the question of using the pulse type of radar homing equipment developed here in these vehicles has never been raised by the Bureau of Aeronautics.

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III. Army Special Weapons Program

The Special Weapons Unit of the Equipment Laboratory at Wright Field has a rather considerable program of work going forward on glide bombs of various types. Their principal interest in this development centers on the pre-set glide bomb and a bomb controllable by direct sight means. The homing equipment which they are chiefly interested in uses infrared radiation. Their rather considerable interest in radar homing means is subordinate to all these other possibilities that I have mentioned.

[illegible] the national defense of [illegible] within the meaning of the Espionage Act, U.S.C. 50; 31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

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At the present time there seems to be evidence that the type of glide bomb being employed by the Army will not fly stably when control impulses from the homing device are applied to it, if it has been altered to accommodate the bulk of the radar equipment. This defect can probably be cured by proper attention paid to the aerodynamic design of the vehicle, but so far it has not been remedied.

IV. Program of NDRC, Division 5

Division 5 is helping with the Pelican and Bat programs of the Bureau of Ordnance (the Dryden vehicle with RH type equipment installed is referred to by Bureau of Ordnance as BAT). This work is under the general direction of Dr. Dryden and is going very satisfactorily as has already been indicated.

The high-angle bomb controllable in azimuth only has also been developed by Division 5 and is regarded by the Army as being very promising. Development is contemplated to adapt this vehicle to control in two dimensions instead of azimuth only, but radar homing devices [illegible] for use with this device because it falls at so [illegible] that target discrimination cannot be secured.

Division 5 is also pushing the development of a medium-scale glide bomb of novel design which is being worked on at the Douglas Aircraft Company. The ultimate application of radar homing devices to this bomb is a distinct possibility, but the state of its development is still so early that it will not be ready for trials with radar homing equipment for many months to come.

Conclusions and Recommendations

In the light of the situation as it has been outlined in the foregoing sections, I should like to suggest that the following recommendations be made to Dr. Bush:

1. Primary cognizance on all project requests having to do with radar homing equipment should be assigned to Division 5 instead of Division 14. This is suggested because of the fact that the radar homing control depends in such a fundamental way on the characteristics of the vehicle which is to be guided.

2. Work in the Radiation Laboratory should now be restricted to making the RH equipment successful in its application to the Pelican vehicle. All other work on radar pulse homing at the Radiation Laboratory should be stopped. This suggestion is made because of the fact that the principal work required in making radar homing equipment successful in a guided vehicle comes after the vehicle, plus flight control, plus homing device, has been assembled and is available for test. A very considerable amount of work has already gone into bringing

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GULF

PETROLEUM AND ITS PRODUCTS

GULF RESEARCH & DEVELOPMENT COMPANY

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P. D. Wyckoff

RDW:CK
cc: Dr. Grondahl (2)
Dr. Eckhardt (1)

CENTRAL FILES

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Original Cont. Missiles
70.2/10 Miss-14 (1/4 M)
AAFMC-266-WF-8-8-42-200M
R&R 8, D2B
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ARMY AIR FORCES
MATERIEL ~~CENTER~~ COMMAND
ENGINEERING DIVISION
MEMORANDUM REPORT ON

6155
JHE:nle:54-6707

SUBJECT: Project MX-225 (Direct Sight Bomb)

Date 23 September 1943

~~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. R. G. Wyckoff
Mr. E. V. Palmer
Mr. C. A. Gustavson
Mr. W. E. Wickerham
Mr. A. Carnvale
Dr. J. P. 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]

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MDAC-266-WP-6-27-41-60M sets

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Engin. Div. Memo. Report No. EMC-5L-673-16
23 September 1943

cylindrical lift shrouds and octagonal tail shrouds. The overall dimensions of the Razz are approximately equivalent to those of a standard 2000 pound demolition bomb. See Appendix II attached for data and Razz 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. H. EVANS, Capt., A.C.
(Name)

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

Concurrence:

Approved by [redacted]
for Chief, Engineering Division.

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

MX-225

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

[redacted]

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

16 NOV 1943

SUBJECT: Expediting Components for Guided Missiles Program.

TO: Assistant Chief of Air Staff
Materiel, Maintenance and Distribution
Headquarters, Army Air Forces
Washington, D. C.

1. In order to meet urgent current needs, the Assistant Chief of Air Staff, Materiel, Maintenance and Distribution is authorized and directed to pursue the active coordination and expedition of all guided missiles development and research projects established under the broad directive of the Air Communications Officer and to press them to the earliest possible availability for Service use.

2. In the execution of this directive it is anticipated that certain articles must be procured to meet immediate requirements although better articles are in an advanced stage of development. The procurement of any type or model of controlled missile is authorized immediately upon its approval by the Air Communications Officer even though it is expected to be superseded by an improved type or model within a short time thereafter.

3. It will be the responsibility of the Assistant Chief of Air Staff, Materiel, Maintenance and Distribution to keep the Air Communications Officer fully advised as to the status of research, development, and procurement of all controlled missiles projects established under this directive.

By command of General ARNOLD:

Barney M. Giles,
Major General, U. S. Army,
Chief of the Air Staff.

[redacted]
By Authority of
The Commanding General
Army Air Forces
11/16/43
Date Initials

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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. Materiel 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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RL, DEB

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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 [illegible] which were purely experimental models. For example, the radio set was not installed in the tail assembly but inside the bomb proper and [illegible] 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 Division has been primarily concerned with the expediting [illegible] 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. [illegible] development of this bomb in both 1000 lb. and 2000 lb. sizes. [illegible] 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 2 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 1c, training for Azon.

c. Procurement: No change in original procurement requirements for 1000 completed units except as noted in paragraph 3a.

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d. Remarks: The [illegible] receiver with slight modification, has been tested and [illegible] by [illegible] for operation with the GB-8. Recently, however, the Hammond Co., [illegible] the Gyros, have designed [illegible] receiver [illegible] for use in conjunction with standard [illegible]-274 receiver [illegible], which is intended to [illegible] the SCR-185. Mr. Hammond prevailed upon Col. Holloman [illegible] to delay procurement of SCR-185 until he, Mr. Hammond, [illegible] in the advantages offered by [illegible] equipment. Consequently, Col. Holloman requested [illegible] conference [illegible] 1943.

e. Conclusion: It is now estimated that 100 of the GB-8 glide bombs will be completed and delivered for operational [illegible] about 1 March 1944. These tests will be conducted by the Army Air Forces Board, possibly at Tonopah, Nevada, with Proving Ground and Wright Field personnel assisting and observing. [illegible] covering the [illegible] of such tests is being forwarded to Orlando for [illegible] comments.

4. GLIDE BOMB - GB-4 (Television-radio controlled)

a. Development: A new wing structure has been designed and tested, with first models being [illegible] company. The television, Block III [illegible] 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 [illegible] the year.

c. Training: [illegible] by [illegible] training. [illegible] personnel will continue to be [illegible] Wright Field and Orlando.

d. Procurement: The [illegible] for [illegible] and 110 receiver-[illegible] is now in [illegible] Signal Corps [illegible] Wright Field [illegible]. Procurement for [illegible] structures, complete [illegible] television [illegible] through Materiel Command. The [illegible] ordered through Signal Corps, but [illegible] 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 3e.

5. RHB (Radar Homing Bomb requiring special radar transmitter to illuminate the target)

a. Development: The Army is taking 100 only development models from Navy Bureau of Ordnance.

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b. Tests: Expected some time during January.

c. Training: Joint with Navy.

d. Procurement: None beyond the [illegible]00 developmental models.

e. [illegible]: Special Weapons Branch [illegible] Wright Field [illegible] following entire project.

6. [illegible] - "B[illegible]" ([illegible] Homing Bomb)

a. Development: Continuing through Navy Bureau of Ordnance.

b. [illegible]: [illegible] early 1944.

c. Training: [illegible] program planned at present.

d. Procurement: [illegible] from Bell Telephone Laboratories [illegible] total quantity of 500 [illegible] units. 35 [illegible] units will be pre-production models.

7. [illegible] (Bomb designed to home on enemy [illegible])

a. Experimental only. [illegible] 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 Fleetwings to Wright Field. No decision yet as to type for future procurement. The XBQ-2 is designed for a 2000 lb. load.

CONCLUSIONS:

From the foregoing, it appears that the [illegible] 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 P. WRIGHT
Colonel, Air Corps

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(AFR 11-30)

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Unmes. Cont Missiles.
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also be good for locating camouflaged or underground factories.

2. UNITS ORDERED IN EXPERIMENTAL QUANTITIES (LESS THAN 200) INCLUDING AZON 2000 lb., RAZON, GB-5, GB-6, GB-7, MOTH, GB-9, GB-10, ROC, XBQ, JET PROPULSION, GLIDERS, A-3

a. Azon - 2000 lb. High Angle Bomb (AZ-2):

(1) Description: Same gyros and radio as 1000 lb. Azon, but larger tail and control surfaces. Fits into shackles for 2000 lb. bomb. Still a N.D.R.C. development. B-17 will carry two internally and two externally. B-25 will carry one. B-24 will probably carry four.

(2) Characteristics: Control is more sluggish than the 1000 lb. Azon, and several drops in early April have shown a tendency to spin. Spin tendencies are expected to be corrected easily, but control will probably always be about one-third less than 1000 lb. Azon. This smaller degree of control is considered satisfactory.

(3) Availability: 20 have been completed for test. Two drops at Eglin gave promising results. The remainder will probably be dropped from 15,000 ft. above ground (approximately 20,000 total altitude) at Tonopah. Union Switch and Signal Company, the vendor for the 1000 lb. Azon, is tooling up for production partly financed by N. D. R. C. and partly at their own expense. No production orders have been determined yet, but it is hoped that decisions can be reached this month. Production will take about three months after orders are placed.

(4) Training: Same as Azon 1000 lb. Bomb.

(5) Comments: Although it seems generally accepted that a 2000 lb. bomb is preferable to a 1000 lb., there is comparatively little push behind this program, pending results on operational use of 1000 lb. bomb.

b. Razon - 1000 lb. and 2000 lb. High Angle Bomb:

(1) Description: High angle bombs controllable in range and azimuth. Uses Felix airframe and servo mechanism. N.D.R.C. development.

(2) Availability: Still experimental due to difficulty of eliminating spins when both controls are applied. Further drops will be made at Tonopah during April 1944.

(3) Training: None

(4) Comments: This device has taken second place to the Felix on the N.D.R.C. development list. The bombardier has difficulty similar to that for the GB-8 in determining range but range determination is simpler than GB-8 due to proximity to the target. This device and the GB-8 would undoubtedly be far more valuable if a suitable range determination device or procedure can be developed. The development of the airframe and servo will be

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complete when the Felix is complete. Final decisions will have to be made on the radio to be used, however.

e. GB-5 Series, 2000 lb. Glide Bombs, Light Seekers:

(1) Description: All use the Aeronca Target Seeker 2000 lb. vehicle (See MHB) Gyro stabilized. This vehicle loses altitude at the rate of approximately 1000 ft. in 15 seconds. (A drop from 6000 ft. takes approximately 1½ minutes).

(a) GB-5A Fairchild photo-electric, marine, target-seeker that homes on light contrast. 30 on order with three delivered, and tests starting shortly. Experimental units have been flown with satisfactory results. 5 to 6 miles range.

(b) GB-5B Hammond flare seeker obsolete.

(c) GB-5C Hammond-Crosley photocell, scanning, marine-type, contrast light-seeker. Homes on marine targets offering visible contrasts against water. Should home on largest vessel in the fleet. Accurate for ranges up to 7-10 miles. Can be dropped at further distances to fly initially as preset with photocell "eyes" opened at operating range. 25 are under procurement with 5 checked on preliminary tests and additional tests starting in May at Tonopah.

(d) GB-5D Fairchild photocell flare-seeker device, designed to home on strong source of light. 20 are under procurement with deliveries estimated for 1 July 1944. Flares are being developed to drop on land targets by low flying fast airplanes (manually or radio controlled). The present flares are dropped by parachute. They are 3 ft. long, 7 inches diameter, weigh 80 lbs and burn 3 minutes at 100,000 candle power and 3 minutes at 1,000,000 candle power.

(e) Special Use for Flare Seekers: The Materiel Command personnel developing the heat and light "seeker" glide bombs feel that they have real potentialities against specific targets, such as block houses or other point objectives. The light seeker is considered particularly promising against flares planted by a low flying fast airplane (remotely or manually controlled) or planted by other means - such as mortars or rockets. The flare would be planted in front of the objective and the bomb coming in, due to its flat trajectory should skid into the target. Although the enemy would probably find means eventually of extinguishing this flare, they would have to act very rapidly. A very important possibility of confusing the enemy, after several have been used successfully and they find out what the flares mean - would be to use the flares against various targets - even when a glide bomb was not going to follow in. If this use is considered practical for operations, and it is desired to have the articles really pushed, for tactical employment, it will be necessary to establish with the Materiel Command a definite military requirement and give high priority to a

[redacted]

Room 10-212
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

File 36

April 13, 1944

Commanding General
Materiel Center
Wright Field
Dayton, Ohio

Attention: Captain John H. Evans,
Special Weapons Section.

Dear Sir:

Some months ago Dr. Bush, Director of the Office of Scientific Research and Development, suggested an investigation into possible modification of a standard bombsight to assist in guiding the Razon bomb in range and, if possible, to permit a limited amount of evasive action during the period in which the Azon or Razon bomb is being guided. The problem has been studied at the laboratory of the Franklin Institute in Philadelphia under the supervision of Mr. G. A. Philbrick, Technical Aide, Section ~~XX~~ 7.2, NDRC. A Norden sight for their use was furnished by the Armament Laboratory at the request of General McClelland's office. It is understood that a somewhat different approach to the first part of the problem has been made at the Gulf Laboratory, using another Norden sight which your office requested for them.

The development at the Franklin Institute has one possible limitation, but if this is not too severe, it seems to me to offer greater flexibility in use and to take care of a limited amount of evasive action, as well. The Franklin Institute device consists of a small mirror, which is inserted into part of the field between the telescope and the synchronizing mirror. As it is not in the focal plane, it acts somewhat like a partially silvered mirror placed at that same position. The whole field of view surrounding the target remains undisturbed, but there is superposed upon it a second image, which is the view looking directly downward, or rather, slightly behind that along the direction of the angle of trail. The flare of the bomb will appear stationary in this superposed field of view, and if the range was correctly estimated, the image of the flare should be superposed on top of the target image. There will also be seen in rapid motion across the field of view the image of the ground as viewed along the line of trail.

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see letter of Sept 44 [redacted]

[redacted]

It is hard from laboratory tests to determine whether or not this moving image will be disturbing to the process of guiding, and it seems to me the best way to determine this would be by actual observations. The size of the small, auxiliary mirror would determine the relative intensity of the superposed image, but this image could not be greatly reduced in intensity without jeopardizing the visibility of the flare. Something might possibly be done by the use of a color filter, particularly if a colored flare were used.

I am writing this letter to give you the general background of the problem. I have suggested to Mr. Philbrick that he get directly in touch with you to see if you could assist in arranging facilities to test his device. It is believed that the practice bombing range near Wright Field would provide a better test than the range at Tonopah, since the scenery at Tonopah might perhaps be described as monotonous. To test the device, it would only be necessary to drop a few dummy bombs with flares attached. Anything that you can do to help Mr. Philbrick will be greatly appreciated, both by Division 5 and, I am sure, by the Gulf group. If the confusion from the moving scenery in the superposed field of view is not too great, the Franklin Institute device is extremely simple and can be built in the form of a field modification kit for the Norden sight. No additional holes would be needed and the mirror mounting could be held by screws already present in the device.

You will shortly hear from Mr. Philbrick about his work. Should you wish to visit the Franklin Institute before arranging the tests, I know he would be very glad to make an appointment to meet you there. His best address is:

Mr. George A. Philbrick
Technical Aide, Section 7.2
National Defense Research Committee
Room 3-253
Massachusetts Institute of Technology
Cambridge 39, Massachusetts.

Sincerely yours,

Joseph C. Boyce /s/

JOSEPH C. BOYCE,
Chief, Section 5.5, NDRC.

[redacted]

COPY

Address reply & ENVELOPE to:
Commanding General
AAF Material Command
Engineering Division
Reference JHE:hls:54
Wright Field, Dayton, Chio

AC-36

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5-10-44

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12 MAY 1944

Collaboration with the N.D.R.C.
Guided Missiles Program.

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

Attention: Development Engineering Branch,
Material Division, Asst. C/AS, MM & D.

1. Attached is a list of guided missiles under development by N.D.R.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 CTI-1350, 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 N.D.R.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,

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

1 Incl.
List of Guided Missiles.

MX-225
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X

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]

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AC-51

[redacted]

Address reply to [redacted]:

Commanding General
AAF Material Command
Engineering Division
Reference: JHP:hlw:9L
Wright Field, Dayton, Ohio

[redacted] COMMAND

[redacted]

AC-36
AC-36

28 APR 1946

ET 0655

Section S-5, N.D.R.C.
Room 10-212,
Massachusetts Institute of Technology,
Cambridge 39, Massachusetts.
Attention: Dr. Joseph C. Boyce.

Gentlemen:

Reference is made to your letter dated 11 April 1946, concerning modification of a standard bombsight to assist in guiding the Razon bomb in range and particularly the testing involved in this development.

The Material Command is extremely interested in this development and will extend every aid to carry it to a successful conclusion. However, tests at Wright Field involving the use of bombs with flares have proven to be very unsatisfactory owing to the limited amount of bomb handling equipment available at this station, and the lack of fire fighting facilities at the bombing range. Tonopah Army Air Field has been set up by this Office as the proving ground for all guided missiles. Therefore, it is requested that Tonopah be considered as the testing grounds for this item rather than Wright Field.

This Office concurs that the development and testing of this bombsight modification should be coordinated with the Razon Project Officer at Wright Field.

Very truly yours,

[redacted]
F. O. CARROLL,
Brig. General, U.S.A.,
Chief, Engineering Division.

Copy to:
N.U.R.C. Liaison Office, Engin. Div.

PROJECT NO. MX-225

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HEADQUARTERS ARMY AIR FORCES

ROUTING AND RECORD SHEET

TAB NO.	
FILE NO.	

SUBJECT: Description and Status of Guided Missiles Now Under Development & Production

TO: Chief of Air Staff

DATE 21 Jun 44

COMMENT NO. 1
WLN/nd/5375

The attached summary describes all guided missiles now under development and production. It should be noted that one, the AZON, has been actively used in the theatres. In addition, the GB-1, which is not remotely controlled, has been given a preliminary trial with the Eighth Air Force. The GB-4 and GB-8 are in production, have been and been fully evaluated as to their capabilities. All other missiles listed are still in various stages of development.

H. M. McCLELLAND
Brig General, U. S. Army

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3-1109 A.F.

CI, AAF 55-61

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SUMMARY OF GUIDED MISSILES

I. Vertical Bombs.

A. VB-1 Azon bomb, 1000 lbs.

1. Description -

The Azon tail replaces the standard tail on the 1000 lbs. bomb, and permits control in Azimuth only. Six (6) Azon bombs can be carried in a B-17, eight (8) in a B-24, two (2) or possibly three (3) in a B-25 and four (4) in a B-26. The bombardier corrects azimuth by remote radio control while observing a flare mounted in the tail. Flares come red, white and green. Two (2) more colors are being requested. At present the radio frequency channels permit up to six simultaneous drops controlled by six different bombardiers, however it is contemplated that more channels will be available shortly.

2. Status -

This equipment is now being used operationally by the 8th, 9th and 15th Air Forces, the 10th Air Force in India considered.

B. VB-2, Azon bomb, 2000 lbs.

1. Description -

This equipment is similar to that used for the 1000 lb. Azon, but larger tail unit control surfaces are used for the 2000 lb. Azon bomb. The B-17 will carry two (2) internal and two (2) external, the B-25 will carry one and the B-24 possibly four (4).

2. Status -

This project is under the cognizance of NDRC.

C. VB-3, Razon bomb, 1000 lbs.

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(AFR 11-30)

1. Description -

The Razon bomb is controllable in range as well as Azimuth, and will be remote radio controlled by the bombardier as in Azon. Parallax is the most serious difficulty but it is hoped that satisfactory modifications to the Norden bomb sight will clear this difficulty.

2. Status -

This project is in a development stage and is sponsored by NDRC.

[redacted]

CF, AAF [illegible]

[redacted]

D. VB-[illegible], [illegible], [illegible] lbs.

1. [illegible] -

[illegible]

2. [illegible] -

[illegible]

E. [illegible]

1. [illegible] -

[illegible]

2. [illegible] -

[illegible] experimental. [illegible] within a range of [illegible]

F. [illegible]

[illegible]

[illegible], Heat

1. Description -

It is proposed that the 1000 lb. standard bomb or the 1100 lb. semi-armor piercing bomb will be used. It will be carried externally on the aircraft. 4 symmetrically spaced stub wings surround the bomb, which will permit the bomb to dive at angles from 30 to 60 degrees. Development of a satisfactory seeker or small television is being considered.

2. Status -

NDRC development sponsored by the Army Air Forces. None of the experimental articles produced to date will carry the necessary equipment and pay load. An effort is being made to develop a circular airfoil, or shroud, which will permit ROC bombs to be loaded internally in an airplane.

[redacted]

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HEADQUARTERS, ARMY AIR FORCES (AFDRA-2F)

Washington

26 June 1944

SUBJECT: Collaboration with the NDRC Guided Missiles Program

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

Attention: Technical Executive

SECRET
By Authority of
The Commanding General
Army Air Forces

20 June 1944 AGD

1. Reference is made to the letter of 12 June, from the Engineering Division, Materiel Command, subject as above.

2. It is directed that the Materiel Command assist the NDRC in conducting all NDRC tests on guided missiles. This assistance is to include equipment, (expendable and otherwise), facilities, and personnel. The amount and type of assistance is to be specified by the NDRC representatives conducting the tests.

3. In order that this necessary assistance can be furnished, the Materiel Command will establish projects on the VB-2, VB-3, VB-4, VB-5, VB-6, VB-7, VB-8, VB-9, VB-10, and VB-11.

4. It is further directed that the Materiel Command assign a project officer to each of the following NDRC projects:

a. VB-2

b. VB-3 and VB-4

c. VB-6

d. VB-11

5. These project officers will be responsible for:

a. Following the NDRC progress carefully

b. Reporting this progress to AC/AAF at least monthly.

c. Securing necessary Materiel Command assistance on any tests.

12

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d. Securing any required assistance from the Production Division, Materiel Command, on information required by the NDRC on production planning or production facilities.

e. Making all preliminary action possible, without delaying development, to minimize the delay when the experimental item is put into production.

f. Securing ABL collaboration when necessary.

6. It is further directed that the Materiel Command will follow, to a lesser extent, i n order to obtain information and furnish progress reports at least monthly, the following NDRC projects:

a. VB-5

b. VB-7 and VB-8

c. VB-9 and VB-10

7. The Materiel Command is to report any other NDRC projects that come to their attention in order that a statement can be secured on required Materiel Command action.

By command of General ARNOLD:

[illegible]
Colonel, Air Corps
Chief, Devel. Engr. Sr. Materiel Division
Office, Asst. Chief Air Staff
Materiel Maintenance and Distribution

[illegible]

- 2 -

Address reply & ENVELOPE to:

[redacted]

84

Commanding General
AAF Materiel Command
Engineering Division
Reference: Dept. 54-7:151254
Wright Field, Dayton, Ohio.

SECRET
AUTH: F. O. CARROLL
BRIG. GEN., U.S.A.
DATE 18 JUL 1944
INITIALS: FOC

Lt. Col. A. Nyman
me: Ext. 2-7159

14 JUL 1944

2-4138

Collaboration With the NDRC
Guided Missiles Program.

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

Attention: Asst. C/AS, MMD, Materiel Division,
Development Engineering Branch.

1. Reference is made to a letter from your Office to this Office dated 26 June 1944, subject as above.

2. The following project officers have been assigned to the respective projects:

a.	VB-2	Capt. J. H. Evans
b.	VB-3 and VB-4	Capt. J. H. Evans
c.	VB-6	Lt. Col. A. Nyman
d.	VB-11	Lt. Col. A. Nyman
e.	VB-5	Abandoned
f.	VB-7 and VB-8	Capt. J. H. Evans
g.	VB-10	Lt. Col. A. Nyman

3. In reference to paragraph 7 of the above letter, another NDRC project which concerns the guided missile GB-9 and possibly others is the jet propulsion project with Division 8 of NDRC designated AC-75 for which Lt. Colonel A. Nyman is the project officer.

4. Division 5 of NDRC has sponsored the development of the Dryden guided missile. At present, the only prospective utilization of this vehicle is for SRB radar control known as "Bat". The tests

Routing
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

C-7-1286

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AA-128

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CENTRAL FILES

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Commanding General, Army Air Forces, Washington 25, D. C. Attention: Asst. C/AS, MMD, Materiel Division, Development Engineering Branch. "Collaboration With the NDRC Guided Missiles Program"

18 JUL 1944

of the 2000-pound load vehicle have not proved satisfactory and work is being concentrated on the use of the Aeronca vehicle for this purpose. This bomb is designated GB-7B. Captain A. R. Swanson is the project officer.

For the Commanding General:

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

29 JUL 1944

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COPY 38

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. R. 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)

<u>AMERICAN</u>

1. London Mission OSRD
   Mr. Bennett Archambault

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2. USSTAF
   Headquarters - Colonel A.R. Maxwell
   Colonel T. Schwartz

   Air Technical Section - Major J. C. E. Williams

   Bovingdon - Major H. J. Rand

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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<u>BRITISH</u>

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1. Ministry of Aircraft Production (MAP)
   Mr. W. J. Richards, Deputy Director of Scientific Research
   Air Commodore H. Leedham, 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 or topics.

1. AZON (VB-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 ofthis 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 ap COPY ion 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]

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planes and a limited assignment of targets as the [redacted]dure. 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.

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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 disucss 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 MAP 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.

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3. Razons and other Projects

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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 sole 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. This is the 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] ght 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.

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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 [redacted] 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,

(AFR 11-30)

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/s/ I. O. Grondahl

Chief, Section 5.2, MDRC

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FROM SMITH COAAF TONOPAH NEV 1720452

TO COMMANDING GENERAL MATERIEL COMMAND WRIGHT FIELD DAYTON OHIOO

ATTN CHIEF SPECIAL WEAPONS BRANCH

GRNC

TAAF 606 X REQUEST PERMISSION TO FLY TO KIRTLAND FIELD NEW MEXICO TO PICK UP URGENTLY NEEDED SPLIT VISION EYEPIECE FOR BOMBSIGHT FOR RECORDING RAZON DROPS PD TUCKOFF OF SULF IS HOLDING UP ALL RAZON DROPS UNTIL THIS EYEPIECE IS PROCURED PD END RAHM

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[redacted]

Lt. Colonel Richardson/mw/6440
AFDMA-2F

[redacted]
Authority of
The [illegible] the General
Army Air Forces
Date Initials

7 SEP 194[illegible]

15

MEMORANDUM TO THE UNDER-SECRETARY OF WAR

THRU: THE ASSISTANT SECRETARY OF WAR FOR AIR

SUBJECT: Development of Self-Propelled Guided Missiles.

1. The Army Air Forces have adopted, as a general set of military characteristics for remotely controllable rockets and pilotless aircraft, the following:

"1. The following military characteristics of remotely controlled missiles are approved. Action on the development and procurement of the missiles and the formulation of appropriate organizations and training programs should be initiated and completed as quickly as practicable.

2. Mission:

a. To intercept and destroy hostile aircraft in flight, flying at speeds from four hundred to six hundred miles per hour and at altitudes varying from ten thousand to sixty thousand feet.

b. To hit and destroy pin point terrestrial targets at extreme ranges.

3. Characteristics:

a. Nature of missile -- a remotely controlled and/or pilotless aircraft.

b. Type of control -- initial flight to be radar or radio controlled; second portion of flight to be under influence of heat, television, and/or radar seeking head with which the missile will be equipped; the termination of the flight to be actuated by an influence fuse which will cause the missile to explode in the proximity of the hostile target, and at a distance therefrom within the lethal radius of the explosive.

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SIGNATURE OF RESPONSIBLE OFFICER			[redacted]			
INTERNAL OFFICE COORDINATION						

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MEMORANDUM TO THE UNDER-SECRETARY OF WAR

THRU: THE ASSISTANT SECRETARY OF WAR FOR AIR

SUBJECT: Development of Self-Propelled Guided Missiles.

a. Launching —

(1) from aircraft in flight.

(2) from the ground — assisted take-off contemplated.

b. Range and altitude —

(1) when launched from aircraft — to the maximum extent of the radar or television control device with which the launching aircraft is equipped.

(2) when launched from the ground — range ten to two hundred miles reaching altitudes up to sixty thousand feet.

4. It is contemplated that the remotely controlled rockets and/or pilotless aircraft, the characteristics of which are set forth above, may complement or supplant fighter aircraft in the defense of military objectives and be used in the nature of long range artillery against pin point objectives in providing close support to ground force operations. It is further contemplated that those missiles capable of being launched from aircraft in flight will complement or supplant conventional aircraft machine guns. For these reasons, a wide range of sizes of missiles is contemplated."

2. Upon the basis of this set of characteristics, Material Command was asked to submit a plan calculated to bring about a joint operation with Ordnance and the Signal Corps on the development of guided missiles of long or short ranges.

3. As a result the Air Forces proposes:

a. That the Material Command of the Army Air Forces continue to direct the development of guided missiles, including any joint developments.

b. That Wright Field, where for several years work has been going on under Material Command direction and involving both Ordnance Signal Corps cooperation, will continue to be the developmental center.

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SIGNATURE OF RESPONSIBLE OFFICER					
INTERNAL OFFICE COORDINATION					

[redacted]

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UNDER

MEMORANDUM TO THE SECRETARY OF WAR

THRU: THE ASSISTANT SECRETARY OF WAR FOR AIR

SUBJECT: Development of Self-Propelled Guided Missiles.

a. That Material Command will seek to consolidate military characteristics insofar as it is possible.

b. That experimental procurement will be made by Material Command.

c. That field tests will be conducted jointly.

4. It is contended that guided missiles generally fall within the developmental jurisdiction of the Army Air Forces. They may be defined within the meaning of the phrase, 'sustained controlled flight under either aerodynamic or aerostatic means' which epitomizes Air Corps' responsibility.

5. Where the controlled missile is to be used as extended artillery it is of primary interest to the Air Forces by reason of the responsibility of the Air Forces for the employment of Anti-Aircraft Artillery.

6. Approval of this program is requested under the provisions of AR 850-25.

For the Commanding General, Army Air Forces:

BARNEY M. GILES,
Lieutenant General, U. S. Army
Chief of the Air Staff.

7 SEP 1944
AAG

OFFICE SYMBOL	1 AFDAA-2	2 AFDAA-1	3 AFAMS-1	4 AFDAO	5 AFALO-P	6 AFAMS-1
SIGNATURE OF RESPONSIBLE OFFICER						
INTERNAL OFFICE COORDINATION			SECRET	Submitted		

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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 I+ 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 ROC).

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 I+ 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.

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Auth: DIR., ATSC
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Date 3 ? ? 1944

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MONTHLY SUPPLEMENT TO DETAILS OF EXPERIMENTAL GUIDED MISSILES PROGRAM

The purpose of this report is to give the monthly status of experimental guided missiles now under development by the Air Technical Service Command, Engineering Division. It will be noted that details of standard guided missiles are omitted except where these items are being employed in a special project.

1. Experimental Units Being Procured in Quantity (200 or more)

   a. GB-7A
   b. GB-7B
   c. VB-6

2. Experimental Units (less than 200)

   a. GB-5A
   b. GB-5C
   c. GB-5D
   d. GB-6A
   e. GB-?
   f. GB-10
   g. VB-2
   h. VB-3
   i. VB-4
   j. VB-9
   k. VB-10
   l. VB-11
   m. VB-12
   n. XBQ-3
   o. XBQ-7 and XBQ-8
   p. Towed Glider Bombs
   q. JB-1
   r. JB-2

3. Special Projects

   a. Project "Castor"
   b. Project "Batty"
   c. Project "Campbell"
   d. Spazon

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1. Units being Procured in Quantity of 200 or more.

a. GB-7A

(1) The fifth unit was dropped on 11 September 1944 on a beacon located at Warren Grove, New Jersey. This missile passed eighty (80) feet over and one hundred forty (140) feet to the right of the target. This glider utilized production type of RHB equipment and a Hammond gyro control system employing an accelerometer for pitch control. Two (2) rates of turn control were used; a slow rate during the early part of the flight and a much higher rate during the last part. The data from this flight, upon being analyzed, indicated that the optical axis of the RHB spinner was located too far below the axis of the glider. Future drops will be made with the optical axis changed by 3°. Two drops will be made during October 1944 on the beacon at Warren Grove, New Jersey and if satisfactory a drop will be made using the Navy's "James Longstreet" freighter as a target.

b. GB-7B

(1) The first GB-7B unit equipped with RHB target seeking equipment is awaiting a gyro control unit before dropping. The outcome of tests on GB-7A will dictate to great extent the type of gyro control equipment needed for GB-7B. A Hammond control unit is being built now and it is expected that the GB-7B will be dropped soon after the series of GB-7A's are dropped this month.

c. VB-6

(1) Two (2) VB-6 (Felix) drops were made 26 September 1944 against the heat target at Tonopah Army Air Field. Points of impact were 75 feet to left of target and 75 feet to right of target. Range miss was very small in both cases. The unit which landed to the right apparently received no control and its good score was only coincidental. The other unit gave a very satisfactory demonstration. Twelve (12) units will be dropped at Tonopah Army Air Field of an older modified type and approximately 12 newly designed units will be dropped at Wendover Army Air Field during the month of October 1944. A "Felix" heat unit is being tested in an Army Air Forces plane at Bedford Army Air Field. This detector indicates higher sensitivity and is an improved design. These tests will continue through the month of October 1944.

[redacted]

[redacted]

to roll over before full-out can be achieved, and make advisable the use of ailerons to maintain level wings in the steep dive. Hammond altimeter control preliminary tests show only partially successful results.

f. GB-10

(1) This glide bomb is similar in general principle to the GB-4. It differs in that the television conversion unit is mounted in an extended nose section instead of in a suspended appendage below the bomb structure and the Aeronca type airframe is used. The television conversion unit will incorporate built-in attitude adjustment to compensate for variable angle of attack. The Farnsworth "Diane" equipment was developed for use on this project. Preliminary models were tested and certain defects detected. Owing to greater progress in the development of other equipment the "Diane" development was dropped. Until completion of the several conversion unit developments, notably the Remington Rand packaged equipment and the RCA "Mimo" device, the further development of this project is of necessity dormant.

g. VB-2

(1) Ten (10) VB-2 units were dropped from the external racks of a B-17 airplane from 21,000 feet at Tonopah, Nevada, in September. All units stabilized and controlled, indicating that aerodynamically the VB-2 is satisfactory. However, these units had neither short flares nor tail fuses and it is expected to drop additional complete units at Orlando, Florida, early in October.

h. VB-3

(1) The September series of tests conducted at Tonopah, Nevada, have shown the pre-production model of the Razon to be satisfactory. It is now planned to incorporate into this model the changes necessary for mass production and have sufficient units made for a final acceptance test. The bomb sight modification for this project is satisfactory.

i. VB-4

(1) Design work is continuing, however, this unit is still on a drawing board status.

j. VB-9

(1) The angle of flight of this device is too steep for radar homing. The radar research group of N. D. R. C. Division 5 found that at angles steeper than 45° homing is not reliable in the "S" band.

[redacted]

k. VB-10

(1) The vehicle planned for use with these devices is similar to that used in the VB-9 except that it will be radio controlled missile, either with television or direct sight intelligence. Tests are being conducted on this vehicle without television or radio control equipment installed. These tests are conducted to determine the characteristics of the vehicle itself. Remote control tests are being planned for 15 October 1944.

l. VB-11

(1) Infra-red homing is believed applicable to this vehicle as soon as a system can be developed which yields a quantitative output. The Polaroid Corporation is undertaking the development of a heat seeker which operates only on the rate of change of the error angle. It proposes to reduce this rate to a constant, of such a value that a collision course must ensue. This device has given moderate satisfaction in laboratory tests, being limited by the lack of sensitivity of available bolometers.

m. VB-12

(1) During the early stages of testing the homing properties of "Roc" light-seeking devices were used. The usefulness of light seekers was limited only to that of testing. However, interest in light seekers is being reactivated since the Services now find application of this device to homing on flares planted on targets. A flare seeker for use as intelligence with "Roc" is difficult to construct in that a proportional signal is required. Fairchild Camera and Instrument Corporation developed a system which gives a proportional signal. Modification of this unit and further development may lend this device to the "Roc" vehicle.

n. XBQ-3

(1) Vibration tests of the main gas tank for the XBQ-3 have been completed and the tank accepted. The new tank will be installed and repairs made to the XBQ-3 now at Wright Field in approximately one (1) month. Upon completion of these repairs and installation, flight tests will be resumed.

o. XBQ-7 and XBQ-8

(1) See Project Castor - Special Projects

p. Towed Glider Bombs

(1) A study is being made to determine the performance characteristics of the "War Weary" P-39 airplane when used as a Glider Bomb by the P-38 and B-25 airplanes. Data from this study is expected to be completed by

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ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
TSENG

MEMORANDUM REPORT ON

Captain J. W. Evans:le
Ext. 2-7127

SUBJECT: VB-3 Vertical Controllable Bomb (Razon)

Date 26 October 1944

OFFICE ~~SECTION~~ TSEPLA-4C5

SERIAL No. TSEPL-4C-673-16-Y

Contract No.

Expenditure Order No. 673-21

Purchase Order No.

A. Purpose.

To report on a trip to Tonopah Army Air Field, Tonopah, Nevada, from 8 August to 9 September 1944.

B. Factual Data.

1. The VB-3 is a Vertical Controllable Bomb in both range and azimuth, hence Razon. It consists of a standard AN-M65 1000 pound bomb to which is attached in place of the standard tail fin a special fin assembly containing a radio receiver, a gyroscope, and servo mechanisms. The complete bomb is carried conventionally on standard 1000 pound bomb racks; is dropped with a standard M series bomb sight, and steered while in flight through a bomb sight adaption designed by Franklin Institute, Philadelphia, Pennsylvania, known as Crab I.

2. A total of nineteen VB-3 bombs were dropped in this series of tests from a B-17 airplane approximately 15,000 feet above the ground. In each case a standard 1000 pound AN-M65 bomb was dropped with the VB-3 bomb in order to establish a reference for scoring the hits and misses. The scoring of eleven of the nineteen VB-2 bombs dropped is shown in Appendix 1 attached. The remaining eight bomb flights are not shown as they failed as successful flights for reasons not pertinent to the Razon apparatus particularly. There is a complete photographic record of the eleven shown in the files of the Special Weapons Branch of the Equipment Laboratory.

C. Conclusions.

1. That the bomb sight adaption by Franklin Institute as used in this series of drops is satisfactory.

2. That the VB-3 shows promise of becoming an invaluable tactical weapon against special targets.

ce Strottd - 25 Nov.

[redacted]

KL-225

17

No. of pages - 3
Y-6876

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12

[redacted]

Memo. Report No. TSEAA-[illegible]
26 October 19[illegible]

3. That the VB-3 although now in the final stages of development is not ready for combat use.

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.:

(1) That development work continue on the VB-3 Vertical Controllable Bomb until completion.

Concurrence:

....

....

Distribution:

Mat. Div., AC/AS, M & S
Section 5.2, N.D.R.C.
Evaluation Br., Tech. Data Lab.
[illegible] [redacted]

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

Approved by [signature]
for Col E. [illegible] Holloman
Chief Equipment Lab.

Approved by H. Y. SMITH, Lt. Colonel, A.C
Chief, Engineering Standards Section.

13

[redacted]

Memo. [illegible] No. [illegible]
25 [illegible]

[illegible]

	R[illegible]		[illegible] (uncontrolled)	
No.	Range	Azimuth	Range	Azimuth
[illegible]	+ [illegible] ft.	- 12 ft.	+ [illegible]00 ft.	+ 200 ft.
2	- [illegible]	- 3	- 125	+ 125
[illegible]	- [illegible]	0	+ 125	- [illegible]
[illegible]	+ [illegible]	+ 5	+ 250	- 1000
5	[illegible]	- 5	+ [illegible]	- 50
[illegible]	+ 121	- 5	0	- [illegible]
7	+ [illegible]	- 2	- 1000	- 1200
[illegible]	- 13[illegible]	+ 5	- [illegible]00	- 250
[illegible]	- [illegible]	+ [illegible]	- [illegible]	- 700
[illegible]	+ [illegible]	+ 10	- 750	- [illegible]
11	- [illegible]	+ 2	- 256	- 350

[illegible] scores for the Razons when analyzed show a mean point of impact [illegible] feet to the right of the target and 17 feet over in range. The probable error from the mean point of impact is 9 feet in azimuth and [illegible]0 feet in range. These drops were all made from 15,000 feet, as measured by the radio altimeter. Converting the above figures to mils:

	Azimuth	Range
MPI	0.2	1.1
Probable Error	[illegible].6	[illegible]

It should be emphasized that these scores are probably considerably better than could be obtained in combat.

[redacted]

Address Reply To
Commanding General, Army Air [redacted]ces
Washington 25, D.C.

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X

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON (AFDMA-2C)

ATTENTION:

26 October 1944

SUBJECT: Razon Bomb

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Office, Chief of Administration (TSTEX)

1. Attached is a copy of a Memorandum of 10 October 1944 from Division 5, N.D.R.C., concerning the Razon bomb.

2. At a meeting of 19 October 1944 with representatives of N.D.R.C. and U. S. Navy, the following matters were brought up:

a. N.D.R.C. has placed a tooling contract with the Union Switch and Signal Company and is planning on securing 150 complete Razon assemblies. The delivery estimates are 50 by the end of December and the remainder by the end of January 1945.

b. N.D.R.C. will probably distribute 50 of these to the Army and 50 to the Navy in addition to 50 that will be tested by N.D.R.C.

C. Prior to the order for 150, Gulf Research will complete 20 more Razon tails with tail fuses for dropping during November.

d. The Navy Bureau of Ordnance wants to secure 300 additional Razon tails. Since the Razon development with N.D.R.C. is an Army development, it was agreed that the quickest way to secure the 300 tails would be to have the Navy transfer the funds to the Army and the Army transfer additional funds to N.D.R.C. to extend their present planned production of 150 to a total of 450.

3. N.D.R.C. now feel that tests of the Razon bomb have progressed to the point where service tests can start.

4. A recommendation is therefore requested by the A.T.S.C. on whether a project should be initiated with the Army Air Forces Board for a test of the Razon bomb, and if so, how many Razon tails are recommended as necessary for this test.

By command of General ARNOLD:

/s/ R. C. WILSON
R. C. WILSON
Colonel, Air Corps
Acting Chief, Engr. Br., Mat. Div.,
Office, Asst. Chief of Air Staff
Materiel and Services

1 Att.
Memo. dtd. 10 Oct. 44 [redacted]

Y-74502 18

69

[redacted]

October [illegible], 194[illegible]

[illegible] Division Members and Liaison Officers

FROM: MDFC Division Headquarters Office

During the latter part of the summer, [illegible] and development [illegible] under contract for Section [illegible] dropped 30 bombs using the [illegible] sight developed for this project by Section [illegible]. Eight of these 30 bombs had defects which resulted in [illegible]. The 22 remaining had scores of such importance that it seems unfair [illegible] you in [illegible] a specific memorandum.

No.	RANGE	Azimuth	[illegible] RANGE	Azimuth
1	+ 250 ft.	- 14 ft.	+ 700 ft.	+ 200 ft.
2	- 45	- 3	- 25	+ 125
3	- 45	0	+ 125	- 700
4	+ 150	+ 5	+ 250	- 1000
5	+ - 71	- 5	+ 50	- 50
6	+ 121	- 5	0	- 240
7	+ 36	- 2	- 1000	- 1200
8	- 135	+ 2	- 200	- 300
9	- 151	+ 39	- 900	- 700
10	+ 85	+ 10	- 756	- 20
11	- 151	+ 2	- 256	- 350

These 11 scores for the [illegible] when analyzed show a mean point of impact 3 feet to the right of the target and 17 feet over in range. The probable error from the mean point of impact is 9 feet in azimuth and 90 feet in range. These drops were all made from 15,000 feet, as measured by the radio altimeter. Converting the above figures to mils, we have:

	Azimuth	Range
MPI	0.2	1.1
Probable Error	0.6	6.0

The attached curve shows the determination of the probable error from the mean point of impact.

It should be emphasized that these scores are probably considerably better than could be obtained in combat. They do indicate, however, that our previous estimate of a probable error of 25 feet in azimuth and 250 feet in range is not over optimistic.

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(AFR 11-30)

[redacted]

Y-5967Y-2

70

[redacted]

"Razon Bomb"

MX-225

TSENG-(TSEPL-374) 11-I-72
Capt. J. H. Evans:mep
Ext. 2-9182

1st Ind.

Hq., Air Technical Service Command, Wright Field, Ohio. 20 NOV 1944

To: Commanding General, Army Air Forces, Washington 25, D.C.
Attention: Engr. Br., Mat. Div., AC/AS, M & S.

1. It was determined at subsequent meetings with N.D.R.C., ATSC and Navy Representatives that a requirement exists for 1,000 of the subject items, these to be procured on N.D.R.C. contracts while specifications were being written by the Army Air Forces to cover large quantity procurement. The specifications to be ready at the completion of the service tests of the Razon Bomb.

2. It is recommended that a project be initiated with the Army Air Forces Board, AAFTCC, Orlando Florida, to conduct service tests and tactical evaluation tests on the subject bomb. It is estimated that one hundred (100) units will be required for the completion of these tests.

3. The subject item is in the final stages of completion, and it is expected that the bomb will be ready to turn over to production by 15 December 1944. A definite date cannot be set for conducting the service tests; however, your office will be notified as to when the service tests can begin.

For the Director:

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

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[redacted]

MX-225 Y-74592

AAFMC-190-WF-5-12-44-375M

CENTRAL FILES

COM. GEN.
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

[redacted]

TSTEX.

200-2
2 Pages
Page 1.

AC-36
CR NDRC
General

ATSC LETTER)
NO. 200-2)

HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND
WRIGHT FIELD - 27 OCTOBER 1944

SUBJECT: Guided Missiles.

TO: Chief, Engineering Division, ATSC.

1. Quoted below for the information and guidance of all concerned with the Guided Missiles program is a memorandum to the Commanding General, Army Air Forces from the Deputy Chief of Staff, subject: "Guided Missiles", 2 October 1944.

"1. The progress in research and development of long-range guided missiles does not yet enable us to form a clearcut understanding of the ultimate tactical employment of these weapons; and therefore not yet warranted is a specific assignment in every case of such missiles to exclusive employment by any one arm or service.

"2. It is, however, essential that research and development in the long-range guided missile field continue toward ultimate production of some useable weapons which can be evaluated with respect to our strategy and our existing weapons. In amplification of previous instructions, The Chief of Staff desires:

"a. That The Commanding General, Army Air Forces, have research and development responsibility, including designation of military characteristics, for all guided or homing missiles dropped or launched from aircraft;

"b. That The Commanding General, Army Air Forces, have research and development responsibility for all guided or homing missiles launched from the ground which depend for sustenance primarily on the lift of aerodynamic forces. For the present the designation of desired military characteristics for the equipment is charged to the Army Air Forces, and to Army Ground Forces as their interests appear;

"c. That The Commanding General, Army Service Forces have research and development responsibility for guided or homing missiles launched from the ground which depend for sustenance primarily on momentum of the missile. For the present the designation of desired military characteristics for the equipment is charged to the Army Ground Forces, and to Army Air Forces as their interests appear.

"3. Propulsion units, whether ram-jet, rocket, or more conventional means; and control systems, whether mechanical, radio,

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[redacted]

Y-70663 32 19

[redacted]

radar, television, or infra-red, are considered as integral components of specific weapons. The research and development of these two aspects of guided missiles therefore fall within the purview of the arm or service having responsibility for development of the weapon in which they are used. In contra-distinction are the developments in warheads, non-integral launching devices, ground components of control systems supplementary to the primary control link, etc., for which any service having a basic technical ability in research should be called upon for assistance.

"4. It is expected that on the basis of the above general approach to the problem, the technical planning and developing agencies of the major commands will freely coordinate their efforts and exchange information on developments and status of their projects, to the end that as any specific weapon approaches a point where it may be tactically useful, each command will be fully cognizant of its potentialities, and thus will be assured of an opportunity to develop a tactical use with respect to its own needs for the weapon."

2. The above quoted memorandum outlines the relative responsibility for research and development of guided missiles by the Army Ground Forces, the Army Service Forces, and the Army Air Forces and also emphasizes the necessity for an active program to develop useable weapons in the guided missiles field.

3. This Headquarters has been advised by higher authority that the memorandum quoted above does not limit or restrict the Army Air Forces in the development of any guided missile or guided missile's controls that could prove of value to the Army Air Forces.

By command of Lieutenant General KNUDSEN:

T. A. SIMS
Colonel, Air Corps
Chief of Administration

OFFICIAL:

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(AFR 11-30)

RALPH NEMO
Colonel, Adjutant General's Department
Adjutant General

DISTRIBUTION: Each Administrative & Special Staff Office, Hq. ATSC - 1
Chief, Engineering & Procurement, Hq. ATSC - 1
Each AAF Procurement District Supervisor - 1
Chief, Engineering Division, Hq. ATSC - 10
Chief, Procurement Division, Hq. ATSC - 5
Chief, Maintenance Division, Hq. ATSC - 5
Chief, Supply Division, Hq. ATSC - 5

Y-70668

[redacted]

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[redacted]

AFAMS-1
Maj.Gen.O.P.Echols/jj/2128

27 October 1944

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MEMORANDUM FOR AIR COMMUNICATIONS OFFICER

PERSONAL ATTENTION - GENERAL McCLELLAND

SUBJECT: Procurement of Guided Missiles

1. As per our conversation this noon, I am returning herewith R&R with reference to procurement of components for guided missiles. Also, as per our conversation, I understand that you can now give us authority to procure approximately 3,000 Azon bombs or components therefor, based on requirements being set up.

2. Request that you furnish me necessary directive to go ahead for the procurement of these 3,000 Azon bombs, in order that I can give the ATSC necessary instructions in time to insure the continuous delivery of the components.

(Signed) O. P. Echols

O. P. ECHOLS,
Major General, U.S.A.,
Asst. Chief of Air Staff,
Materiel and Services.

Incl.
R&R - 3 Comments
w/1 Inch.

10/29 4:30

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AFAMS-1

[redacted]

1208

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AFAM
JTD No. 6324

28 October 1944

MEMORANDUM FOR MAJOR GENERAL O. P. NICHOLS:

SUBJECT: Procurement of Guided Missiles.

1. With reference to your memorandum of 27 October, subject as above, your attention is invited to attached copy of R&R dated 27 October from Colonel Combs, Deputy Chief of Staff, Combat Operations, Twentieth Air Force. It is therefore requested that you give ASTE the necessary instructions to procure the 3000 Razon bombs with the components therefor, taking into consideration existing commitments that have been made for the 2000 Servo and Gyro mechanisms.

H. M. McCLELLAND
Brig Gen, USA
Air Communications Officer

Incls:
cy of R&R #1
fm XX AF dtd 10/27

original to Materiel Division with following note, 10/28, 11:15

"Materiel Division. Give Wright Field the requirement for 3,000 Razon. Let them work out the details.
/s/ope"

10/28

21

26

[redacted]

COPY of a carbon copy

Supply of 3,000 Razon Bombs

Air Communications Officer 27 Oct. 1944

JC/S, Combat Operations 1

Request that you initiate action to supply 3,000 Razon bombs to the Twentieth Air Force.

CECIL E. COMBS
Colonel, Air Corps
JC/S, Combat Operations

SECRET

Confidential CONFIDENTIAL

EQUIPMENT LABORATORY
ENGINEERING DIVISION
AAF MATERIEL COMMAND

Date: 30 October 1944

Inter-Office Memorandum on:
Materiel Command Conference ( )
Officially Authorized Travel (X)
Name and Location of
Activity Visited: Section 5.2 NDRC-Gulf Research and Development Co., Pittsburgh, Pa.
Subject: VB-3(Razon) -- Spazon

Purpose: To report on a conference held at Gulf Research and Development Co. on 26 October 1944 -- To discuss Spazon tests.
Personnel Present:

Col. S. R. Stewart-ATSC
Capt. J. H. Evans-ATSC
Mr. Hugh H. Spencer-NDRC
Mr. R. D. Wyckoff-Gulf Research and Development Co.
Dr. L. O. Grondahl-NDRC-Union Switch and Signal Co.
Representatives of the Navy
Maj. Brown-ATSC

Equipment Observed and/or
Topics Discussed and Decisions Reached (if any):

1. NDRC reviewed the status of the VB-3 development as follows: tests at Tonopah Nevada in August 1944 had shown the VB-3 to have an average accuracy for 11 drops of ±93 feet in Range and ±8 feet in azimuth, showing much promise as a precision bombing weapon; however, from analyzed data it was determined that the amount of control available for range was insufficient. Therefore, additional tests to begin about 15 November are necessary. These tests are for a modified version of the VB-3 as tested with a 40% increase in control. Ten units are to be tested.

2. The Aircraft Radio Laboratory voiced a need for a tail assembly for antenna measurements and noise study. It was decided that a tail unit minus the innards would be made available to them on 1 November for antenna study, and one complete tail assembly on 8 November for noise study. The

Conclusions (if any):

over

1. That additional development is necessary for the Razon.

2. That a mechanically armed tail fuse should be seriously considered for all VB bombs.

3. That NDRC would aid ATSC in the Spazon testing.

Recommendations (if any):

4. That redesign of the VB-3 for production would begin immediately.

Recommendations--none

Remarks: (Use reverse side.
Always refer to
applicable paragraph.)

Prepared by: John H. Evans

Noted: S R Stewart
for G. V. HOLLOMAN, Colonel, A.C.,
Chief, Equipment Laboratory.

Approved: Capt. S R Stewart
S. R. STEWART
COL., AIR CORPS

CONFIDENTIAL
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tail assembly for antenna study will be picked-up by an ATSC airplane either 1 Nov. or 4 Nov. for delivery to Wright Field.

3. The Navy stated emphatically that electric fuses would not be accepted by them for any guided missiles. Therefore, it was agreed that the mechanical armed tail fuse for the VB-1, VB-2, and VB-3 be tested.

4. Gulf Research and Development Co. was informed that Spazon tests would begin about 8 Nov. That 25 bombs would be dropped 6 of which to be dropped without radios. Gulf Research and Development Co. will furnish Dr. J. P. Molnar to aid in the experiment and cameramen to take slit pictures of the drops.

5. Union Switch and Signal Co. stated that the redesign for a production model of the Razon would begin immediately. Work would begin on those parts that are unlikely to be changed as a result of the anticipated tests.

Folder C

GULF

PETROLEUM AND ITS PRODUCTS

25 MAR

GULF RESEARCH & DEVELOPMENT COMPANY

P. O. DRAWER 2038 · PITTSBURGH, PA.

October 30, 1944

CONFIDENTIAL

AIR MAIL

Captain J. H. Evans
Special Weapons Division
Equipment Laboratory
Wright Field
Dayton, Ohio

Dear Captain Evans:

Since the Ordnance Department has been making flares for VB-1, we have depended upon Army sources for flares used in our tests rather than supplying our own, since we have no commercial source of supply for the electrically-ignited units.

For the coming tests at Wendover involving twenty VB-3 units, we should have available about 24 flares. In recent months there has been some difficulty with the Ordnance flares, and in the recent VB-2 tests at Tonopah at least six failures were observed in the initial six drops. The flares ignited properly but burned out in about fifteen seconds. After this performance flares were used from another lot available at Tonopah, and no further difficulty was encountered. However, there was some mixup concerning the several lots on hand, and so we are uncertain whether we can be sure of selecting reliable flares from any now available at Wendover. Moreover, we do not know what quantity of any kind is on hand there.

For VB-3 we need either red or white flares, the latter being preferable. Will you please advise at the earliest possible date whether there is any possibility of securing the necessary 24 flares for our tests from a lot which is known to be reliable. It is our understanding that Ordnance has done something about this flare problem, but we are in the dark regarding it. Moreover, if reliable flares are now available from them, I am sure that your group is in the best position to obtain them.

Your "Spazon" tests will provide a good opportunity to check on flare perfprmance, and I hope that at least 20 units will

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be available for VB-3 from the same lot that you use; so that if they are found reliable, we can be certain of similar results on our tests. We cannot afford to lose any of our limited stock of VB-3 bombs due to flare failure.

Yours very truly,

R. D. Wyckoff

RDW:mr

CC: Dr. L. O. Grondahl

MDAC-446-WF-12-24-41-5M sets of 5

VB-3

3

Authority for: ☐ A. Study ☐ B. Design ☐ C. Fabrication ☐ D. Test

Expenditure Order No. 673-51

Account No. 11A

I. DETAILS OF WORK AUTHORIZED (Make definite and concise):

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To cover 1) liaison with Section 5.2, National Defense Research Committee in the development of the VB-3, 1000 pound Vertical-Bomb, Visually Controllable in Both Range and Azimuth (Razon), and 2) experimental-testing of subject equipment.

Authority: Classified ltr. AC/AS, MM&D to CG Materiel Command dated 25 June 1944.
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 1000 pound (VB-3) Razon is being developed by NDRC. Such bomb will be controlled by a special tail fin assembly containing gyroscopic stabilizing equipment, a servo mechanism, and a radio receiver. This type of control equipment makes it possible to visually control the missile from a carrier aircraft in such manner that sighting errors in range and azimuth may be corrected during flight of the bomb.

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?

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 which will be 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 ons. Transition will include preparation of production specifications and prints, and preparation of operating manuals.

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.

No outside purchases required.

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. b. List of Branches which will be required to do work.

a. Capt. J. H. Evans
b. Equipment Lab., Aircraft Radio Lab., Aircraft Lab., Tech. Data Lab.

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
$ 800	$ 500	$ 500	$ 2500	$ 4300	J. H. E.

V. ENGINEERING PROGRAM.

a. State Project and Item Number on Engineering Program. b. If not on Program state modification proposed.

Project 611-4
Item 673-6

4 NOV 1944

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Initiated by L. E. Shanabrook Branch Equipment Date 31 Oct. Coordinated by .....

Signed Branch Chief G. V. HOLLOMAN Colonel, A.C. Approved Section Chief F. O. CARROLL Brig. General, U.S.A. Approved Executive .....

Close out requested (Date) ..... Reason .....

..... Signed ..... Approved .....
Branch Chief Section Chief

DUPLICATE

24

White-Rodgers Company - Guided Missiles Servos

TSWRC4C
Attn: Mr. Opitz

TSBPR4Q

8 November 1944
Maj.H.F.Marshall
2-5233

1

1. The following memorandum is to confirm telephone conversation of the undersigned with Mr. Opitz, Industrial Service Sub-Section, extension 2-6127, concerning White-Rodgers application for DPC expansion and their retention of equipment already received under previous authority in connection with Azon.

25

2. Mr. Opitz wanted to know the present orders affecting this equipment and the probable future orders.

3. It was explained that so far as Guided Missiles were concerned at present the principal order was for 550 trim boards and throttle motors for what was known as the Castor Project and that these had a high priority.

4. Regarding Razon, it was explained to Mr. Opitz that there is at present no established production requirement. The Razon development is being expedited but when a requirement would be established is uncertain. However, if a requirement is established they will undoubtedly want the No. 6905 item very quickly. However in view of the unfortunate experience with the large quantity requirements established for Azon it was unlikely that any requirement in excess of 2000 per month would be established for Razon although they would want these 2000 per month almost immediately from the time of the establishment of the requirement.

5. It was suggested by Major Marshall to Mr. Opitz that so far as possible under the regulations applying tools and equipment now in use or that would be required by White-Rodgers for up to 2000 No. 690[illegible] units per month for Razon should not be declared surplus.

6. Major Marshall estimated that the Razon requirement if it was forthcoming would probably be established within the next 90 days.

H. F. MARSHALL
Major, Air Corps
Procurement Division Coordinator
For Guided Missiles Program

CG: Chief, Proc. Div.
Attn: Mr. Donnelly
Chief, Spl. Weapons Br.
Attn: Col. Stewart
Chief, Aero Equip. Sub-Section
Attn: Lt. Col. Miller

Y-8403-2 25

C Aco-17 2/47 186 Secret by authority of C
O CO / O
P 10 Nov 44 WGT P
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[redacted]

General Gross/ek/3020
10 November 1944

MEMORANDUM FOR THE CHIEF OF AIR STAFF:

Subject: Razon Bombs

I. Purpose: To furnish information on the above subject as per your request made during a recent conference in General Arnold's office.

II. Discussion:

1. There are two types of Razon bombs; the VB-3 and the VB-4.

a. The VB-3 is a thousand pound high angle bomb, controllable in both range and azimuth by means of direct control. A flare is used for visual perception. The tail surfaces and servo equipments are installed on the rear of a standard one thousand pound bomb. The development of this bomb is being conducted by NDRC and flight tests by the Materiel Command. Actual tests are being run at Tonopah, Nevada. The following resulted from eleven VB-3 drops:

	AZIMUTH	RANGE
Mean Point of Impact	0.2 mile	1.1 mile
Probable Error	0.6 mile	6.0 mile

Eleven drops are insufficient to fully evaluate the VB-3. However, the very greatly increased accuracy over the uncontrolled bombs dropped simultaneously with the VB-3 is most encouraging and as a consequence the Twentieth Air Force has made a request for 3000.

b. The VB-4 is a two thousand pound high angle bomb which functions identically to the VB-3 described above, with the exception of the weight difference. This equipment is a development of NDRC, and as yet, no experimental models have been constructed. Design work is temporarily suspended, pending the results of the VB-3 test program.

2. By letter dated 29 September 1943, signed by Deputy Chief of Air Staff, Brigadier General Hall, the ACO was charged with full responsibility for all phases of the controlled missile program to include requirements, developments, experiments, and procurement relating thereto. By Paragraph 11, AAF Regulation 20-45, 2 October 1944, the Special Consultant to the Commanding General, Army Air Forces (Dr. Bowles) is granted directional authority over the ACO.

3. Military Characteristics for guided missiles, including Razon, have been established through mutual coordination of ACO, AC/AS, OC&R,

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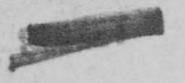

Special Assistant for Antiaircraft, and AC/AS, M&S. The military requirement for any special and specific article and the quantity procurement thereof must depend upon the relative value operationally of the article as compared to standard and more conventional missiles. Although increased accuracy of the Razon type of missile may be offset by the reduction in bomb load per airplane and the additional operational equipment required, certain targets, incapable of being hit by the more conventional missile will demand special types of missiles having a high degree of accuracy and unconventional trajectories, irrespective of any sacrifice in bomb load which must be made. Pending demonstration of the operational suitability of the Razon bombs, no quantity requirement has yet been established. The VB-4 being an adptation to the two thousand pound bomb of the controlled equipment for the VB-3, procurement of the VB-4 will follow immediately the establishment of the operational suitability of the VB-3.

III. Recommendations:

Because of the great potential value of a bomb which can be controlled in azimuth and range in reducing the number of airplanes per target required and the recent encouraging results of tests, it is recommended that:

a. The procurement of 3000 VB-3 tail assemblies be initiated immediately.

b. The initial procurement of 3000 VB-3's be adjusted in quantity as necessary to provide for adequate tests and as may subsequently appear to be consistent with the results thereof.

/s/
DONALD WILSON
Brigadier General, U. S. Army
Asst. Chief of Air Staff
Operations, Commitments & Requirements

47

ADDRESS REPLY TO
COMMANDING GENERAL, ARMY AIR FORCES
WASHINGTON 25, D. C.

ATTENTION:

HEADQUARTERS, ARMY AIR FORCES
WASHINGTON (AFDMA-20)

X 2B

SUBJECT: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs.

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Office, Chief of Administration (TSTEX)

1. Confirming conversation of 8 November 1944 with Major H. F. [redacted], a requirement for three thousand (3000) VB-3 "Razon" tails for 1000 lb. bombs has been received by this office.

2. It is directed that the Air Technical Service Command take the following action:

a. The assignment of sufficient funds to the National Defense Research Committee to procure one thousand (1000) VB-3 tails. This procedure is necessary since development on this item is not entirely complete and it is necessary to make available at the earliest possible date sufficient VB-3 tails for AAF Board tests, tests by the Navy of 300 VB-3s, and the start of service tests in the theaters. A request to the N.D.R.C. for this procurement of 1000 VB-3s has been initiated by this office through the War Department Liaison Officer for the N.D.R.C.

b. The direct procurement by the Air Technical Service Command of 2000 additional VB-3 "Razon" tails, in order to make a total procurement by the Army Air Forces of 3000 VB-3s.

3. The following conditions are to apply to the Air Technical Service Command procurement:

a. The VB-3 "Razon" tails procured are to be for the same purpose as those developed by the N.D.R.C. Changes to design, however, may be made at the discretion of the Air Technical Service Command.

b. The procurement is to include the quantity of component spares considered necessary by the Air Technical Service Command.

c. Deliveries are to start immediately after completion of deliveries to the N.D.R.C. and are to proceed at the maximum rate of deliveries to the N.D.R.C. or at higher rates considered feasible to the Air Technical Service Command.

d. The procurement will include all necessary items for the VB-3 except for the radio receiver. The radio receiver will be procured by the

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Subj: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs (Cont'd)

Signal Corps and furnished as a C.F.E. item.

e. Components and materials from the cancellation of the VB-1 Azon tail procurement are to be used as much as can be considered practical in both the N.D.R.C. and the A.T.S.C. procurements.

f. All VB-3s procured by the A.T.S.C. are to be packed for overseas shipment.

4. It is further directed that prompt information be forwarded to this office on the following:

a. The schedule for deliveries of the 3000 VB-3 "Razon" tails.

b. The test equipment and tools considered necessary for the use of the VB-3 "Razon" tail and a statement of the procurement action being taken by the A.T.S.C. on these items.

By command of General ARNOLD:

J. F. PHILLIPS
Colonel, Air Corps
Chief, Materiel Division
Office, Asst. Chief of Air Staff
Materiel and Services

[redacted] Y-88187

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Lt.Col Stace/lb/4908

[redacted]

(AFDNA-2C)

11 November 1944

SUBJECT: Procurement of One Thousand (1000) VB-3 "Razon" Tails for 1000 lb. Bombs.

TO: War Department Liaison Officer for NDRC (Col. Osborne)
Room 4E-632
Pentagon Building,
Washington, D. C.

1. This confirms conversation of 9 November 1944 with Lt. Col. Allis.

2. It is requested that arrangements be made with the National Defense Research Committee to procure one thousand (1000) VB-3 "Razon" tails for 1000 lb. bombs.

3. This procurement is in addition to the NDRC pre-production procurement for testing and the quantity will be used for tests by the Army Air Forces Board, and the Navy for proposed service tests by the theatres, and for possible other uses by the Army Air Forces.

4. The radio receivers for the one thousand VB-3s will be furnished by the Army Air Forces through the Signal Corps. The ordnance items for the one thousand VB-3s will be furnished by the Army Air Forces through Ordnance. The NDRC procurement should include all other items necessary for the VB-3 "Razon" tail including any additional components considered necessary for spares. Specifications are to conform to Army Air Forces standards whenever possible.

5. Funds for this procurement will be supplied by the Air Technical Service Command under AC Project No. 36. A formal allocation of funds will be made by the Air Technical Service Command upon receipt of a cost estimate from the NDRC.

6. Allocations and delivery instructions for the one thousand VB-3 "Razon" tails here requested will be furnished by the Air Technical Service Command.

7. Since there is a need for these missiles for operational use, it is requested that deliveries be expedited as much as possible.

8. Attached for your information is a copy of a letter to the Air Technical Service command directing the allocation of funds to the NDRC for the VB-3 procurement.

For the Commanding General, Army Air Forces:

J. F. PHILLIPS,
Colonel, Air Corps.
AAF, Liaison Officer with the NDRC.

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HEADQUARTERS ARMY AIR FORCES
WASHINGTON 25, D. C.

AFDBS-4K-DA-4

14 November 44

SUBJECT: AN/CRW-7 Radio Receiving Equipments.

TO: The Chief Signal Officer, War Department, Washington 25, D. C.

Attention: Requirements Division.

1. It is requested that immediate action be taken to procure three thousand and three hundred (3,300) each AN/CRW-7 Radio Receiving Equipments which are urgently required by the Army Air Forces. The AN/CRW-7 Receivers will be used in connection with the "VB-3 Razon Tails".

2. The subject equipment has been classified as "Limited Procurement" type by the Army Air Forces.

3. The quantity of three thousand and three hundred (3,300) receivers includes ten percent spare factor.

4. The Air Technical Service Command is taking the necessary action to procure "VB-3 Razon Tails". Since the subject receivers will be Government Furnished Equipment (GFE) to the Razon Tails, it is requested that coordination between your Headquarters and Air Technical Service Command be effected in order to insure concurrent delivery. Since requirements for the above equipment are most urgent, it is requested that precedence assigned be such that it will insure delivery as soon as possible.

5. For purposes of the Army Supply Program, subject item will appear on page 4, item 19-1 of the next revision which will include Army Air Forces 1945 requirements for three thousand and three hundred (3,300) each AN/CRW-7 Radio Receivers.

For the Commanding General, Army Air Forces:

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D. W. BENNER
Colonel, Air Corps
Chief, Air Services Division
Office, Asst. Chief of Air Staff,
Materiel and Services

[redacted]

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14 November 1944

MEMORANDUM FOR LT. COL. ALLIS

In regard to the NDRC procurement of Razon and Felix, Razon development is not complete at this point. Further tests will be made this month on a changed design. It is anticipated that further changes will also have to be made as a result of further tests. It is very difficult to place an ATSC production order while a device is still in development - particularly when it is still in development by an agency outside of ATSC. It is considered preferable therefore to have the NDRC procure sufficient units for the AAF Board tests, the Navy tests, and probably preliminary service tests. It is considered that prior to the end of these tests sufficient information will be available to ATSC to permit them to continue with the procurement of the items. The Razon radio and Ordnance items were actually developed by the Aircraft Radio Laboratory and Ordnance, and since it seems apparent that orders can readily be placed through the standard Signal Corps and Ordnance channels, the radio and Ordnance items will be procured by the Signal Corps and Ordnance and furnished to NDRC as GFE on the 1000 Razons.

A very similar situation is apparent on Felix. Development is not considered entirely complete and it will be necessary to have the AAF Board tests, Navy tests, and service tests, and very probably changes in design will result from these tests. It is again considered preferable to keep the production with the developing agency until the development is actually complete, and since production is wanted urgently, the preliminary production will be placed in the hands of the development agency.

In the case of Felix, the only GFE items furnished will be the Ordnance items. The electronic components were developed by NDRC. The Aircraft Radio Laboratory did not enter into this development.

W. A. Stone
Lt. Col. Ext. 4908

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ATSC Form No. 80-302 (2 NOV 44)

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ARMY AIR FORCES
HEADQUARTERS
AIR TECHNICAL SERVICE COMMAND

Hdqt:TSTEX
Wright Field, Dayton, Ohio
17 November 1944

TECHNICAL INSTRUCTIONS

Serial No.: TI-2003, ADDENDUM NO. 4

Subject: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs

To: Procurement Division
Engineering Division
Supply Division

1. Problem Presented:

a. To transfer sufficient funds to the National Defense Research Committee to cover procurement of 1000 VB-3 "Razon" tails for 1000 lb. bombs.

b. The direct procurement of 2000 additional VB-3 "Razon" tails for 1000 lb. bombs to make a total procurement by the Army Air Forces of 3000 VB-3s.

2. Factual Data:

a. The assignment of sufficient funds to the National Defense Research Committee to procure 1000 VB-3 tails is necessary since development is not entirely complete and it is necessary to make available at the earliest possible date, sufficient VB-3 tails for AAF Board test, test by the Navy of 300 VB-3s and the start of service tests in the theaters. A request to the N.D.R.C. for this procurement of 1000 VB-3s has been initiated by the Office, Assistant Chief of Air Staff, Materiel and Services to the War Department Liaison Officer for the N.D.R.C.

b. The following conditions are to apply to the direct procurement by this Command of the 2000 additional VB-3 "Razon" tails:

(1) The VB-3 "Razon" tails procured are to be for the same purpose as those developed by the N.D.R.C. Changes to design however, may be made at the discretion of the Air Technical Service Command.

(2) The procurement is to include the quantity of component spares considered necessary by the Air Technical Service Command.

(3) Deliveries are to start immediately after completion of deliveries to the N.D.R.C. and are to proceed at the same maximum rate as deliveries to the N.D.R.C. or at higher rates if considered feasible

[redacted]

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Serial No.: TI-2003, ADDENDUM NO. 4.

HFM:cjt:TSTEX
Wright Field, Dayton, Ohio
17 November 1944

Subject: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs

To: Procurement Division
Engineering Division
Supply Division

(4) The procurement will include all necessary items for the VB-3 except the radio receiver. The radio receiver will be procured by the Signal Corps and furnished as a G. F. E. item.

(5) Components and materials from the cancellation of the VB-1 Azon tail procurement are to be used to the greatest possible extent.

(6) All VB-3s obtained on direct procurement by the Air Technical Service Command are to be packed for overseas shipment.

3. Authority:

a. Commanding General, Army Air Forces, by letter dated 11 November 1944, subject, same as above, from, Chief, Materiel Division, Office, Assistant Chief of Air Staff, Materiel and Services.

4. Action Desired:

a. That the Engineering Division cooperate with the N.D.R.C. on the development of VB-3 "Razon" tails and furnish to the Procurement Division all drawings and engineering data required by the Procurement Division for procurement of the 2000 additional VB-3 "Razon" tails. The Engineering Division will also furnish to the Supply Division any information necessary to enable the Supply Division to determine thetesting equipment and tools necessary for the use of the VB-3 "Razon" tails and furnish to the Maintenance Division, engineering information necessary for preparation of appropriate technical instructions.

b. That the Procurement Division take the following action:

(1) The assignment of sufficient funds to the National Defense Committee to cover the procurement of 1000 VB-3 "Razon" tails.

(2) Upon receipt of the necessary drawings and engineering data from the Engineering Division, procure 2000 additional VB-3 "Razon" tails to make a total procurement for the Army Air Forces of 3000 VB-3s.

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Serial No.: TI-2003, ADDENDUM NO. 4

Subject: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs.

To: Procurement Division
Engineering Division
Supply Division

(3) Make the necessary arrangements for the radio receivers, which will be procured by the Signal Corps, to be delivered to the contractor as a G.F.E. item and incorporated in the "Razon" Tails.

(4) Determine, with the assistance of the Supply Division, the quantity of component spares considered necessary for the total procurement of VB-3 "Razon" tails and procure these spares.

(5) Arrange for the 2000 VB-3s procured by this Command to be packed for overseas shipment and delivered as directed by the Supply Division.

(6) Furnish to the Office, Assistant Chief of Air Staff, Materiel and Services, through the Office, Chief of Administration, the schedule for deliveries of the 3000 VB-3 "Razon" tails at the earliest possible date.

c. The Supply Division is to take the following action:

(1) Furnish to the Procurement Division, any assistance necessary for the procurement of the quantity of component spares necessary for utilization with the VB-3 "Razon" tails.

(2) With the assistance of the Engineering Division and the Maintenance Division, determine the test equipment and tools considered necessary for the use of VB-3 "Razon" tails and initiate procurement action for this equipment and further furnish a statement to the Assistant Chief of Air Staff, Materiel and Services through this office of the required equipment and the action being taken to procure this equipment.

d. That the Maintenance Division assist the Supply Division in the determination of the test equipment and tools considered necessary in the use of the VB-3 "Razon" tails and issue any necessary Technical Instructions.

By Command of Lt. General KNUDSEN:

T. A. SIMS
Colonel, Air Corps
Chief of Administration

cc: Maintenance Division

[redacted]

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HEADQUARTERS, ARMY AIR FORCES
WASHINGTON (AFDMA-2C)

SUBJECT: Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs.

Nov 20 1944

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Office, Chief of Administration (TSTEX)

1. Reference is made to a directive of 11 November 1944 to the Air Technical Service Command, subject "Procurement of VB-3 "Razon" - Tails for 1000 lb. Bombs."

2. A copy is attached of a letter of 11 November 1944 to the War Department Liaison Officer for NDRC, subject "Procurement of One Thousand (1000) VB-3 "Razon" Tails for 1000 lb. Bomb."

3. It may become apparent, before completion of the NDRC procurement order, that testing and development of the VB-3 "Razon" tails have reached a point where it would be preferable for the Air Technical Service Command to take over the balance of the procurement. In this case, the Air Technical Service Command will complete with NDRC the arrangements considered advisable on transfer of procurement.

4. It is requested that the information included in this letter be forwarded to the necessary Air Technical Service Command offices, including the Ordnance Officer, Procurement Division and Engineering Division, Equipment Laboratory, and the Aircraft Radio Laboratory.

By command of General ARNOLD:

J. F. PHILLIPS
Colonel, Air Corps
Chief, Materiel Division
Office, Asst. Chief of Air Staff
Materiel and Services.

1. Att.
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OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

REFER: SO:IS

November 20, 1944

War Department Liaison Officer with NDRC
Headquarters, Army Service Forces
War Department
Washington 25, D. C.

Re: Project AC-36, extension to,
Procurement of VB-3 "Razon" Tail Equipments

Dear Sir:

Subsequent to the receipt of your letter of November 16, 1944, Dean E. L. Bouland and I discussed the subject project with Brigadier General McClellan and other officers on November 20, 1944.

Pursuant to those conversations, OSRD is prepared to accept this extension on the following conditions. OSRD will issue a letter of intent to its contractor, the Union Switch and Signal Company, Swissvale, Pennsylvania, for 1000 VB-3 "Razon" tail equipments at a cost not to exceed $1,000,000. In its letter of intnet the OSRD will state that it is anticipated that these equipments will be included by the Army Air Forces in the production order which it expects to issue to the Union Switch and Signal Company, and in the event this is done the OSRD letter of intnet will be withdrawn. If, however, the Air Forces' production contract is not forthcoming, OSRD will then proceed to follow the letter of intent with its own contract.

OSRD is prepared to obligate its own funds for a short period of time to support the letter of intent upon the assumption that the Air Forces' procurement contract can be entered into without undue delay.

However, if the procurement contract is not negotiated by January 15, 1945, the Army will be expected to transfer to OSRD the funds necessary to support the letter of intent in order that the OSRD funds initially obligated may be released to permit the carrying on of the regular activities of OSRD. In that event, the funds will be retransferred to the Army when the Army production contract permits OSRD to withdraw its letter of intent. Should

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it develop, however, that for some reason the Army production contract was not forthcoming, OSRD would then use the transferred funds to support the work under the letter of intent.

While these conditions are in accord with the understanding reached at the conferences on November 20, 1944, I shall appreciate your confirming them for the record.

Very truly yours,

Irvin Stewart
Executive Secretary

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SPECIAL WEAPONS TEST UNIT
Wendover Army Air Field
Wendover, Utah

WHH/ll
TSEPL-3I11

22 November 1944

SUBJECT: Razon Tests at Wendover, Utah.

TO: Director, Air Technical Service Command,
Wright Field, Dayton, Ohio.

Attn: TSEPL-3I4, Capt. J. H. Evans.

1. Ten (10) each Razon tails have been received, all of which have the shroud moved forward of the location on previous models. Ten (10) more are available at Gulf Research and Developing Company, but shipment will be suspended pending the performance of the initial drops with this model.

2. Seven (7) of the ten (10) Razon units received at Wendover have the new type, heavy-duty Willard battery, ER-10-12.

3. It is anticipated that approximately two and one-half days will be occupied in checking the Razon components. Any missions will, consequently, be delayed for at least this period of time.

4. Weather this date is of a type which would permit satisfactory drops from 15,000 feet above target. The weather conditions, however, would have opposed any missions between Saturday night and today, and would in themselves have cancelled any missions planned even if such missions had been possible from other considerations.

For the Commanding Officer:

William H. Hess
WILLIAM H. HESS,
1st Lt., A. C.

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23 November 1944

TSBPH
(Aeronautical Equipment Sub-Section)

MX-325

TI-2003, Addendum No. 4
TI-2003, Addendum No. 5

1. There is being transmitted under separate cover TI-2003, Addendum No. 4, covering the Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs, and TI-2003, Addendum No. 5, covering Procurement of VB-6 "Felix" Equipment for 1000 lb. Bombs.

2. Both of these directives provide for immediate procurement of 1000 each of the VB-3 "Razon" and VB-6 "Felix" Equipments. This procurement is to be made from the National Defense Research Committee. TI-2003, Addendum 4, also provides for the production of 2000 VB-3 units from specifications and drawings to be supplied by the Engineering Division. The procurement of the 2000 quantity, however, cannot be initiated until production data is available. As will be noted from both directives, a request to the NDRC for the procurement of 1000 each of VB-3's and VB-6's had been initiated by the Office, Assistant Chief, Air Staff, Materiel and Services, to the War Department Liaison Officer for the NDRC. It is believed, however, that this was merely a request to get the project started and that it will be necessary for Procurement Division to initiate authorities for purchase in order that a formal purchase order may be placed with NDRC. Before authority for purchase is initiated, Aeronautical Equipment Sub-Section will contact Office, AC/AS, M&S, to definitely determine whether or not funds have been transferred to the NDRC to cover this procurement.

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3. As will be noted from TI-2003, Addendum 4, the radio receiver will be procured by the Signal Corps. This statement is not clear as to whether it is intended to mean that action has already been taken to establish requirement for the receiver with the Signal Corps, or as to whether it is intended that Procurement Division initiate the requirement. Definite determination should be made in regard to this equipment in order to prevent any duplication of orders.

4. Under the provisions of TI-2003, Addendum 4, the Navy Department is to be furnished with 300 VB-3's and while the quantity of VB-6's to be furnished to the Navy Department is not established by directive TI-2003, Addendum 5, it is understood that 300 of the latter mentioned units will also be furnished to the Navy.

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5. In this connection, information has been received from the BAGR to the effect that BuOrd Order NOrd 01693 is being initiated by the Navy to cover the procurement of 300 VB-3 "Razon" units. No information has been received as to the Navy Order No. for the VB-6 units, however, a request has been forwarded to the BAGR to have the order expedited.

6. In that the Navy Orders will show the Navy procurement authority to which the equipment should be charged, this procurement authority for the quantities of units to be furnished to the Navy, together with the Navy Order No., etc., should be shown on the Authority for Purchase when issued.

/s/ W E Donnelly

W. E. Donnelly
Assistant to Chief,
Procurement Division

cc:
BAGR
TUSPO

[redacted]

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SPECIAL WEAPONS TEST UNIT
Wendover Army Air Field
Wendover, Utah

WHH/11
TSEPL-3I11

28 November 1944

SUBJECT: Razon Tests at Wendover.

TO: Director, Air Technical Service Command, Wright Field, Dayton, Ohio.

Attn: Capt. J. H. Evans, TSEPL-3I4.

1. A mission carrying one Razon and one dummy in each bomb bay had been planned for Saturday morning. However, since the mission of Friday afternoon carrying tail fused standard Azon equipment disclosed that the racks continued not to release at bombing altitude electrically, the Saturday Razon mission was cancelled.

2. Inasmuch as Razons must be dropped electrically in order that the proper computations may be fed into the bomb sight, if these initial Razon tests are to give reliable data, such bombs should not be dropped by salvo. It is the opinion of Mr. Wyckoff that all Razon missions should be suspended until the rack failure to release electrically has been remedied, since it is not felt that the limited amount of Razon equipment on hand justifies expending the equipment needlessly at a time when there would be some doubt as to the reliability of the results shown.

3. Saturday afternoon, 25 November 1944, during a Spazon mission, the following steps were taken to trace the source of trouble leading to electrical release failures:

a. First attempts to drop the load from 20,000' by electrical impulse led to unsatisfactory results. A voltmeter previously inserted into the circuit leading to the fourth post of the kick-out plug of the lower, left bomb station indicated that no pulse was being received. Such lower, left position was chosen at random as being representative of all other positions. It was necessary to release the entire load by salvo.

b. This apparent failure of an electrical impulse to reach the bombs was borne out in previous missions where the bombs failed to release electrically because, had such a pulse reached the bomb, the gyros would have become uncaged; such uncaging, however, was not evidenced since subsequent runs with bombs away on salvo showed the falling bombs to erect properly. Had the bombs been uncaged beforehand, intervening maneuvers of the aircraft could have been expected to have dumped such uncaged gyros.

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Ltr. to Dir., ATSC, Wright Field, Dayton, Ohio, Attn. Capt. J. H. Evans, TSEPL-314, Razon Tests. 28 Nov. 1944

c. After salvo of the bombs, the stations were recocked, and response to both intervalometer and toggle electrical pulses tested. The voltmeter showed no pulse being received in either case. Such tests were being conducted at approximately 20,000' msl. The aircraft then descended to approximately 17,000' msl., and again the releases were checked for response to both the intervalometer and toggle selection. The left bay responded completely, the other not at all. All positions were again recocked, and the same steps were repeated. This time, all stations released, and this was borne out by an indication on the inserted voltmeter. This altitude appeared to be the critical position for the existing conditions on this particular day, and, consequently, no further tests were made at lower altitudes. It should be borne in mind that the racks had been previously checked on the ground and at 8,000' with satisfactory results. Free air temperatures as indicated in the bombardier's compartment were roughly minus 20° C. at the higher altitude and minus 12° C. at the lower altitude. Radiosonde data (showing temperature, pressure and humidity distribution aloft), as recorded by the soundings at Boise, Idaho and Ely, Nevada, were consulted by the Base Weather Station for comparable temperatures aloft. An interpolation of these two soundings, considered to be representative at Wendover for the period in question, are listed below together with the moisture distribution at intervals of 1,000 feet.

Representative Temperature-Humidity Distribution Aloft at Wendover Field for 1500 PWT, 25 November 1944 as Interpolated from the Boise and Ely Radiosonde Soundings for 1105 PWT (1805Z) of the Same Date

Altitude	Temperature ° C.	Spec. Humidity in Gms. Water Vapor per Kilo. of Air
25,000'	-36°	0.1
24,000'	-34°	0.2
23,000'	-32°	0.2
22,000'	-28°	0.3
21,000'	-26°	0.3
20,000'	-24°	0.3
19,000'	-21°	0.4
18,000'	-19°	0.4
17,000'	-17°	0.5
16,000'	-15°	0.5
15,000'	-14°	0.5

d. The above temperatures are included in this report with the thought in mind that either temperature, or moisture, or both might be the critical consideration. The apparent disagreement between the temperatures as indicated roughly from the bombardier's compartment and from the Radiosonde is not serious. The two sets of data show the temperature-humidity differential between the two altitudes which is the important consideration.

8

Ltr. to Dir., ATSC, Wright Field, Dayton, Ohio, Attn. Capt. J. H. Evans, TSEPL-3I4, Razon Tests. 28 Nov. 1944

4. Work will continue to attempt to isolate, and if possible, eliminate the failure of the bomb releases to respond to electrical impulses. Conversations with the personnel familiar with the operation of the bomb releases indicate that such rack troubles, although not commonplace, are likewise, not infrequent. When such conditions do occur, in combat, the usual procedure is to salvo the load. Further details of the results of continued tests here will be forwarded as available.

For the Commanding Officer:

William H. Hess

WILLIAM H. HESS,
1st Lt., A. C.

[redacted]

SPECIAL WEAPONS TEST UNIT
Wendover Army Air Field
Wendover, Utah

WEH/ll
TSEPL-3I11

28 November 1944

SUBJECT: Razon Tests at Wendover.

TO: Director, Air Technical Service Command, Wright Field, Dayton, Ohio.

Attn: TSEPL-3I4, Capt. J. H. Evans.

1. B17-514 was loaded with one Razon in the bottom station and one dummy in the middle station of each bay for a morning mission on Tuesday, 28 November 1944. Bombs were to be dropped from 15,000' above target. Weather was ideal. On the bomb run, troubles developed in the bombsight, and the mission was suspended. Later examination showed bombsight stabilizer failure.

2. With the bombsight difficulties remedied, the same load of bombs was carried to the target area in the afternoon. The left bay Razon and dummy were dropped first. The dummy landed 200' over in range and approximately 25' left in azimuth; the Razon radio receiver is believed to have not functioned since the bomb appeared to have received no control until possibly at the very end of the drop. This Razon bomb stayed within the target area and complete measurements in range and azimuth will be taken from the bomb bay pictures. Due to no response to control, this Razon showed no reliable evaluations as to the stability or instability of this type of bomb with the present shroud location when control is applied.

3. On the second bomb run, the right bomb bay Razon and dummy were dropped. Upon application of control the Razon went into wild gyrations. From the ground, the bomb appeared to be both spinning and oscilating, and at one time in the drop, the nose appeared to be higher than the tail. This bomb fell approximately 2,000' short in range and landed flat, spilling the tail components over a wide area. Some error in azimuth was experienced also. Due to the gyrations, these errors in range and azimuth are meaningless. The dummy bomb on this drop landed almost perfectly in range and approximately 200' right in azimuth.

4. These first drops show quite conclusively that the present location of the shroud is too far forward; however, it is believed advisable to drop another one or two of this design anyway. Gulf Research is air expressing another tail in which the present shroud location has been moved rearward approximately 2". Such relocated shroud will be tested for stability upon receipt. No drops of any sort are anticipated for tomorrow because of present weather trends; it is believed that low ceilings will be prohibitive to drops.

[redacted]

Ltr. to Dir., AFSC, Wright Field, Dayton, Ohio, Attn. TSEPL-3l4, Capt. J. H. Evans. 28 Nov. 1944

5. Unless the next drops show results contrary to those already indicated by these first drops, it is probable that the shroud will again have to be located at the rear of the tail as in the first models.

For the Commanding Officer:

William H. Hess

WILLIAM H. HESS,
1st Lt., A. C.

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AAF-CF 471.6-0-2 Razon

[redacted]

Lt.Col.Stace/15/4908

(AFDMA-[illegible])

[illegible] November 1944

X 400.112 NDRC

SUBJECT: Assumption of N.D.R.C. Contract on VB-3 "Razon" Tails by ATSC.

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Office, Chief of Administration ([illegible])

1. Reference is made to the following directives:

a. Directive of [illegible] November 1944, subject "Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs."

b. Directive of [illegible] November 1944, subject "Procurement of VB-3 "Razon" Tails for 1000 lb. Bombs."

2. Attached is a letter of [illegible] November 1944 from the Office of Scientific Research and Development, subject "Project AC-[illegible], Extension to, Procurement of VB-3 "Razon" Tail Equipments," with 1st Indorsement of 28 November 1944 from N.D.R.C.

3. In accordance with the attached letter, it has been agreed with OSRD that the Air Technical Service Command will take over procurement of the 1000 VB-3 "Razon" tail equipments as soon as testing and development have reached the point where ATSC is able to place the order on a production contract.

4. This may involve an ATSC contract for the remaining [illegible] VB-3 "Razon" tails if sufficient development and testing is completed at an early enough date.

5. It is directed therefore that ATSC take all necessary steps to take over all, or as large a portion as possible, of the 1000 procurement at the earliest practicable date.

By command of General ARNOLD:

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(AFR 11-30)

[illegible]
Colonel, Air Corps,
[illegible]

P-49786

OFFICE SYMBOL	[illegible]	[redacted]			
GRADE AND SURNAME OF COORDINATING OFFICERS	[illegible]				38

1238

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Combat. Project 95.320
Sp Weap. S. EB-40

[redacted] 3

Suspense 12-20-44

95.320

Razon

In Turn
(1). 20th Air Force, Deputy Chief of Staff for Combat Operations Attn: Lt Col DuBose 4E184
(2). AC/AS, M&S, Materiel Division, Equipment Section Guided Missiles Unit Attn: Lt Col Stace

1 Dec 1944
1
Major Rand/blj/5375

FROM: Air Communications Officer, Equipment Division

1. The 20th Air Force has established a requirement for RAZON.

2. This requirement is initially for test purposes and decision as to extent of use of RAZON by the 20th Air Force will depend on the outcome of its test program.

3. Because of possible antenna problems which may come up, it is requested that an immediate study of RAZON installation in a B-29 be undertaken.

4. RAZON will not be in production until the end of January so the final mock up and test flights should not be allowed to interfere with more pressing B-29 problems.

AFACO-E/SP
AFACO-E

S. A. MUNDELL
Colonel, Air Corps
Chief, Equipment Division
Office of the Air Communications Officer

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(AFR 11-30)

5 Dec.
Vogel - Summary; referring to Weichbrod.

~~Col. DuBose Now Has The Original 12-16-44~~
This is in Mail On Way From Col. DuBose 12-16-44

Lt Col Stace

39

[redacted]

AAFMC-26-WF-3-44-20M

[redacted]

C [redacted] T I A L

X
AC-36

ARMY AIR FORCES
AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND
TSEMG
MEMORANDUM REPORT ON

Lt.W.H.Hess:mep
Ext. 2-9182

SUBJECT: Project MX-591 (Formerly part of Project MX-225)

Date 14 December 1944

OFFICE TSE L-3I4

Contract or Order No.

SERIAL No. TSE L-3-673-46

Expenditure Order No. 673-51

FOR OFFICIAL USE ONLY
(AFR 11-30)

A. PURPOSE:

1. To report on trip to Wendover Field, Wendover, Utah from 6 November to 8 December 1944 covering tests on Razon (VB-3).

B. FACTUAL DATA:

1. Personnel present at the tests were:

Air Technical Service Command

1stLt. William H. Hess

Naval Air Station, Traverse City, Mich.

Lt. (j.g.) Bastedo

Gulf Research & Development Company

Dr. J. P. Molnar
Mr. R. D. Wyckoff
Mr. Kent Crooks
Mr. C. A. Gustavson
Mr. F. W. Palmer
Mr. L. D. Palmer

40

2. Two (2) each VB-3 (Razon) units, Mark II, were drop tested 29 November 1944 to evaluate the stability characteristics of the shroud location of this model. The shroud had been moved forward approximately six (6) inches from the previous Mark I location in order to secure an increase in bomb maneuverability. Two (2) drops, each consisting of one (1) Razon and one (1) standard 1000 pound bomb used as a dummy, were made from 15,000 feet above the target. (See appendix 1)

3. Two (2) each VB-3 (Razon) units, Mark II but further modified by moving the shroud location approximately two (2) inches to the rear (thus placing the shroud approximately four inches forward of the Mark I location) were drop tested 5 December 1944. Two drops, each consisting of one Razon and one standard 1000 pound bomb used as a dummy, were made from 15,000 feet above the target. (See Appendix 2)

4. Only a limited number of drops were required during this test period in order to compare these later VB-3 designs with earlier

[redacted]

Incl # 2

[redacted] 24

[redacted]

Memorandum Report Number TSFLA-2-673-46
14 December 1944

ones; reference is made to Memorandum Report, No. TSFLA-40-673-[illegible],
Subject: VB-3 Vertical Controllable Bomb (Razon) dated 26 October 1944.

5. All of the Razon units dropped during subject test period were provided with a cavity of sufficient volume to permit installation of an electronic-armed tail fuse. No tail fuses were installed, however, on these drops.

C. CONCLUSIONS:

1. That the VB-3 Mark II, does not exhibit sufficient stability during drops.

2. That the modified VB-3, Mark II (with the shroud adjusted approximately two inches) does not exhibit sufficient stability during drops.

3. That the VB-3, Mark I exhibited greater stability than either of the two designs tested during the period covered by this report. Reference is made to Memorandum Report Number TSFLA-40-673-16-Y, Subject: VB-3 Vertical Controllable Bomb (Razon) dated 26 October 1944. Comparison of the more recent designs with earlier ones shows the advisability of a final design in which the shroud would again be located near the rear of the tail unit.

4. That some type of tail fuse would be adaptable for use with the VB-3. Reference is made to Memorandum Report No. TSNPL-3-673-16-A-3 Subject: T-79 Tail Fuse for VB-3 Vertical Bomb (Azon) Project MX-225, dated 14 December 1944.

D. RECOMMENDATIONS:

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

a. Section 5.2, N.I.R.C.

(1) That development work be continued on the VB-3 Vertical Controllable Bomb (Razon) until completion.

Prepared by: William H. MEES, 1st Lt. A.C.

Approved by: C. V. HOLLOWAY, Colonel, A.C.
Equipment Laboratory

Approved by: H. V. SMITH, Colonel, Air Corps,
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

Concurrence:

Distribution: AC/AS [illegible]; Eval Sr.
Tech data lab (TSFL-2);
Chief Section 5.2, N.I.R.C.;
Chief Division 5, N.I.R.C.

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(AFR 11-30)

[redacted]

Y-116420 - 4

MX-591
- 2 -

[redacted]

Memorandum Report Number TSEWL-3-673-44
14 December 1944

APPENDIX 1

1. On the mission of 28 November 1944 two each VB-3's, Mark II were dropped from 15,000 feet above the target with results as follows:

a. Left bay; one Razon and one dummy:

(1) The dummy landed 270 feet over in range and 25 feet left in azimuth.

(2) The Razon exhibited no response to radio control signals. The radio receiver was believed to have failed. This bomb struck within the target area (diameter 500 feet) but landed short in range and right in azimuth, and from inspection of the crater appeared to have entered the ground at a rather flat angle. However, no marked spinning, yawing or pitching of the bomb was witnessed by ground observers stationed at the target.

b. Right bay; one Razon and one dummy:

(1) The dummy struck approximately 8 feet short in range and 200 feet right in azimuth.

(2) Upon application of radio control the Razon exhibited wild gyrations, showing marked yawing and pitching. From the ground it appeared that at one time in the fall the nose of the bomb was higher than the tail. The bomb, due to its erratic flight, fell approximately 2000 feet short in range and off to the left in azimuth; due to the gyrations of the bomb in flight, these errors in range and azimuth are meaningless.

c. Evaluation of this mission indicated that the shroud location on the bombs dropped was too far forward, resulting in marked instability of this particular Razon design. It was also indicated that a compromise position of the shroud, somewhere between the forward location (as on the Mark II) and the rear location (as on the Mark I) should be tested. See appendix 2 for the results of such tests with modified Mark II units.

[redacted]

Y-116420-Y

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Memorandum Report Number TSEL-3-673-46
14 December 1944

APPENDIX 2.

1. On the mission of 5 December 1944 two each VB-3's, modified Mark II, were dropped from 15,000 feet above the target. Such modification consisted of moving the shroud toward the rear approximately two inches thus placing it approximately four inches forward of its location on the Mark I VB-3. Distribution of the tail components, such as the radio receiver, battery, and gyro, was the limiting factor in the location of the shroud to the rear; further movement to the rear would have necessitated placing the radio, gyro and battery forward and close to the bomb as in the Mark I. The results of these drops were as follows:

a. Left bay; one Razon and one dummy:

(1) The dummy struck 190 feet short in range and 125 feet to the left in azimuth.

(2) The razon exhibited a large amount of yawing, although the bomb remained in a stabilized position. The strike was fairly accurate, 100 feet over in range and 26 feet left in azimuth, but the unstable characteristics of the bomb in flight were not to be desired.

b. Right bay; load consisted of one Razon and one dummy:

(1) The dummy failed to release on electric impulse due to malfunctioning of intervalometer.

(2) Razon yawed and pitched as soon as control was applied and in the last few seconds of flight was observed to have entered a rapid, flat spin. Bomb fell far short of the target, approximately 1500 feet, and 60 feet left in azimuth. The bomb penetrated the ground comparatively lightly, and was found close to the surface with the components scattered about the immediate area.

c. Evaluation of the mission indicated that the shroud was still placed too far forward, at the expense of stability.

27

Lt. Col. Stace/lb/4908

(AFDMA-2C)

16 December 1944.

SUBJECT: Razon Tail Units for Training

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Engineering Division (TSEND)

1. It is directed that twenty (20) complete Razon tail units be forwarded to Fort Dix at the earliest possible date for training purposes. Since the delivery on the regular production tails will not start before late January, it is requested that all of the Razon tails delivered be secured from the N.D.R.C. on their pre-production order and that at least one of these tails be expedited to Fort Dix for inspection and information.

2. In accordance with a conversation of 14 December 1944 with Mr. Hugh H. Spencer, Division 5, N.D.R.C., it was agreed that this request and other similar requests for the N.D.R.C. pre-production models should be forwarded to N.D.R.C. by the Air Technical Service Command.

3. The shipping instructions for Fort Dix are: "AAF Property Office, Fort Dix Army Air Base, Fort Dix, New Jersey," marked for "13th AAF Base Unit (Special Weapons)."

4. Information is requested on when this equipment can be made available.

By command of General ARNOLD:

D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engr. Br., Mat. Div.
Office, Asst. Chief of Air Staff
Materiel and Services

AFDMA-2

Y-122116

41

AC/AS, ms S, 15-B/opp) 116

[redacted]

4C
4D

VB-3 (RAZON) 1,000 LB HIGH ANGLE RANGE AND AZIMUTH CONTROLLED BOMB
VB-4 (RAZON) 2,000 LB HIGH ANGLE RANGE AND AZIMUTH CONTROLLED BOMB

Progress and Availability:

1. Six additional drops were made in November of the new increased maneuverability design. These bombs were unstable in yaw and pitch and NDRC will go back to the previous design with the lesser degree of control.

2. The NDRC have issued letters of intent for the 1000 units they were authorized funds to procure. They have requested, however, that ATSC take over all this procurement at the earliest practical date.

3. Estimated deliveries on the 1150 secured by NDRC are:

	Razon Tail
January	30
February	120
March	300
April	700*

*This rate can probably be increased to 1000/month. The present radio receiver schedule is still unsettled, and although every effort will be made to meet the Tail schedule, the radio receiver will probably be a bottleneck item.

4. Fuses are still a difficulty and might result in a delay.

5. The VB-4 program will go on the drawing boards in early January. Full size wood mock-up should be available in late January, in order that the bomb capacity of various airplanes can be determined. No actual development or production will take place until it is determined whether the bomb load that can be secured with the VB-4 will be acceptable to the services.

[redacted]

C5-5383,AF
4C
4D
(18 December 1944)

42

ATSC Form No. 10-6 (17,Oct 44)

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. Number all comments consecutively. Separate comments by horizontal lines across page.

SUBJECT: Conducted Noise on Razon Tail

TO: TSEPL-3I
Att: Equipment Lab.

FROM: TSERR-2C3 DATE: 12/19/44 COMMENT NO. 1

1. Tests on the complete Razon tail and equipment supplied this Laboratory by Gulf Research show a conducted radio noise from gyro and servos on the battery leads of 300-500 microvolts in the radio frequency spectrums of the control link. Reduction of this gyro and servo noise to approximately 50 microvolts will insure reliable operation of the radio control equipment.

2. In accordance with AAF Materiel Command Office Memorandum No. 43-19 and related directives it is requested that the necessary steps be taken to insure the reduction of the radio interference from the non-radio electrical apparatus in the Razon tail to a conducted signal of 50 microvolts on the battery leads.

3. This matter has been coordinated with the Systems Engineering Laboratory, TSERR-2H7, of the Radio and Radar Section which maintains experimental and testing facilities for the study of radio noise.

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(AFR 11-30)

GEORGE L. HALLER,
Lt. Col., Air Corps,
Chief, Special Projects Lab.,
Radio and Radar Section,
Engineering Division.

TOD: 2-4130
3/182

cc: Maj. Lee,
Systems Engr. Lab.,
TSERR-2H-7

TO: TSERR-2H-7 FROM: TSEPL-3I4 Date: 12-28-44 Comment No. 2
Attn: Capt W.B. Frazier

1. Reference is made to a telephone conversation between Major Lee of your office and Lt. Hess of this office, covering request for the Systems Engineering Laboratory to conduct noise studies on subject equipment, in order that this office may further comply with TI-2003, Addendum 4 dated 17 November 1944.

2. As agreed in referenced conversation three (3) each gyro units will be furnished your office immediately for study and recommendations.

3. Three (3) servo units will be obtained and forwarded immediately upon receipt to your office for study also.

4. A complete tail assembly is being requested of N.D.R.C. for the purpose of further noise studies. Since the tail design has recently undergone several modifications it is anticipated that there will be some delay in obtaining the latest model. It

WF, Area B;10-20-44-1 Mil.

(CONTINUE ON OTHER SIDE)

43

TO: TSEHR-2B-7 FROM: TSEFL-311 DATE: Dec 41 COMMENT NO2 cont.

Attn: Capt W.O.Frazier

is estimated that such ball will be available 1C January 1942.

Lt.W.H.EWISE/mep
Ext. 3-5516

for D. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

cc: Capt E.V. Conroy
TSEHR-2B3.
Capt G. A. Wright
TSEFL-317.

(DO NOT WRITE BELOW THIS LINE)

TO TSEMR-2-7 FROM TSEPL-314 DATE 12 Dec 44 COMMENT NO2 cont.
Attn: Capt W.B.Frazier

is estimated that such tail will be available 20 January 1945.

Lt.W.H.HE3E/mep
Ext. 3-5310

for G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

cc: Capt E.V. Cousey
TSEMR-2e3.
Capt R. A. Wright
TSEPL-317.

(DO NOT WRITE BELOW THIS LINE)

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15

Union Switch & Signal Company

Union Switch & Signal Construction Company

SWISSVALE, PA.

December 2[illegible], 1944

[redacted]

Commanding General
A T S C
Attention: TSEPL-[illegible]
Captain J. [illegible] Evans
Wright Field, Dayton, Ohio

Dear Sir:

When I was discussing VB-3 with Mr. [illegible] of the Gulf Research and Development Company yesterday, he suggested that the 150 units on the NDRC development contract be made with the octagonal lift shroud. When these units are received in the field for tests the additional shroud can be used or can readily be removed for comparative tests.

In order to proceed on this basis it will be necessary for us to know two things as quickly as possible. The first is whether or not we can proceed on the assumption that the T-[illegible] fuse will be acceptable to the Ordnance Department. The alternative to this is the use of the T-50 fuse which will require that the shell of the VB-3 be made longer. The second point on which we will need information is the design and dimensions of the anemometer type fuse arming device which the Ordnance Department is to develop. In order to complete our drawings we should have a completely dimensioned drawing of the arming device including of course details of the mounting bracket so that holes may be provided in our assembly for mounting it.

When I was talking to Mr. [illegible] of NDRC yesterday I asked him to obtain, as quickly as possible, the final information on the antenna design for VB-3 from Major Brown at Wright Field. At the conference held at the Gulf Research and Development Company on Wednesday, December 20 Major Brown indicated that it would be several months at least before the final details of the antenna would be released. Obviously, this time must be shortened if we are to produce any of the development models of VB-3 during the first two months of next year. Anything that you can do to expedite the information requested in this letter will be appreciated.

Yours very truly,

L. O. Grondahl

[redacted]

[illegible]

Director, Research and Engineering

Y-126963

44

10-I-349
1-4-45

13

[redacted]

VB-3

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL: TSESE-4 (TSEPL-514)

XXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXX
HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND

Lt.W.H.Hessinger
Ext. 3-5316

5 January 1945

ORIG FILE COPIES TO:	INITIALS
RECORDS DIV.	Ygee
[illegible]	
VALUE OF PAPER [illegible] ONE: PERMANENT ☑ TRANSITORY ☐	

Dr. L. O. Grondahl,
Chief, Section 5.2,
N.D.R.C.,
Union Switch & Signal Company,
Pittsburgh 18, Pennsylvania.

Dear Sir:

Reference is made to your letter of 23 December 1944 requesting information regarding the VB-3 design.

The Ordnance Department has stated that it will approve the use of the T-75 tail fuse for the VB-3, provided the item shows satisfactory performance during drop tests. To date no drop tests have been made of the T-75 fuse with VB-3 equipment; it is anticipated that a small quantity of such fuses modified for VB-3 use will be available for installation on a portion of the VB-3 units to be dropped during the latter portion of the coming Wendover tests.

The anemometer type arming device exhibited at the Pittsburgh conference 20 December 1944 will be used with the gear box mounted externally of the central VB-3 cylinder for the present. However, the Ordnance Department has been requested to continue development of a "paddle-wheel" type airstream arming device which will also incorporate a gear box to be mounted under the surface of the VB-3 central cylinder to provide a clean design. The development of such a "paddle wheel" arming device will require considerable time, and the anemometer type will be used on the VB-3 development and production models meanwhile, subject, of course, to proper performance on the forthcoming tests.

No dimensioned drawings of the T-75 fuse for use with VB-3 are available at present. A representative of the Ordnance Department will be at Wendover to make the necessary installations for the experimental drops. Information regarding the location of the mounting bracket holes will be available shortly thereafter.

[redacted]
MX-591

Y-127488

Dr. L. O. Grondahl, Chief, Section 5.2, N.D.R.C., Union Switch & Signal Company, Pittsburgh 18, Pennsylvania.
5 January 1945.

The Radio and Radar Section has been contacted concerning the antenna design, and has been requested to expedite the current tests being conducted by that section. Tests are being run with the forward lift-shroud in position as well as with it removed, and such tests will continue as rapidly as possible.

Very truly yours,

H. Y. SMITH,
Lt. Colonel, Air Corps,
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

Copy to TSESE-4

[redacted]

MX-591

PROJECT NO. .....

Y-127488

49

[redacted] /

ADDRESS REPLY TO
HEADQUARTERS OF THE ARMY AIR F[illegible] 5
WAR DEPARTMENT
WASHINGTON, D. C.

413.44 Razon

WAR DEPARTMENT
HEADQUARTERS OF THE ARMY AIR FORCES
WASHINGTON

AFMA-OF/7

27 December 1944

SUBJECT: Necessity of Razon for B-29 and Procurement of Ten Service Test Kits for Plane Installation

TO: Director
AAF Air Technical Service Command
Wright Field
Dayton, Ohio

Attention: TSTEX

1. The Twentieth Air Force has established a requirement for Razon, which is initially for test purposes. The decision and the extent to which Razon will be used will depend upon the outcome of the test program. It is therefore requested:

a. That a mock-up and test of a Razon installation in a B-29 aircraft be made.

b. That a quantity of ten (10) service test kits composed of equipment necessary for a complete installation in a B-29 aircraft, be procured in order to insure that an adequate number of aircraft equipments will be available for tests.

45

c. That the necessary tool and test equipment be procured for the above-mentioned kits and the 8,500 Razon bombs now under procurement.

d. That this office be notified of electronic equipment necessary both by quantity and type for the ten kits and the test equipment, in order that this equipment can be procured and allocated for this purpose. At present a quantity of 660 test equipments AN/CRM-5 are under procurement for the Razons. This quantity was determined in accordance with JAC Case 1950 and is believed to be excessive for this test program. The type and quantity of test equipment necessary for this program should be determined, keeping in mind the fact that the Razon is expendable.

2. A 1-A priority is hereby assigned, but inasmuch as Razon will not be in production until the end of January, mock-up and test flights should not be allowed to interfere with more pressing B-29 problems.

By command of General ARNOLD:

B. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engineering Branch
Materiel Division
Office, AC/AS, Materiel & Services

[redacted]

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Y-130009

16

File VB-3

MATER[illegible] COMMAND ROUTING AND RECOR[illegible] SHI[illegible]

INSTRUCTIONS:
1. Use full address for sender and addressee 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: Tail Fuze Requirement for VB-3 (Razon) [redacted]

Comment Number 1.

To: TSOKD-1
Attn: Capt. A. P. Vandenberg

From: TSEPL-314

Date 30 December 1944
Dict. By Lt. W. H. Hess
Phone No. 3-5316
mcp

1. A requirement exists for a tail fuze to be used with the VB-3, Vertical controllable Bomb Tail assembly (Razon) as is used with a standard 1000 pound general purpose bomb, AN-M44.

2. The advantages of tail fuzes for missiles of this sort, to be used in addition to nose fuzes, have been previously discussed elsewhere.

3. The present VB-3 tail has been designed to provide mounting of the type T-75 fuze, to be used minus the spacer ring incorporated in the T-75 fuze as used with VB-1 (Azon). The tail fuze used with VB-3 should consequently be of dimensions and design similar to the T-75 fuze. An airstream arming mechanism should be provided.

4. It is requested that action be initiated by your office requesting the Chief of Ordnance to set up a project to provide a suitable tail fuze for use with the VB-3.

Jack Lieut Maj AC

for W. F. HOLLMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

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2. To: TSEPL-314 From: TSOMD-1 Date: 5 January 1945

Attn: Lt. W. H. Hess Dict. by: Vandenberg/faw
Phone No. 2-8209

1. Inclosed for your information is copy of letter from this office to Air Ordnance Office, Washington, D. C., which sets forth requirements for a tail fuze for use with VB-3. This letter was submitted in accordance with request contained in Comment No. 1 above.

1 Incl,
ltr dtd 5 Jan '45
to Air Ord

Alden P. Taber

ALDEN P. TABER,
Colonel, Ord. Dept.,
Chief, Ordnance Section.

[redacted]

MX-591 T-128534

AAFMC-890-WF-8-18-44-150M

(Start comments on other side at this end)

46

AC/AS-MRS-1

RESTRICTED

Controlled Missiles 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:

FOR OFFICIAL USE ONLY (AFR 11-30)

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

C5-5468, AF

RESTRICTED

26

[redacted]

COPY

AC-36X

5 January 1945

SUBJECT: Strategic Air Forces in Europe Requirements for Felix and Razon

TO: Director
AAF-Air Technical Service Command
Wright Field, Dayton, Ohio

ATTN: Engineering Division (TSENG)

1. Attached is a paraphrased copy of a cable of 3 January 1945 from General Spaatz, CG, US Strategic Air Forces in Europe, St. Germain, France.

2. Comments are requested on the recommendation of using Razon and Felix with the projected large bombs of 4000 lbs or greater.

3. Comments are also requested concerning the extent to which Felix can be used through smoke screens and through clouds.

By command of General ARNOLD:

D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engr. Br., Mat. Div.
Office, Asst. Chief of Air Staff,
Materiel And services.

1 Att.
Para. Cpy of Cable

[redacted]

COPY

2nd - 5 Feb 45

X-8072

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SECRET

"Strategic Air Forces in Europe Requirements for Felix"

1st Ind. TSESE-4 (TSEFL-314)/JHE/mep

HQ AAF ATSC Wright Field, Dayton, Ohio

TO: Commanding General, Army Air Forces, Washington 25, D.C.
Attention: Engineering Branch, Materiel Division, AC/AS M & S.

1. With reference to paragraph two above, projects have not been initiated for the use of VB-3 (Razon) and VB-6 (Felix) with bombs of 4,000 pounds or greater. It is felt that without specific requests for such a development such projects should not be initiated until the present VB-3 and VB-6 using the 1,000 pound bomb are perfected.

2. In the preliminary report on VB-6 (Felix) for 1 December 1944 published by N.D.R.C. it is stated under item 6 on page one "Bombs can be dropped through high overcast, light smoke and haze, but not through low clouds, fog or dense smoke screens." This fact has not been checked by this office; however, it is felt that the contents of the report are reliable.

For the Director:

H. Y. SMITH,
Lt. Colonel, Air Corps,
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

1 Incl.
w/d

Copy to TSESE-4

X-8072-1

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ATSC Form No. 45
(16 Sep 44)

Confidential

XXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXX

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL:
TSEPL-4 (TSEPL-314)

HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND

Lt.W.H.Hessmop
Ext. 3-5316
11 January 1945

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

Dr. L. O. Grondahl,
Chief, Section 5.2,
N.D.R.C.,
Union Switch & Signal Company,
Pittsburgh 18, Pennsylvania.

MX-591

FOR OFFICIAL USE ONLY
(AFR 11-30)

Dear Sir:

Preparation of Army Air Forces production specifications for the VB-3 requires that certain photographic views of the equipment be obtained. Such photographs could be obtained most expediently by having them taken at Pittsburgh, since the equipment will be first available at that place.

All views furnished should show the tail assembly mounted to a standard AN-M65 general purpose bomb case or mock-up. The views needed are as follows:

Side view of tail assembly (with forward lift shroud in place)

Rear oblique view of tail assembly (with forward lift shroud in place)

Side view of tail assembly (with forward lift shroud removed)

Rear oblique view of tail assembly (with forward lift shroud removed)

Confirming verbal request of 21 December 1944, it is requested that seven (7) prints approximately 8 inches x 10 inches of each of the above listed views be furnished the Air Technical Service Command, Attention: Equipment Laboratory of Engineering Division, as soon as is conveniently possible, in order that the specifications may be completed with the least delay.

Very truly yours,

for H. Y. SMITH,
Lt. Colonel, Air Corps,
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

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MX-591

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X-5216

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CENTRAL FILE COPY

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IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL: TSESE-4 (TSEPL-3I4)

HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND
Capt. J. H. Evanstmep
Ext. 3-5316

12 January 1945

Dr. L. O. Grondahl,
Chief, Section 5.2,
N.D.R.C.,
Union Switch & Signal Company,
Pittsburgh 18, Pennsylvania.

Dear Sir:

A request has been submitted to Chief, Division 5, N.D.R.C., for twenty (20) each VB-3 Tail assemblies to be allocated to Fort Dix for training purposes, one of which to be delivered as soon as possible for inspection and information. It is requested that Air Technical Service Command be supplied with the information as to when these items, particularly the one required for inspection and information, can be made available to Fort Dix.

Very truly yours,

H. Y. SMITH,
Lt. Colonel, Air Corps,
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

Copy to TSESE-4

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

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AAFMC-100-WF-5-20-42-2 MH. CENTRAL FILES

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OFFICE FOR EMERGENCY MANAGEMENT
NATIONAL DEFENSE RESEARCH COMMITTEE
OF THE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P STREET NW.
WASHINGTON, D. C.

AC-36

Union Switch & Signal Company
Pittsburgh 18, Pennsylvania

January 18, 1945

[redacted]

Army Air Forces
Headquarters, Air Technical Service Command
Wright Field, Dayton, Ohio

Attention: TSESE-4 (TSEPL-314)

Gentlemen:

We have a letter signed by Major R. A. Schmidt for Lt. Colonel H. Y. Smith, Chief, Engineering Standards and a copy of a letter from the same office to Mr. H. H. Spencer, Chief, Division 5, NDRC. In both letters the request is made that 20 VB-3 tail assemblies be sent to Fort Dix for training purposes as soon as they are available. We shall, of course, comply with this request at the earliest possible moment.

The present status is that full engineering information is not yet available from the development group, but it is expected that we shall have this information by the end of January. We have our drawings well under way and some materials ordered, both in the shop and outside. The final design however cannot be completed until we get the final information and we expect that the drawings will be complete by February 15. By the end of February it is possible that we can build a few units as far as the mechanical construction is concerned. The first radio sets are promised for about the middle of March so that complete units will not be available until about that time. As soon as that situation has been reached and as soon as we have allotted us many as are necessary for the preliminary tests, we will send the required number of units to Fort Dix.

Yours very truly,

L.O. Grondahl

Chief, Section 5.2, NDRC

LOG:hma

[redacted]

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[redacted]

Initials
Date

Maj. H.F. Marshall
TSBPR4Q Tel. 2-5233

TSBPR4Q

13 January 1945

Guided Missiles
VB-3 "Razon" equipment
for 1000 lb. Bombs

Commanding Officer
Eastern District
AAF ATSC
67 Broad Street
New York 4, N.Y.

mx-591

Attn: Production Executive

1. The purpose of this letter is to advise your District of the essential facts in connection with the present authorized program for procurement and production of the subject item so that you may take necessary action to assure coordinated and expedited production action between organizations within your District.

2. A Letter of Intent has been placed with Union Switch & Signal Company, Swissvale, Pa., by the Office of Strategic Services, for the National Defense Research Council, covering the production of 1000. When engineering and development has reached a stage where design standardization is effected the NDRC Letter of Intent will be replaced by AAF procurement and procurement will be made of an additional 2000. Design development has been handled by NDRC personnel and Engineering Division, Special Weapons Branch, has been directed to cooperate with the NDRC on the development until such time as production and tests permit standardization and to furnish the Procurement Division all drawings and engineering data that may be required in the event that further procurement is directed. Capt. J. H. Sears, Chief, Vertical Bombing Unit, Special Weapons Branch, is the responsible AAF Officer in connection with this design development. His telephone extension at this Headquarters is 3-5316.

3. The Procurement Division has been directed to determine the delivery schedule for the 1000 VB-3 equipments and the potential follow-on schedule that could be secured. Your office should obtain the delivery schedule and report it to this Headquarters, Attention: TSBPR4Q, at the earliest possible date.

4. The Confidential Technical Instructions covering this purchase requires that components and materials from the cancellation of the VB-1 Azon Tail Procurement are to be made available and used as much as considered practicable in the NDRC procurement.

AAFMC-190-WF-12-17-43-500M

[redacted] CENTRAL FILES

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[redacted]

Subj: Guided Missiles
To: Commanding Officer, Eastern Dist.
Date: 13 January 1945

5. Since the Azon Tail Procurement was made with Union Switch & Signal Company, Swissvale, Pa., and G & A Aircraft Company, Willow Grove, Pa., both in Eastern District and the surplus components from this procurement either are stored at these contractors or the location thereof is known to the personnel of Area Offices concerned, your office should follow to assure compliance with this provision.

6. A sufficient quantity of Directional Control Gyros are on hand at Union Switch & Signal Company and have been set aside for their use in the initial 1000. A quantity of batteries has been similiarly set aside. The Pittsburgh Sub-Area Office is familiar with these actions.

7. Pending such time as Purchase Request is issued for AAF procurement to replace the NDRC Letter of Intent this production should receive the same close follow-up by the District organization that would be given if it were present AAF procurement.

By Command of Lieutenant General KNUDSEN:

K. A. SHEPARD
Colonel, Air Corps
Acting Chief,
Production Section

H.F. MARSHALL
TSEPR4D

CC: TSEPLJ Attn: Capt. Evans
TSF X Attn: Major Mullins
TSBUY Attn: Mr. Connelly
CG, Midwest Dist., ATSC

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

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AAFMC-190-WF-12-17-43-500M CENTRAL FILES

K-12070

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CONFIDENTIAL

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. 19 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:

FOR OFFICIAL USE ONLY (AFR 11-30)

12/15/44

12:20

J. N. GRUITCH
Lt. Col., Ord. Dept.
Chief, Tech. Dev. Br.
AFDAO

V-117383

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File 320

HEADQUARTERS ARMY AIR FORCES
Office, Asst. Chief of Air Staff, Materiel and Services

Inter-Desk Memorandum

TO: MEMORANDUM FOR RECORD [redacted] Date 22 January 1945

SUBJECT: Procurement of Azon and Razon Guided Missiles

Dr. Grondohl
Dr. Murray
Dr. Boyce
Mr. Field
Major Quillian
Major Jenson
Major Short
Lt. Clark

Conference was called in Col. Tetley's office on 19 January 1945 to provide the necessary background on which to base a decision for the future course of action to be followed in procurement of Azon and Razon. Dr. Grondohl advised that the surplus Azon components were being loaded and shipped from the Union Switch and Signal Co. plant. He understood that disposal action had been received from ATSC and he believed that large quantities of partially completed components were scheduled for destruction. Large quantities of partially completed parts of gyro motors for GB-4 (4 carloads) were also scheduled to be destroyed. Col. Tetley investigated the feasibility of holding the destruction of the Azon components until such time as OC&R could be queried regarding a possible requirement to reopen the Azon production-line in view of the reported success with Azon equipment in the CBI Theater. Representatives at ATSC have stated there is no objection to 30 day delay. ~~and it was been recommended to Air Serv. Division that a 30 day delay be directed.~~

The following details were reported regarding Razon:

a. Dr. Boyce is convinced Razon can be controlled by one very well trained bombardier. However, the training problem would be easied considerably if two operators were used.

b. The present control box requires a slight modification in the position of the various controls to provide greater ease of operation.

c. Cathode ray units are being procured for training Razon operators. One unit is due to be shipped to the Special Weapons School at Ft. Dix.

d. Dr. Grondohl expects to have full engineering information available by the end of January and drawings should be completed in February.

e. Radio set was reported to be the bottleneck. Radio receivers will not be available from Harvey Unit (?) until the end of March, thus dictating April as the earliest date for Razon tails.

f. The Union Swithh and Signal Co has not received an order for the 2000 Razon units which ATSC were directed to procure directly.

It was the opinion of NDRC personnel that the airplane warm-up circuit should be standardized for Azon, Razon and Felix.

Dr. Boyce recommended that Belly Movie Cameras should be installed in each ship fitted for Azon and Razon.

Dr. Grondohl advised Ordnance personnel that an anemometer for the T-75 tail fuses is acceptable from an aerodynamic standpoint for either VB-1 or VB-3.

NDRC representatives advised that they would forward wiring diagrams and parts of Razon equipment to the Special Weapons School, Ft. Dix, for training purposes.

JFV/lb/4908

FOR OFFICIAL USE ONLY
(AFR 11-30)

From [redacted]

THIS FORM WILL NOT BE USED OUTSIDE THE AC/AS, M&S

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VB-3 3n.

SPECIAL WEAPONS TEST UNIT
Wendover Army Air Field
Wendover, Utah

WEH/11
TSEFL-3111

24 January 1945

SUBJECT: Identification of Razon Types.

TO: Director, ATSC, Wright Field, Dayton, Ohio.

Attn: TSEPL-514, Capt. J. M. Evans.

1. It is the purpose of this correspondence to set down in tabular form for reference purposes the various types of Razon (VB-3) designs which have been considered to date.

2. Listed below are the designations as used by the Gulf Research and Development Company for each of the separate models, together with the general over-all features of each. Certain additional remarks have been added in some instances for purposes of further identification.

a. Mark I. - Single shroud mounted at the rear; 11 1/2 inch central cylinder diameter; no tail fuze cavity; individual linkages to ailerons from solenoids; rudder and elevator surfaces 2 1/2" x 12", with travel of 30 degrees in 0.5 seconds; servo motors 6 r.p.m.; radio, gyro and battery mounted in forward half of tail cylinder. This was the model dropped at Tonopah sometime around late August or early September, 1944.

b. Mark I-a. - Single shroud mounted at the rear; 12 inch central cylinder diameter; T-75 tail fuze cavity provided; disc linkage common to all four ailerons; rudder and elevator surfaces 3" x 12", with travel of 15 degrees in 0.5 seconds; servo motors 4 r.p.m.; radio, gyro and battery mounted in forward half of tail cylinder. This model is among those being dropped at Wendover at present.

c. Mark II. - Single shroud mounted toward front; 12 inch central cylinder diameter; tail fuze cavity provided; disc linkage common to all four ailerons; rudder and elevator surfaces 3" x 12", with travel of 20 degrees in 0.7 seconds; servo motors 4 r.p.m.; radio gyro and battery mounted in rear half of tail cylinder. This model was drop tested at Wendover during November 1944, and the results indicated low stability.

[redacted] X-23487

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Ltr. to Dir., AT..., Attn. Capt. J. E. Evans, Subj ...tification of Razon Types, dtd. 24 January 1945, cont'd.

d. Mark II-a. - Same as Mark II above, except that shroud was moved rearward 2 1/8 inches. This model was only an emergency design and was tested during the same series of November tests as Mark II. Low stability was also experienced with this model.

e. Mark III. - Double shroud with the leading edge of the forward shroud extending beyond the forward end of the central cylinder and with the trailing edge of the rear shroud extending beyond the rear end of the central cylinder; 12 inch central cylinder diameter; tail fuze cavity provided; disc linkage common to all four ailerons; rudder and elevator surfaces 3" x 12", with travel of 20 degrees in 0.7 seconds; servo motors 4 r.p.m.; radio, gyro and battery mounted in forward half of tail cylinder. This design never got beyond the drawing board stage, and its prints are the ones from which the mock-up is being fabricated by the Engineering Shops at Wright Field; however, the latest dimensions corresponding to the current Razon design were forwarded to your office in letter dated 15 January 1945, subject "Mock-up Dimension Changes", in which it was requested that the mock-up be modified accordingly.

f. Mark IV. - Double shroud with the trailing edge of the rear shroud flush with the rear end of the central cylinder, and with an octagonal forward lift shroud; 12 inch central cylinder diameter; T-75 tail fuze cavity provided; disc linkage common to all four ailerons; rudder and elevator surfaces 3" x 12", with travel of 15 degrees in 0.5 seconds; servo motors 4 r.p.m.; radio, gyro and battery mounted in forward half of tail cylinder. This model is among those being tested at present at Wendover. A slightly modified version of this model using a 23 5/8" diameter cylindrical forward lift shroud instead of the octagonal shape is also being tested at Wendover at present.

For the Commanding Officer:

William H. Hess

WILLIAM H. HESS,
1st Lt., Air Corps,
Razon Project Officer.

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IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL: TSEEE-4 (TSEPL-314)

[redacted]
HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND

Lt.D.M.Baltimore:msp
Ext.35316

26 JAN 1945

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

Dr. L. O. Grondahl,
Chief, Section 5.2,
N.D.R.C.,
Union Switch & Signal Co.,
Pittsburgh 18, Pennsylvania.

Dear Sir:

There is being sent to you by parcel post a new type of flare mounting bracket which has been developed by Air Technical Service Command for use in VB-3 and any other device on which T-6 type flares are used. This bracket was developed to enable the flares to be mounted in VB-3 units after the bombs have been loaded in the bomb bay and to allow fastening the flares easily in a most cramped area.

As you will see from the sample, the flare and ring screwed to it merely have to be pushed into the outer holding ring, revolved slightly, and the flare is locked into place. No tools are necessary to install it. The spring holding the latching pin in place is to be extended beyond the pin, and curved upward to fit a thumb or finger. In case it becomes necessary to remove the flare, then a flick of a finger is all that is needed.

Your comments are invited as to the practicability and construction of the assembly, and any suggestions would be appreciated. It is hoped that this assembly will be installed on the production model of the VB-3.

Very truly yours,

L. T. SMITH,
Lt. Colonel, Air Corps,
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

EPL-314
EPL-314

PERMANENT

MX-591

PROJECT NO.
This document contains information affecting the national defense of the United States within the meaning of the Espionage Act, U.S.C. 50:31 and 32. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

CENTRAL FILES

Copy to TSEEE-4

AAFMC-190-WF-5-20-42-2 Mil.

X-17664

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4C
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VB-3 (RAZON) 1,000 LB, HIGH ANGLE, RANGE AND AZIMUTH CONTROLLED BOMB
VB-4 (RAZON) 2,000 LB, HIGH ANGLE, RANGE AND AZIMUTH CONTROLLED BOMB

Progress and Availability

1. The general overall physical characteristics of the VB-3 are at present under slight modification. An octagonal control shroud with rudders and elevators is mounted at the rear of the tail assembly. An additional "lift" shroud is added near the forward end of the tail, and its retention or removal is dependent upon evaluation of drop tests completed in late January. The internal components are redistributed, with the radio receiver, gyro, and batteries in the forward section of the central cylinder; this is necessary in order to place the servo units rearward and near the control shroud.

2. The control shroud is located as distant as possible from the bomb center of gravity in order to gain yaw and pitch stability in flight. The forward lift shroud is added for purpose of gaining lift and maneuverability.

3. Redesign presently under way makes necessary entire new measurements of the antenna impedance and the radiation pattern by the Radio and Radar Laboratory. It is estimated that a period of two (2) months will be required for the completion of such measurements. The revised design has not been finally established.

4. Preparation of AAF Specification for the VB-3 has been initiated preparatory to future production procurement by the Army Air Forces to supplement procurement already initiated by NDRC.

5. It is now expected that a final design will be determined by 15 February 1945.

6. The VB-3 tooling is just starting. NDRC is working towards a schedule of 150 in March 1945, 150 in April, 300 in May, and 500 per month thereafter. Union Switch and Signal Co believe that the presently planned tooling could produce 2000 to 3000 per month, but the customary problems of securing materials and personnel would be encountered in any such expansion of rate.

7. No drops have been made yet using a single operator for both range and azimuth.

8. No orders have been placed for any of the "Crab" bomb sights. The desired timer has not been developed as yet for this sight to compensate in range for the effect of the amount of time the bomb is controlled.

[redacted]

28 January 1945

C5-6380, AF

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THIS PAGE IS UNCLASSIFIED

AC/AS, 11-4, 15(2)/400) 115

[redacted]

VB-3 (RAZON) 1,000 LB, HIGH ANGLE, RANGE AND AZIMUTH CONTROLLED BOMB
VB-4 (RAZON) 2,000 LB, HIGH ANGLE, RANGE AND AZIMUTH CONTROLLED BOMB (CONT.)

9. The 10th Air Force have had very successful results with Azon and feel that there are a large number of targets in their territory well adapted for the use of Razon.

10. The 10th Air Force also expressed a requirement for 300 2000 lb Azons per month. No decision has been made, however, concerning any production of either a 2000 lb Azon or Razon. The wood mock-up of the VB-4 (2000 lb Razon) will not be completed until after the design of the VB-3 is frozen. Completion date of this wood mock-up is now estimated as 1 March 1945. No tooling will be started until it is determined how well the VB-4 can be fitted into present bomb-bays.

11. The ATSC has been directed to assemble 10 service test hits composed of equipment necessary for a complete installation of VB-3 (Razon) in B-29 aircraft. The necessary tool and test equipment for the 10 hits and the 3,300 VB-3 (Razon) bombs under Procurement, are also being procured by the ATSC. This action is being taken under TI-2029 Addendum 20.

[redacted]

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Union Switch & Signal Company

Union Switch & Signal Construction Company

W. H. CADWALLADER
VICE PRESIDENT AND GENERAL MANAGER

SWISSVALE, PA.

February 2, 1945

ARMY AIR FORCES
VB-3 Razons

Air Technical Service Command
Procurement Division
TSBPR-4-Q
Wright Field, Dayton, Ohio.

ATTN: Major H.F. MARSHALL

Gentlemen:

Referring to your telephone inquiry as to what could be done from a production standpoint on the manufacture of the VB-3 Razons, wish to advise as follows:

We now have an order for the development of this VB-3 Razon, as well as for the making of 150 for test purposes. Complete engineering information is not yet in our hands but we understand that final data will be available sometime not later than February 20th. Based on this information we should be able to deliver 20 of the test instruments on or about April 1st and complete the balance so that all of them will be sent out sometime not later than May 15th.

The manufacture of these 150 test Razons will all be a matter of hand work. In order to put this instrument on a production basis it is desirable to make tools so as to produce economically. The making of the drawings and the finishing of the dies, jigs, etc. will require approximately 90 days from March 1st, which means that the tools should be complete sometime the latter part of May.

After completion of tools we estimate that we should be in shape to begin turning out the Razons at the rate of 5 per day by July 1st, and after a few days at this rate should be able to step up to 10 per day. We feel we should be able to make delivery of approximately 225 during July.

On August 1st we should be able to step our production up to 20 per day, which means that we should be able to turn out in the neighborhood of 500 during the month of August.

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On September 1st, if we have sufficient [illegible] ahead, we could step up our production to 40 per day, which means that we should be able to turn out during the month of September approximately 1,[illegible] and could continue at this rate indefinitely.

These deliveries are contingent on our being able to only get the engineering information promptly, but, also, on our being able to get the necessary raw material which we would have to purchase, as well as delivery of the G.F.E. material such as radios, etc.

These promises are, we feel, about as good as we can make at this time, but upon receipt of a contract we would do everything we possibly could to anticipate the dates given and advance them as much as possible. In order to justify our stepping up production to 1,[illegible] per month we feel that we should have a contract covering at least [illegible],000 of these [illegible].

We believe this will give you all the information you require, but, if not, and any further data is necessary, we will be very glad to furnish on request.

Yours very truly,

H. H. Cadwallader

Vice-Pres. & [illegible]

[illegible]

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(AFR 11-30)

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[redacted]

6 FEB 1945

TO: Budget and Fiscal Office
Army Air Forces

SUBJECT: Fiscal Year 1945 and 1946 Fund Requirements for Project 190, Guided Missiles

X45211 Radio Control Plane

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	7,500	18,000
JB-2	8,000	12,000
PB-6	1,500	2,400

7 FEB 1945

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(AFR 11-30)

OFFICE SYMBOL	1 AFDHA-2	2	3	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER						
INTERNAL OFFICE COORDINATION						58

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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	5,000,000	7,500,000
	$92,000,000	$135,500,000
Procurements to date (AAF funds only)	15,000,000	
Allowance for other Projects under consideration	[illegible]	[illegible]
	[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

[redacted]

OFFICE SYMBOL	1	2 AFDeo	3 AFAMS 2A	4	5	6
SIGNATURE OF RESPONSIBLE OFFICER	[signature]	[signature]	[signature]			
INTERNAL OFFICE COORDINATION						

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AAFMC-268-WF-3-11-45M

[redacted]

ARMY AIR FORCES

AIR TECHNICAL [redacted] SERVICE COMMAND

ENGINEERING DIVISION

MEMORANDUM REPORT ON

Lt.W.H.Hess
Ext. 35316

Date 9 February 1945

SUBJECT: Project MX-591 Tests at Wendover, Utah.

OFFICE TSEPL-314

Contract or Order No.

SERIAL No. TSEPL-3-673-[redacted]-A

Expenditure Order No. 673-51

A. PURPOSE:

1. To report on trip to Wendover Field, Wendover, Utah, from 10 to 31 January 1945, covering tests on VB-3 (Razon).

B. FACTUAL DATA:

1. Personnel present at the tests were:

Air Technical Service Command

Major W. C. Williams
Capt. E. H. Vandenberg
1st Lt. W. H. Hess

Navy, Bureau of Ordnance, Experimental Unit

Lt. (j.g.) G. R. Bastedo

Gulf Research & Development Co.

Mr. R. D. Wyckoff
Dr. J. P. Molnar
Mr. C. A. Gustavson
Mr. R. K. Crooks
Mr. E. M. Palmer
Mr. L. D. Palmer

2. Eighteen (18) each VB-3 (Razon) units were drop tested at Wendover Field beginning 16 January and ending 29 January 1945. All of these units represented design changes since the last previous drops and these later models were divided into two categories. The one type covered by this report had the trailing edge of the control shroud mounted flush with the rear of the central cylinder, and was designated by Gulf Research & Development Company as Mark I-a. The other type was identical to the Mark I-a in overall characteristics except that an additional lift shroud had been added at the forward end of the central cylinder, and this model was designated by Gulf Research & Development Company as Mark IV; two versions of Mark IV were dropped -- one with an octagonal forward lift shroud and the other with a cylindrical shaped one.

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MX-591

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ARMY AIR FORCES

AIR TECHNICAL ~~MATERIEL COMMAND~~ SERVICE COMMAND

ENGINEERING DIVISION

MEMORANDUM REPORT ON

Lt.W.H.Hess
Ext. 35316

Date 9 February 1945

LISTED
N-812

SUBJECT: Project MX-591 Tests at Wendover, Utah.

OFFICE TSEPL-3L4

Contract or Order No.

SERIAL No. TSEPL-3-673-44-A

Expenditure Order No. 673-51

A. PURPOSE:

1. To report on trip to Wendover Field, Wendover, Utah, from 10 to 31 January 1945, covering tests on VB-3 (Razon).

B. FACTUAL DATA:

1. Personnel present at the tests were:

Air Technical Service Command

Major W. C. Williams
Capt. H. H. Vandenberg
1st Lt. W. H. Hess

Navy, Bureau of Ordnance, Experimental Unit

Lt. (j.g.) G. R. Bastedo

Gulf Research & Development Co.

Mr. R. D. Wyckoff
Dr. J. P. Molnar
Mr. C. A. Gustavson
Mr. R. K. Crooks
Mr. E. M. Palmer
Mr. L. D. Palmer

2. Eighteen (18) each VB-3 (Razon) units were drop tested at Wendover Field beginning 16 January and ending 29 January 1945. All of these units represented design changes since the last previous drops and these later models were divided into two categories. The one type covered by this report had the trailing edge of the control shroud mounted flush with the rear of the central cylinder, and was designated by Gulf Research & Development Company as Mark I-a. The other type was identical to the Mark I-a in overall characteristics except that an additional lift shroud had been added at the forward end of the central cylinder, and this model was designated by Gulf Research & Development Company as Mark IV; two versions of Mark IV were dropped -- one with an octagonal forward lift shroud and the other with a cylindrical shaped one.

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3. Of the type with rear shroud only (Mark I-a) eight (8) units were dropped. In each instance a standard 1000 pound general purpose bomb was dropped as a dummy for reference purposes. The drops were all made from 15,000 feet above target. (See Appendices 1, 2, and 3)

4. Of the type with the additional forward shroud (Mark IV), seven (7) were dropped with octagonal shrouds, and three (3) were tested with circular ones. Each Mark IV was dropped simultaneously with a standard 1000 pound general purpose bomb for dummy from 15,000 feet above target. (See appendices 1, 2 and 3)

5. Four (4) of the units dropped were fitted with tail fuzes of the type T-75E1 which is airstream-armed. Included were both Mark I-a and Mark IV Razons. All tail fuzes tested detonated properly.

C. CONCLUSIONS:

1. That the stability characteristics of both the Mark I-a and the Mark IV are satisfactory.

2. That the double-shrouded (Mark IV) version of the VB-3 can be deviated from its initial trajectory to a greater degree than the single-shrouded version, and that an octagonal forward lift shroud is to be desired over a circular forward shroud.

3. That errors in range can be partly but directly attributed to insufficient ballistic data on the missile available at present.

4. That the T-75E1 tail fuze would be desirable for use with the VB-3 missile.

D. RECOMMENDATIONS:

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

a. Division 5, N.D.R.C.

(1) That the initial production version of the VB-3 (Razon) incorporate essentially the same shroud location and same component distribution as the Gulf Research & Development Company Mark IV (octagonal forward shroud) with such minor variations as may be required to facilitate production.

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Memorandum Report Number TSEPL-3-673-16-A
9 February 1945

(2) That the VB-3 not be turned over to the Army Air Forces Board at Orlando, Florida, for evaluation and service tests until proper release by Air Technical Service Command.

b. Engineering Division, Air Technical Service Command, Equipment Laboratory.

(1) That complete ballistic data on the VB-3 pre-production or production version be obtained by Air Technical Service Command, in cooperation with such agencies as required, before the missile is submitted to the Army Air Forces Board for evaluation. (Action to be initiated upon the receipt of 20 of the production items)

Distribution: AC/AS M & S (5 copies);
Eval. Br., Tech Data Lab (TSEAL-6D);
Chief, Section 5.2 N.D.R.C.;
Chief, Division 5 N.D.R.C.
Res. Proj. Br. TSESE 91.

Prepared by William H. Hess
William H. HESS, 1st Lt. A.C.

Approved by: G. V. HOLLOMAN, Colonel, A.C.
Equipment Laboratory.

Approved by: H. Y. SMITH, Lt. Colonel, A.C.
Chief, Engineering Standards
Service Engineering Section,
Engineering Division.

[redacted] Clarence:

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- 3 -

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Memorandum Report Number TSEPL-3-673-46-A
9 February 1945

APPENDIX 1.

1. The entire eighteen (18) VB-3 (Razon) units tested were not all dropped primarily in an attempt to strike the center of the target.

2. Some units dropped were deliberately given "provocative" control in an effort to determine the amount of stability against roll; other units were pre-set to deviate away from the target in order to disclose the amount of available deflection after given periods of fall. Five (5) of the units were expended for such tests, of which one (1) failed functionally.

3. Stability against roll was high in both the single-shrouded (Mark I-a) version and the double-shrouded (Mark IV) model. One unit of the double-shrouded variety was given full "right" control after having dropped for fifteen (15) seconds from 15,000 feet above the ground and it had deflected approximately 2660 feet to the right of its dummy upon impact, as compared with a single-shrouded unit dropped similarly and which deflected between 1550 to 1600 feet right from its dummy.

[redacted]

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Memorandum Report Number TSEPL-3-673-46-A
9 February 1945

APPENDIX 2.

1. Of the total eighteen (18) VB-3 units expended during the series of tests covered by this report three(3) failed functionally. One of these three failures was due to a malfunctioning rate gyro, another was attributed to radio receiver failure after approximately one-half of the drop, and a third was believed to have been caused by a power (battery) failure after 10 to 15 seconds of fall.

2. A probable fourth unit also failed, because it would not respond to control signals during the very last few seconds of flight and it fell approximately 400 feet short of the target.

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Memorandum Report Number TSEPL-3-673-46-A
9 February 1945

APPENDIX 3.

1. Ten (10) units of the quantity dropped during the series of tests covered by this report can be regarded as having been representative of the strike pattern obtained during these tests. Subtracted from the total number of eighteen (18) units are the five (5) units intentionally expended for "non-accuracy" tests, together with the four (4) units --(one of which duplicates in the first quantity of five) which failed mechanically.

Mark I-a Single Shroud

No. 190	short 100 feet	right 40 feet
No. 199	over 515 feet	left 60 feet
No. 200	over 205 feet	left 25 feet
No. 201	over 115 feet	right 20 feet
No. 202	over 35 feet	left 15 feet

Mean distance from target center: in range.....188 ft., in azimuth...32 ft

Mark IV Double Shroud (octagonal forward shroud)

No. 191	over 140 feet	left 55 feet
No. 196	over 110 feet	right 20 feet

Mean distance from target center: in range ...125 ft; in azimuth...38 ft.

Mark IV Double Shroud (circular forward shroud)

No. 197	over 75 feet	right 10 feet
No. 204	over 205 feet	left 12 feet
No. 205	over 245 feet	left 20 feet

Mean distance from target center: in range.... 175 ft; in azimuth...14 ft

All Mark IV double shroud (both types)

Mean distance from target center: in range... 155 ft; in azimuth... 23 ft.

[redacted]

X-34395

[illegible] AC [illegible]
[illegible] 19 [illegible]

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Copy for Col. Brown

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.N.W. 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 BAT 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. Most research has been stopped by the diversion of test personnel to man several squadrons to send overseas with BAT for operational theater tests.

3. Dr. [illegible] - 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 fuse developed for the VB-1. Studies are underway to shorten the VB-2. [illegible] will start drop tests soon on the VB-2. The evolution of the double shroud on the VB-3 is expected to produce a device with accuracy of within 90 ft. in range; with 30 to 40 ft. in range possible with sighting improvements; azimuth accuracy practically same as VB-1.

4. [illegible] - Philadelphia project - principal activity is the development of "[illegible] television" for the [illegible] project. Tests are expected in February or March. [illegible] expect to receive six equipments by 28 February and four more by 30 April. 150 units are on order for the Army. The range in the Philadelphia test was good at 10 miles with [illegible] watts output.

5. Dr. Boyce - Douglas Project - All [illegible] tests are conducted with "proportional control." Azimuth control is good; range control is not satisfactory but improving. Of the next 35 [illegible] tests, 25 are expected to be conducted with [illegible] 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. Mr. [illegible] explained

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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)
4908

57

PETROLEUM AND ITS PRODUCTS

GULF RESEARCH & DEVELOPMENT COMPANY

P. O. DRAWER 2038 · PITTSBURGH, PA.

30

February 14, 1945

Capt. J. W. Evans
Special Weapons Division
Equipment Laboratory
Wright Field
Dayton, Ohio

[redacted]

Subject: YB-3 Samples

Dear Capt. Evans:

Two YB-3 units, addressed to you as above, were shipped via express yesterday afternoon. These are for your permanent use and no charges are involved. These units represent our final design but the production model will incorporate the following changes:

1. Control flaps will be changed to 11" x 2-1/2".

2. The kick-off plug will be a 4-prong as in YB-1.

3. The method of mounting the bell unit on the base plate will be changed. Instead of the eight radial screws into the edge of the mounting plate, four large bolts will pass through the base of the lift-shroud supports in a direction parallel to the bomb axis and tilted inward to engage threaded holes in the face of the mounting plate.

4. Both shrouds will be constructed of steel, whereas in our model the rear control shroud is of aluminum.

5. The control rods to the flaps will be flat strips approximately 1/2" x 1/8" (reversible in the unit assembly) and the turnbuckle adjustment will be eliminated.

These changes will have no major effect on the external appearance of the unit nor to the performance of any radio antenna tested on our models.

You will note that in one unit, we have replaced the pair of standard 24 volt A-1, B-7-1 storage batteries, by an improved unit known as Willard type CB-10-13. This unit has been made by Willard as a sample

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only, and is not available in production. It is our understanding that it cannot be obtained in quantity until a sufficient number can be placed on order to warrant construction of the necessary dies for the plastic cases. However, it is so much superior to the N-T-6 in all respects, that we hope it can be made standard for VB-3. The production model will be designed to accomodate either without change. We have included the new battery in our sample so that the superior qualities of the ER-10-12 may be noted and perhaps some pressure applied to expedite procurement.

Please see that at least one of the above units is placed in the hands of A.R.L. for their radio antenna development.

Yours very truly,

R. D. Wyckoff

RDW:CRF

cc: Dr. Grondahl
Mr. Spencer
Dr. Eckhardt

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XXXXXXXXXX
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Lt.W.H.Hennessy
Ext. 35316

IN REPLY ADDRESS BOTH COMMUNICATION AND ENVELOPE TO ATTENTION OF FOLLOWING OFFICE SYMBOL: TSESE-4 (TSEPL-314)

XXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
HEADQUARTERS, AIR TECHNICAL SERVICE COMMAND

14 FEB 1945

AC-36

Dr. L. O. Grondahl,
Chief, Section 5.2,
N.D.R.C.,
Union Switch & Signal Company,
Pittsburgh 18, Pennsylvania.

Dear Sir:

The Chief, Division 5, N.D.R.C., has been notified that previous shipping instructions furnished to that Division listing the 16th Army Air Forces Base Unit at Fort Dix as the address, for twenty (20) each VB-3 tail assemblies should be corrected as follows: Army Air Forces, Property Officer, Fort Dix, Army Air Base, Fort Dix, New Jersey, marked for the 116th Army Air Forces Base Unit (Special Weapons).

In a letter from Section 5.2, N.D.R.C. to Headquarters, Air Technical Service Command dated 18 January 1945 it was indicated that the requested twenty (20) VB-3 tail assemblies would be furnished to Fort Dix as soon as the radio receivers had been received and as soon as the number necessary for preliminary tests had been allotted. Any steps that can be taken to expedite the shipment of the first one at the earliest possible date to precede the balance of the twenty (20) will be appreciated. This preliminary one is needed for inspection and information purposes in order that the training program for the VB-3 Razon ground and air crews may be outlined before the arrival of the later tail assemblies.

Very truly yours,

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(AFR 11-5)

H. Y. SMITH,
Lt. Colonel, Air Corps,
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

Copy to:
TSESE-4,11

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PROJECT NO. MX-591

This document contains information affecting the national defense of the United States within the the meaning of the Espionage Act, 50 U. S. C. 31 and 32, as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

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AC-36+

Lt.W.H.Beasmop
Ext. 35316

19 FEB 194

TSESE-4 (TSEPL-314)

Razon Tail Units for Training.

ORIG FILE COPIES TO:	INITIALS
	Yes

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

Attention: Engineering Branch,
Material Division, AC/AS M & S.

1. Reference is made to a letter from your headquarters dated 15 December 1944, subject same as above, and to the 1st Indorsement to the above letter by Air Technical Service Command dated 9 January 1945.

2. Section 5.2, M.D.R.C. has notified this office that shipment of the twenty (20) each VB-3 (Razon) tail assemblies to the Army Air Forces Property Officer, Fort Dix Army Air Base, Fort Dix, New Jersey marked for the 116th AAF Base Unit (Special Weapons) would be accomplished as soon as possible, but that shipment would be delayed until the first production radio receivers were on hand and until after the required number of VB-3 tail assemblies necessary for preliminary tests had been allotted.

3. Section 5.2, M.D.R.C., has been specifically requested to expedite the shipment of the preliminary one (1) required for inspection and information to Fort Dix and it is estimated that shipment of that item will be made during the first week in April. It is further estimated that the balance of the twenty (20) tail assemblies requested will be available from among the pre-production units (Razon) units for shipment from twenty to thirty days later than the preliminary unit.

For the Director:

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(AFR 11-30)

H. Y. SMITH,
Lt. Colonel, Air Corps,
Chief, Engineering Standards,
Service Engineering Section,
Engineering Division.

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B. PITTSBURGH PROJECT

(1) Summary of Work Previously Reported. The original objective of this project was the development of a high-angle bomb, transportable in existing standard bomb racks, and sufficiently controllable to convert present "near misses" into hits. Earlier research work under contract with M. I. T. and Gulf Research & Development Co. has now been concentrated at Gulf, with production engineering handled by Union Switch & Signal Co. as covered in Part 7 of this report.

Emphasis has been on tail assemblies which could be attached to standard general purpose bombs by the existing fin mounting threads. The simplest version, known as "Azon", consists of a tail with four fins, each of which contains a control flap. The horizontal pair of flaps are gyro controlled to prevent rolling, while the vertical pair are operated by radio from the dropping plane to steer the bomb in azimuth only. The bombardier uses a standard sight for range, and then lines up target and missile by visually following the path of a flare in the Azon tail.

This weapon exists in models for attachment to 1000 or 2000-lb. standard GP bombs, the complete units being known as Army VB-1 and VB-2 respectively. VB-1 is now in production on an Army order, and has already played a part in the campaigns in Italy and Normandy. The Section has made two men available as field technicians and cooperates on any engineering difficulties which develop. VB-2 has performed successfully in tests and is now being engineered for production as a Division headquarters project.

As a result of combat and test experience, work is in progress to reduce VB-1 dispersion when dropped in train. Encouraging results have been obtained by the AAF in releasing bombs simultaneously from several airplanes by automatic radio control. The entire salvo was then controlled by one operator, who attempted to steer the center of gravity of the pattern to the center of the target. A Gulf modification of VB-1, known as "Spazon", also shows promise. In this unit the bomb is forced to rotate continuously for approximately the first 20 seconds of its flight. Rotation is then stopped and control proceeds in the standard Azon manner.

A second version of the missile, known as "Razon", is controllable in both range and azimuth. In order to provide stability in this model, it has been found necessary to make the tail assembly octagonal in shape. Flaps in the horizontal and vertical surfaces of the octagon act respectively as elevators and rudders to steer the bomb, while ailerons on the 45° struts are gyro controlled to prevent rolling. Control is the same as with Azon except that a special bomb sight is necessary. A modification of the Norden sight, known as

[redacted]

[redacted]

"Crab I", has been constructed by Section 5.6 in cooperation with Section 7.2, and has performed satisfactorily.

Initial drop tests using "Crab I" have been made of the Razon tail assembly attached to a 1000-lb standard GP bomb, the complete unit being known as Army VB-3. Results were quite encouraging, but it was believed that the design should be re-engineered to increase maneuverability. Accordingly a new model is being designed with an additional octagonal shroud about 8" long and without control surfaces mounted forward of the regular tail. Design of a larger version, identified as Army VB-4 when attached to a 2000-lb. standard GP bomb, is pending on the results of tests with the new VB-3.

The Razon type tail is also used on two target-seeking versions of the high angle bomb. The first, known as Army VB-5, consisted of a 1000-lb. bomb in a special shell housing a light-sensitive or photo-electric homing device. These units as tested also had a cylindrical stationary fin or shroud around the body of the bomb to improve stability. Results were quite successful, but this model to date has only been used for experimental purposes.

The other target-seeking model, "Felix" or Army VB-6, comprises a 1000-lb. standard GP bomb with attached Razon type tail and also a special nose assembly housing a heat-sensitive homing control. This device is furnished by Section 5.5 and is therefore more fully covered under Part E of this report. At the request of the Services a "crash program" was instituted to produce a considerable number of VB-6s for a special target. This program is discussed under Part F.

Razon type tails, together with the body shroud previously mentioned have also been used on bombs controlled by radio from target information furnished by television equipment mounted in the missile. These are designated in 1000 and 2000-lb. sizes as Army VB-7 and VB-8 respectively. Results were encouraging, but it is believed that windstream operated vanes or "ears" should be employed to aim the television camera into the direction in which the bomb is going. If so equipped the Section considers the missile is probably practical.

(2) Progress Since Previous Report (12/15/44). The Section has continued to cooperate with the AAF Board at Orlando in the latter's tests to determine the characteristics of VB-1 at high altitudes and when mass-dropped in pattern. An analysis of the results of early tests with this missile is now in progress at Eglin and will be made available to the Board.

[redacted]

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Previous Spazon trials have shown that the timers used could not be relied upon to stop rotation of all the bombs in a salvo at the same time. Consequently, if steering were attempted too soon, the missiles might go in opposite directions, thus increasing the dispersion rather than reducing it. The unit has now been redesigned so that rotation will be stopped simultaneously in all bombs by radio control applied by the bombardier. Initial movement of the regular Azon control stick uncages the stabilizing gyros in all the missiles. A time delay built into the control box then renders the stick inoperative for a predetermined interval in which the bombs right themselves, after which control proceeds in the standard Azon manner. It is expected that the redesigned Spazons will be tested at Wendover in the next few weeks, after which units will be sent to Orlando for evaluation by the AAF Board.

Studies have recently been initiated at Orlando and elsewhere on the suitability of VB-2 for mounting in various bomb bays. A shorter tail fuse has made it possible to decrease the length of the tail structure by 1-3/4". A few units so modified have been drop tested and performed satisfactorily. An additional 1-1/2" decrease in overall length has been obtained by recessing the flare into the tail structure. These two changes make VB-2 practical for stowage in the bomb bays of both B-17 and B-24 planes. Gulf is now modifying 36 tail structures which will be sent back to Orlando for test.

The Mark IV model of the 1000-lb. Razon has finally been chosen as the general design for VB-3. As previously noted, this model has

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an additional octagonal shroud without control surfaces, called the lift shroud, near the front end of the tail structure. The control shroud, which is slightly smaller in dimensions, is mounted at the rear end of the tail structure as in the original Mark I version. Fig. 1 shows the tail assembly as viewed from the front or bomb end, and Fig. 2 an overall view of the unit mounted on a standard AN-M-65 1000 lb. G.P. bomb. With control applied 15 sec. after release from 15,000 ft. altitude, Mark IV has a maneuverability of 2650 ft. as contrasted with 1650 ft. for Mark I, and still possesses adequate stability.

It is planned to construct and test 20 or 30 Mark IV VB-3 units to obtain additional performance data before design of the preproduction model to be built by Union Switch is frozen. The problems of tail fuze installation and antenna structure are being studied by Wright Field, and final information is expected shortly. It also appears that a change in servo-motor speed from 4 to 2-1/2 R.P.M. may be necessary. It is hoped that information will be complete and construction under way before the end of February.

In using VB-3 with the Crab sight, it is necessary to determine accurately the time of fall of the bomb to avoid errors in range. This can be calculated for an uncontrolled missile from the altitude of the plane above target as obtained from a radio altimeter. However, the situation is further complicated with

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VB-3 by the fact that the amount of control applied to the bomb in flight will vary its dropping time. Range error due to this cause is likely to be as high as ± 200 ft. from 15,000 ft. altitude. It is hoped that a corrector can be designed which will change the speed of the sight in accordance with the length of time during which control is applied and thus automatically correct for the effect on range. Design of such a device is being studied by the Section.

At a recent meeting of Section 5.2 and Division representatives, it was decided not to make the tests of the Remington Rand and Farnsworth television-equipped bombs. More extensive tests are to be made with television in the Los Angeles ROC and personnel cannot be spared from projects of higher priority.

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E. MECHANISMS

With the organization of Division 5, Section 5.5 was created to coordinate the work within the Division on control mechanisms actuating guided missiles. This work can be subdivided as follows:

(1) Stabilization and Servomechanisms

(a) Summary of Work Previously Reported. The major work on stabilization and servo devices for the Division 5 weapons has, with one exception, been carried out under the section in charge of each particular missile. The Servomechanisms Laboratory at the Massachusetts Institute of Technology has designed and constructed an alternative stabilization and servo system for use with the Washington glide bombs. The development was facilitated by a dynamic test table which simulates in the laboratory many of the conditions of actual flight. Preliminary flight trials have given promising results but conclusions should not be drawn prior to thorough flight testing.

(b) Progress Since Previous Report (12/15/44). Further delays have occurred in building the four models of the simplified version of the M.I.T. stabilization and servo system for use in the 8-ft. Pelican air-frame.

Figs. 5, 6, and 7 show details of the components and Fig. 8 the assembly line in the newly completed servo building.

(2) Radio Links

(a) Summary of Work Previously Reported. Activities in this field have been largely confined to two designs of superheterodyne receiver for use in high-angle guided bombs. One type was built at Harvey Radio Laboratories following an M.I.T. design and later copied by General Instrument Company for the VB-2 2000-lb. Azon. Other copies, with additional filters to give two-coordinate control, are being constructed at Harvey for use by Gulf in testing the Razon bomb and for tests of the radio-controlled ROC. A second type has been built by Philco and its major features are now being copied by Delco under AAL auspices for use with AZon and Razon. A modulator for the ROC radio control has also been constructed at Bendix which provides for transmission of a signal proportional to the control stick position.

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F. GENERAL PROJECTS

(1) Summary of Work Previously Reported. As the weapons developed by Division 5 have approached closer to combat use, projects have been instituted to engineer the various devices for production. These projects are administered by Division headquarters personnel in conjunction with engineers made available under contract with M.I.T. The work is carried on in close cooperation with the Sections in which the development originated and with the OSRD Transition Office to cover the necessary modifications between a working laboratory model and a design suitable for quantity production. This procedure was followed for VB-1 and is now in operation for VB-2, VB-3 and VB-6.

Under this program a tail fuze has been added to VB-2 to supplement the original nose fuze for greater reliability of detonation. A shorter flare has been developed by Army Ordnance which permits loading the missile into the bomb bays of the B-17 and B-24 airplanes. Also, a new battery has been designed with approximately 2-1/2 times the capacity of the existing one and having a much greater shelf life, suitable for VB-1 and VB-3 as well as VB-2. Initial drop tests of the latter missile at Tonopah were quite successful, and the test program is now being continued by the AAF board at Orlando.

Work on the VB-3 1000-lb. Razon has been proceeding at a retarded pace pending tests with a modified design produced under Section 5.2. A total of 15[illegible] units will be constructed, part of which will be tested by NDRC at Wendover and the balance by the AAF board at Orlando. At the request of the AAF, the Division has instituted a crash program for the production of 1000 VB-3s pending the preparation of formal Air Force specifications. It is understood that this contract will be taken over by the AAF as soon as practicable.

Successful tests of VB-6 at Tonopah resulted in a similar request by the AAF for 1000 of those missiles, and a contract has been instituted on the same basis as for VB-3. Tests of handmade prototypes of the production design constructed under another NDRC contract will be made at Orlando.

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TSEPL-314

Lt. W. H. Hess/wep
55316

17 FEB 1945

Requirement Prior to VB-3 Tests

Commanding Officer,
Wendover Field,
Wendover, Utah.
Attention: Special Weapons Test Unit,
Captain W. A. Chihm.

1. Present indications are that the VB-3 tests will resume at Wendover between 5 and 15 March 1945 and continue approximately three to four weeks. The usual complement of civilians from Gulf Research & Development Company, that is six to ten, will be present for these tests, together with the project officer and at least one enlisted man from the Vertical Bomb Unit. The six enlisted men from Sergeant [illegible], Privates First Class Holloway, Jacobsen, Kordes, Kuss, [illegible] and Qualls will be used for this series of tests.

2. In addition to the usual requirements, the following specific requirements are listed:

a. B-17 No. 42-30514 -- Since the primary objective of this series of tests will be to collect ballistic data on the VB-3 missile, it will be necessary to know accurately true air speed and absolute altitude, along with other data. It is requested, therefore, that the air speed indicators on No. 514 in both the pilot's compartment and the bombardier's compartment be re-calibrated against a reference standard and also against each other, and that the zero setting of the radio altimeter be checked. B-17 No. 42-30921 should be available as a stand-by aircraft.

b. Thirty (30) each T-6[illegible] guide flares -- This quantity is in addition to the thirty (30) of this same item requested by this office to be shipped by Ordnance to Wendover for the pending Razon tests. If a sufficient total quantity is not on hand, this office should be notified immediately of the balance required.

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CENTRAL FILES

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Commanding Officer, Wendover Field, Wendover, Utah.
Attention: Special Weapons Test Unit, Captain M. A. Chiba.
"Requirements Prior to VB-3 Tests"

17 FEB 1945

c. Fifty (50) each sand-loaded AN-M65 1000 pound bombs, inert -- These will be used without recorders, but should be painted white. It is requested that eight (8) of the painted bombs be placed on bomb cradles at the side of Hanger No. 5 nearest the T-building used during previous VB-1, VB-3 and Spasen tests, or in front of such T-building. The striping of the bombs for the VB-3 program will be accomplished by project personnel shortly after arrival; a quantity of black paint sufficient to stripe twenty-five (25) bombs and to number fifty (50) will be required by these tests. This quantity of bombs is in addition to the quantity required by the pending Spasen tests, and this office should be notified immediately if a total sufficient quantity are not on hand.

d. Exact measurements of, and some additions to, the Vertical Bomb range -- Stakes should be driven into the target circles at all points indicated by the inclosed sketch and at intervals of 1000 feet all along the center run-in road; tolerances should be ±1 ft. The center run-in road should be extended an additional 5000 feet at the "camera-shack" end (that is, the end most distant from the target center; this extension has not been shown on the sketch, but has been indicated. A road perpendicular to the present three parallel roads and through the target center will be required as shown on the sketch; this road may be as narrow as four to six feet and may be constructed in such a way as to not mutilate the present roads or circles.

e. Wind directions at all levels at and below 20,000 feet above target -- The range area is located in a valley removed from the airfield where the usual pibal runs are made by the base weather personnel. The winds over the target at lower levels are affected by the frictional influence of the surrounding mountains and the flow patterns are not necessarily the same as for the area around the landing field. In the collection of ballistic data during this series of tests, the winds at the target area at lower levels as well as upper levels will be of great importance.

(1) It is requested that the Station Weather Officer at Wendover Field be contacted to ascertain whether personnel from his unit will be available to conduct special pilot balloon ascents at the target area once each day at such time immediately preceding the morning

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Commanding Officer, Wendover Field, Wendover, Utah.
Attention: Special Weapons Test Unit, Captain M. A. Chiba.
"Requirements Prior to VB-3 Tests"

17 FEB 1945

mission but sufficiently before time as to permit the observed data to be recorded by mission time. Missions are planned for 10:30 local time each day because of photographic considerations.

(2) If the Wendover Field weather station personnel and equipment are not sufficient to provide such pibals at the target area, it is requested that the Regional Control Officer, 24th Weather Region, be contacted through the Station Weather Officer, Wendover Field, in an effort to have the necessary personnel and equipment made available to Wendover for the test period. The Regional Control Officer of the 2nd Weather Region has already been contacted by this office, but the 2nd Region is unable to assist since Wendover falls within the jurisdiction of the 24th Weather Region. Request this office be notified of the results.

For the Director:

S/Stewart, Col AC

G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

1 Incl.
Sketch of target n/d

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"Requirements for Mechanically Armed Flare for High Angle Bomb, Project MX-225."

2nd Ind. TSEML-3IL/WHH/mep

HQ AAF ATSC Wright Field, Dayton, Ohio, 21 FEB [illegible]

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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I. P. S.
A. S. C.
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copy of basic already in record files, attached is copy of 1st Ind. mep

CENTRAL FILES

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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. H. 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:

for G. V. HOLLOMAN,
Colonel, Air Corps,
Chief, Equipment Laboratory,
Propulsion and Accessories Section,
Engineering Division.

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Secret by authority of
CG AAF

26 FEB 1945 [initials]
Date Initials

Col Travis/lj/72422
Wrtn 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 AFRDK	2 AFAEC	3 AFDGR	4 AC	5	6
SIGNATURE OF RESPONSIBLE OFFICER	J.H. Rothrock	Griffin	McKee	[redacted] Thorwell		
INTERNAL OFFICE COORDINATION	JMT	JBJ	Hill		Turner	

(2) GT-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-6D (GB-12) (Flare Seeker) - No tactical requirement. The use visualized by O.N.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 Azon 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.

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SIGNATURE OF RESPONSIBLE OFFICER						
INTERNAL OFFICE COORDINATION						

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(9) VB-9, 10, 11, and 12 (RDC, Mod. Angle) - The merit of the RDC 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 RDC 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] General, U.S.A.		
				[redacted] Chief of Air Staff		
				Operations, Commitments and Requirements		

- 3 -

CONFIDENTIAL

AFDFD-B

8 March 1945

MEMORANDUM FOR BUDGET OFFICER FOR THE WAR DEPARTMENT:
(Attention: Lt. Colonel McConahay)

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

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(AFR 11-30)

HQ. AAF
- 8 MAR 1945
AFO MAIL SECTION

TOb/vc 6128

OFFICE SYMBOL	1. AFDFD-B	2.	3.	4.	5.
GRADE AND SURNAME OF COORDINATING OFFICERS					

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Lt. F. Schillizzi/[illegible]
Ext. [illegible]

21 Mar 194[illegible]

MX 591

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
ASST. TSEPL-2D
CHIEF OF ADM.
SPECIAL STAFF
CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAIN.
ENG. & PROC. SERV. DIV.
MAIN. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

Crab 1 Modification to the M-Series Bombsight

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

Attention: AC/AS, Materiel and Services, Development Engineering Branch, Mr. G. Boehm.

1. In order to familiarize your office with the Crab 1 Modification to the M. Series Bombsight and its present development program, and to insure a definite future development, the following status report is transmitted:

a. Crab 1 was developed by the Franklin Institute, under contract to the National Defense Research Committee to adapt the M-Series bombsight for use with guided missiles ("Razon" bombs). Physically, Crab 1 is a small stationary full-silvered mirror which is inserted between the telescope objective lens and the target mirror in such a manner as to intercept a portion of the light from the target normally entering the telescope, and to substitute for this portion, light coming from the controllable bomb.

b. On 19 January 1945 T.I. No. 2029, Addendum 20, dated 2 January 1945, subject, "B-29 - Mock-Up Razon and Procurement of Service Test Kits" was received in which Air Technical Service Command was directed to procure a service test quantity (10) of the Crab 1 modification kits. Authority for this Technical Instructions was a letter from the Chief, Engineering Branch, Materiel Division, Asst. Chief of Air Staff, Materiel and Services, dated 27 December 1944, subject as above. A 1-A priority was assigned to this project.

c. In accordance with this Technical Instructions, the General Scientific Corporation of Chicago, Illinois was contacted 17 February 1945; a contract was let for fifteen (15) Crab 1 kits to be manufactured from Franklin Institute experimental drawings.

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Letter to: Commanding General, Army Air Forces, Washington 25, D.C.
Attention: AC/AS, Materiel and Services, Development Engineering Branch, Mr. G. Boehm.
"Crab 1 Modification to the M-Series Bombsight" 21 Mar 1945

d. During the preliminary engineering tests of the Razon bombs, Air Technical Service Command personnel learned of a modified Crab 1 attachment which was being developed by Mr. H. Van Dyke of the L. N. Schwien Engineering Corporation, Los Angeles, California. This modified attachment incorporated a full size half-silvered mirror in place of a half-size full silvered mirror. This doubles the field of the auxiliary mirror and lessens the possibility of the operator losing the bomb image. However, there are many other pertinent details associated in a design of this type, and at present, the Air Technical Service Command does not have sufficient information on the modified Crab in order to properly evaluate it.

e. At a conference held at Air Technical Service Command on 16 February 1945 between personnel of this Command and the office of the Asst. Chief of Air Staff, Materiel and Services, the following information was divulged:

(1). The "Razon" program was urgent and had an 1-a priority.

(2). There was a requirement for one-hundred (100) Crab attachments by 1 July 1945.

(3) That both the 20th and the 14th Air Forces were extremely interested in controllable missiles.

(4) That mock-up of the B-29 airplanes for the 20th Air Force would take priority over mock-up of B-24 airplanes for the 14th Air Force.

f. Major J. F. Vogel, the AC/AS, Materiel and Services representative, indicated that the Air Technical Service Command should plan to procure 100 Crab attachments; either the original Crab 1 or the modified Crab, whichever proved to be the more successful. It was also indicated that official authority for this procurement would be forthcoming.

g. As a result of this conference, a request was made by Air Technical Service Command to Dr. J. C. Boyce, Chief of Section 5.5, N.D.R.C. for all information that was available concerning the modified Crab attachment. It was learned that N.D.R.C. had contracted with the L. N. Schwien Corporation to fully develop and manufacture one-hundred of the modified kits.

2. Inasmuch as the Air Technical Service Command is procuring the Crab 1, and N.D.R.C. is procuring the modified Crab, which may

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(AFR 11-30)

[redacted]

X-74418

THIS PAGE IS DECLASSIFIED IAW EO 13526

[redacted] "

Letter to: Commanding General, Army Air Forces, Washington 25, D.C.
Attention: AC/AS, Materiel and Services, Development Engineering Branch,
Mr. C. Bosha.
"Crab I Modification to the M-Series Bombsight"

or may not be superior to the Crab I. Action is being taken to secure several sets of the modified kits from W.D.A.C., for comparative tests. This Office will make the necessary installations, prepare experimental test requirements and forward same to Eglin Field for actual test work.

L.F.McCoy,
Colonel, A.C.,
Chief, Propulsion & Accessories Section
Engineering Division.

X-7[illegible]

[redacted]

AAFC Form No. 10-808 (3 Jan 48)
(Or AAFC Form No. 43)

62

[redacted]

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MAT. 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

Lt. G. R. Swanson
ejt Ext. 3-9242

24 March 1945

Proposed Expansion of VB-1 and VB-3 Programs

SECRET
AUTH: DIR., AFSC
Initials END
Date 24 MARCH 45

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

Attention: AC/AS, M&S
(Major Vogel)

1. Confirming telephone conversation between Major Vogel and Lt. Swanson on 23 March 1945, the cost of the VB-1 under the present letter of intent for 1000 units is $425.00 per unit. For a total of 3500 to 4000 units, Union Switch and Signal Company estimates the cost could probably be dropped to about $375.00. These prices are based upon the premise that certain components of the VB-1 purchased by the Government upon termination of previous contracts will be resold to Union Switch and Signal Company at the termination prices of approximately $215.00 per unit. The only components for the VB-1's at the above mentioned price which will be Government Furnished Equipment will be the radios, flares and flare plugs.

2. The first estimated price of the VB-3's was $1000.00 which was followed by another of $750.00. Union Switch and Signal Company now estimates that the VB-3's can be produced in quantities for a total of $450.00 to $500.00 per unit.

3. The inventories mentioned above as having been purchased by the Government on termination of previous Union Switch and Signal Company contracts included 5972 gyro assemblies, 5040 servo motors complete and 16,706 batteries. One gyro and servo and 4 batteries are used per VB-1 or VB-3 assembly and one gyro and servo and 10 batteries are used per VB-6 assembly. By a simple modification the VB-1 gyro can be so modified as to be used in the VB-3 or VB-6. The VB-1 servo can not be used in the VB-3, but with a modification process, which is almost as expensive as the original article, it may be used in the VB-6. The AN/CRA-7 radios used in the above articles now cost

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WF, Area B-1-1-45-600M

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ATSC Form No. 10-508 (3 Jan 45)
(Old ATSC Form No. 43)

COORDINATION
DIRECTOR OR DEP.
AIR INSPECTOR
MGT. CONTROL
CHIEF OF ADMN.
SPECIAL STAFF

Commanding General, AAF, Washington 25, D. C.
SUBJECT: Proposed Expansion of VB-1 and VB-3 Programs
24 March 1945

$300.00 per article. It is estimated that the cost will be dropped to slightly above $200.00 in mass production. All of the AN/CRW-2 radios now in stock are ear marked for other projects.

For the Director:

J. J. Brown Maj AC
For: M. R. SHEPARD
Colonel, Air Corps
Acting Chief, Production Section
Procurement Division

cc:
TSESE2G
TSPPM4

CHIEF, ENG. & PROC.
CHIEF, SUPPLY & MAINT.
PERS & BASE SERV. DIV.
MAINT. DIV.
SUPPLY DIV.
ENGINEERING DIV.
PROCUREMENT DIV.
READJUST DIV.
OTHER

[redacted]

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W. R. Area B-1-1-45-600M

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[illegible]

VB-3 Razon Requirements

(1) Air Communications Officer, Spec. Projects Section
(2) AC/AS, Operations, Commitments and Requirements Requirements Division, Munitions & Missiles Section — 26 Mar 45
AC/AS, Materiel and Services — 1

Major Vogel/ajr/6901

1. The estimated delivery schedule on VB-3 Razon is as follows:

20	preproduction units for NDRC by approx.	1 April 1945
130	" " " " " "	15 May 1945
225	Production units in	July 1945
500	" " "	August 1945
500	" " "	Sept. 1945
500	" " "	Oct. 1945
500	" " "	Nov. 1945
500	" " "	Dec. 1945
275	" " "	Jan. 1946

The delay between the preproduction and production items is required to secure tools and establish the production line.

2. The following information is forwarded for possible assistance in determining follow-on production orders for VB-3:

a. The procurement of materials and sub-contracted items requires that the manufacturer receive orders a minimum of six (6) months prior to the start of production on that order. Therefore, if the 500 per month production is to be maintained, additional orders must be placed prior to August 1945. If a production rate of 1000 per month is desired, a minimum total order of 7000 VB-3's is required. If the order for the additional 4000 units is placed with the manufacturer during April 1945, the following production schedule is estimated:

July 1945	225
August	500
September	750
October	1000
November	1000
December	1000
January 1946	1000
February	1000
March	525
TOTAL	7000

These schedules for VB-3 are based on completing the 1000 VB-1 order before VB-3 production starts.

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Spec. Weap. A-GB-SP-2/1499 157

[redacted]

VB-3 Razon Requirements (cont)

(1) Air Communications Officer, Spec. Projects Section
(2) AC/AS, Operations, Commitments and Requirements
Requirements Division, Munitions & Missiles Section
AC/AS, Materiel and Services

26 Mar 45
1 (cont)
Major Vogel/mjr/6901

3. ATSC drop tests on Razon are scheduled to begin at Wendover Field, Utah the first week in April 1945. It is recommended that AAF Board personnel observe these Wendover tests to insure that the AAF Board Razon evaluation tests, which are understood scheduled to start in late May and be completed by the end of June, may be completed expeditiously and with a minimum expenditure of VB-3 bombs. Navy personnel should also view both. Wendover and AAF Board tests.

4. It will be noted that the results of the AAF Board tests can hardly be available before mid July 1945 therefore, practically no time will be available to secure theater requirements if the present production facilities are to be maintained in operation, AS NOW SCHEDULED.

5. The Spason modification for massed drops of the VB-1 Azon can also be adapted to the VB-3 Razon. No interest has been evidenced in using Razon in massed drops to date. If such requirements are anticipated, request that this office be advised so the Razon test program may be so modified. In view of the above production considerations, it is recommended that the use of Razon with the Spason modification be considered a separate and distinct "follow-on" program, to the present program of individually controlling each Razon.

6. It is understood your office is awaiting the AAF Board's evaluation of Razon and will then determine theater requirements, therefore, it is requested that you estimate the date your office should be in a position to state AAF production requirements for Razon. If the estimated date is later than August 1945, do you recommend a slower production rate than outlined in paragraph 1 to maintain the availability of the operating production facilities beyond January 1946.

7. If Razon is expected to "supplant" Azon, it is recommended that the requirements for these two items be coordinated.

D. C. DOUBLEDAY
Colonel, Air Corps
Chief, Engr. Br. Mat. Div.

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(AFR 11-30)

[redacted]

1309

Space Warp d., SAS-54-3/4PP 160

[redacted]

VB-3 Razon Requirements

(1) AC/AS, OCR, Requirements Division, Munitions and Missiles Section — 5 April 45
(2) AC/AS, Materiel and Services
Air Communications Officer, Equipment Division — Lt Col Norvell/jo/5375

1. Reference is made to paragraph 3 of comment 1, Operations, Commitments and Requirements have been notified of the approximate dates for Razon tests at Wendover Field and will in turn request Army Air Forces Board personnel to be present. The Navy will also send observers during the period from 15 April to 1 May.

2. The Spazon development has not worked out satisfactorily for use with the Azon type of bomb. NDRC are now investigating the practicability of applying this system to Razon. This office does not contemplate further production of Razon until the Army Air Forces Board's final evaluation. It is estimated that this evaluation may be completed during 1945. No change in the original delivery schedule is recommended at this time.

3. With reference to paragraph 7, comment 1, the responsibility for operational use of both Azon and Razon rests with OCR and this office will be guided by their comments and recommendations as to one supplanting the other.

AFACO-E/SP_____
AFACO-E_____

S. A. WUNDELL
Colonel, Air Corps

[redacted]

[redacted]

VB-3 Razon Requirements

AC/AS, Materiel and Services

16 April 1945

AC/AS, OC&R, Requirements Division   Maj Weinbrenner/dr/72485

1. Razon is still in the experimental stage. No service requirement will be set up until this weapon has been found to be satisfactory by the Army Air Forces Board.

2. If tests indicate that Razon can "supplant" Azon, requirements will be coordinated.

LESLIE O. PETERSON
Colonel, Air Corps
Acting Chief

Bomb Br________

GRG BR________

Hum Unit________

[redacted]

67

[redacted]

R 460

X

2 April 1945
1630Z

PRIORITY

FROM [illegible]

TO [illegible]

IN REPLY CITE: WAR 61171

[illegible] VF [illegible] effect. (WAR 61171) to Knudsen from Double-day [illegible] necessary [illegible] delay between end [illegible] and start [illegible] order. See copy sent your office (Lieutenant [illegible]) [illegible] letter [illegible] March 1945 advising that [illegible] order [illegible] be placed prior to 1 April 1945 to prevent delay on basis of completion [illegible] in September 1945. [illegible] advises tooling has progressed rap-[illegible] every effort to complete delivery [illegible] by 1 July and there is [illegible] possibility [illegible] meeting that schedule. Request information by 5 April on your action to eliminate danger of delay after NDRC order completed.

ACTION: [illegible]

[illegible] (2 Apr 1945) 1515Z [illegible]

DISTRIBUTION: [illegible]

1. TSPMY ([illegible]) Action
2. Cable Sec
3. [illegible]
4. TSCMP
5. TSCAL
6. TSCH (TSCLPA) [illegible]

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file 324

[redacted]

Procurement of 3,000 VB-3 units.

TJBPR-3H1 TJE:L-3.4 4 Apr 1945 1

1. Reference is made to telephone conversation between Captain J. A. Dungan of Procurement Division and Captain Evans of the Engineering Division on 2 April 1945, concurrence is hereby stated in the procurement of 3,000 VB-3 units on Union Switch & Signal drawings Nos. 247450 and 247451. These drawings are to be used as procurement data pending availability of Army Air Forces drawings and Army Air Forces specification on or about 1 May 1945.

2. This action is considered necessary to prevent any unnecessary delay in the procurement of materials for production of 3,000 VB-3 units at the earliest possible date.

JHE/mep
35316 192

S. R. STEWART
Colonel, Air Corps
Chief, Equipment Laboratory
Propulsion and Accessories Subdivision
Engineering Division

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VALUE OF PAPER CHECK ONE
PERMANENT ☑ TRANSITORY ☐

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[redacted]

ASSISTANT CHIEF OF AIR STAFF, MATERIEL AND SERVICES
MATERIEL DIVISION

1125

SECRET
By Authority of
The Commanding General
Army Air Forces

5 April 1945 [illegible]
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. The progress report of 24 January 1945 was the preceding summary to the attached. Interim reports on the more important developments have been forwarded to the offices having primary interest.

2. Particular attention is called to Section "[illegible]", showing the new priority system.

3. This summary will be the last overall guided missiles summary of this type prepared by the Materiel Division, AC/AS, Materiel and Services.

4. Present plans for a future guided missiles summary include:

a. Preparation by the Air Technical Service Command, Wright Field, of a new summary giving complete information on each guided missile that the AAF is developing or procuring, or that NDRC is developing for the AAF, or that the AAF is procuring from other sources. This will include information from the initiation of each guided missile program to 1 June 1945. The summary will be ready for distribution by 15 June 1945.

b. Preparation by the ATSC of monthly supplements to this summary including all important developments or changes to the development, testing, availability, or operational programs.

5. It is now considered likely that these summaries will be registered documents, and that they will be sent directly to the using office by the ATSC. It is requested, therefore, that each office now securing this summary and desiring the ATSC future summaries, send a complete identification of the office and the present mailing address to the Special Weapons Section, Engineering Branch, Materiel Division, AC/AS, M&S, Room 5D-876, The Pentagon Building.

6. Any office that wishes to be placed on the mailing list should send a request with an explanation of the necessity for receiving the summary to:

FOR OFFICIAL [illegible] ONLY
(AFR 1950)

[redacted]

DS 8979,AF
(5 April 1945) 74

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VB-3 (RAZON) 1000 LB, HIGH ANGLE, RANGE AND AZIMUTH CONTROLLED BOMB
VB-4 (RAZON) 2000 LB, " " " " FOR OFFICIAL USE ONLY " " "

(AFR 11-30)

Progress and Availability

1. In drop tests completed at Wendover Field, Utah, eighteen bombs were dropped using the latest VB-3 design with two octagonal lift shrouds, one at each end of the tail. This design is highly satisfactory and little difficulty was experienced while putting the bombs within the 100 foot circle of the target. An analysis of the drop tests show the desirability of using the additional forward lift shroud; comparison tests showed a deflection of approximately 2660 feet when full "right" control was applied after 15 seconds fall from 15,000 feet to the double-shrouded VB-3 as against 1550 to 1600 feet deflection for a single-shrouded version.

2. A satisfactory antenna design for VB-3 has been established for use with the new Dalco receiver, AN/CRT-2. Tests on radio interference caused by conducted and radiated noises of the individual components of the VB-3 tail assembly have been completed and the recommendations for suppression of such noises have been submitted.

3. The following figures represent the latest information regarding the number of VB-3 (Razon) units which can be carried in type B-24 aircraft:

a. 4 ea. VB-3 units can be carried in the rear bay, using stations numbered 2 and 5 on the left and 7 and 10 on the right.

2 ea. VB-3 units can definitely be carried in the forward bay using stations numbered 12 on the left and 17 on the right.

2 ea. additional VB-3 units can be carried in the forward bay using stations numbered 15 on the left and 20 on the right provided the 10° of clearance for fall is not held to; clearances are satisfactory in all directions except to the rear of the VB-3 tail where the fall clearance is approximately 4° . In some B-24 series the station numbered 20 is eliminated completely as a VB-3 position because of the additional space used by some hydraulic equipment which is installed directly behind station 20.

TOTALS - 6 to 8 ea VB-3 units can be carried. If six VB-3's are carried then 2 each standard 1000 pound bombs can also be carried; with seven VB-3's, 1 each standard 1000 pound bomb; and with eight VB-3's no standard 1000 pound bombs.

b. In B-24 type aircraft fitted with bomb bay fuel tanks, such tanks and fittings must be removed prior to loading with VB-3 units. The vertical members from the catwalk to the top of the bay, a temporary installation, must be removed.

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[redacted]

4C
4D

4. The estimated cost of VB-3 tail assembly, exluding bomb, in quantity production is now:

Tail assembly, excluding radio and Ordnance	$500.00
Radio (AN/CRW-7)	300.00*
Ordnance Kit (not including Tail Fuze)	16.50
	$816.50

*The cost of the AN/CRW-7 is expected to drop to $200.00 in quantity production.

5. NDRC estimated the VB-3 production as follows: (Note: The NDRC estimated production schedule is approximately two months better than previous Union Switch and Signal Co. estimates)

20 preproduction items (80% tool made)	15 April 1945
130 completes NDRC preproduction order (100% tool made)	1 May 1945
500 production items by 1 June 1945	
500 production items by 1 July 1945	

The follow order for 2000 VB-3 on ATSC contract will probably be 500 per mo. and follow NDRC contract. The ATSC letter of contract is expected to be delivered by 10 to 12 April 1945.

6. ATSC are scheduled to begin drop tests at Wendover Field approximately 15 April 1945. These tests will include:

a. Approximately 25 for ballistic tests, taking until early May. This will include tests of single bombardier control for first time.

b. Approximately 10-15 production models for engineering service tests will follow until approximately 15 May.

c. AAF Board tests are not anticipated before 1 June 1945.

7. An investigation of practicability of adapting the Spadon modification to Razon equipment will be initiated in the near future.

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05-8579,AF

Sheet 2 of 2 5 April 1945

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SECRET

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12000 LB HIGH ANGLE RAZON CONTROLLED BOMB (TALLBOY)

1. DESCRIPTION: The British-design, 12,000 lb. semi-armor-piercing bomb, modified to be controlled in range and azimuth. Length 21.0 feet, diameter of case 38 inches, diameter of shroud 54 inches (around center of gravity), Octagonal tail. Specially modified B-29 carries one. British carry one in specially modified Lancaster.

2. CHARACTERISTICS: Prospective control in range and azimuth probably on the order of 100 mils. Case of S.A.P. construction and special shape to achieve maximum penetration, carrying 6,000 lbs. explosive load. Original British bomb of rotating design without control; when dropped from 35,000 ft is estimated to have 1,250 to 1,300 ft per second impact velocity. Controlled bomb will probably strike with approximately 1,000 ft per second impact velocity.

3. TRAINING: VB-1 and VB-2 personnel can be used for Tallboy. Certain field training will probably be necessary to adapt VB-1 and VB-2 experience to Tallboy, and to acquaint armorers and airplane mechanics with the techniques of handling very large bombs and the specially modified aircraft. Tallboy will probably require more intensive training due to the fact that less control is available than for VB-1 and VB-2. British experience has indicated desirability of special training preparation for each tactical operation.

4. COMMENTS: This bomb is primarily designed for deep penetration of heavily fortified targets; U-boat and E-boat pens, underground factories, V-sites and other special military structures being examples. The bomb case and tail cone are so streamlined that effective control necessitates the addition of aerodynamic surfaces forward of the tail, so that the total amount of control will be determined by allowable sacrifice in performance. The 54" diameter 20" chord shroud around the C.G. presently planned (will give approximately 1/3 the controllability of the VB-3), will have approximately 4 times the drag of the bomb and will reduce impact velocity to approximately 1,000 ft per second. NACA assistance has been asked for aerodynamics, particularly in view of transconic experience of NACA. In order to provide a missile with supersonic speed and greater penetrating power, NACA has agreed to recommend a design of bomb to achieve approximately 1,250 ft per second and greater controllability than is obtainable with the present plan. The development project will be carried on by NDRC Division 5, which is contracting the work with Gulf Research Corporation.

5. AVAILABILITY: Development is estimated to be completed in six to nine months from 26 February 1945, when work started at ATSC. Tallboy requirements at present are 10 live bombs per month for last six months of 1945. These will be used uncontrolled until controlled models become available.

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(AFR 11-30)

C5-8579,AF

SECRET

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(5 April 1945)

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Carton - G.M. AC-36
R.E. Mat Div - 23

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[redacted]

File AC 36

7 April 1945.

Mr. Hugh H. Spencer,
National Defense Research Committee,
Massachusetts Institute of Technology,
Cambridge 39, Massachusetts.

Dear Mr. Spencer,

I am in receipt of your letter of March 6th inclosing the report of your technical observer on operations in Burma and describing the new VB-3 bomb. The film was viewed by my staff and I today and is quite impressive.

At the present time three of my B-24's are being modified in India to equip them for Azon bombing. The rail system of Japanese occupied China constitutes the enemy's primary line of communication. It traverses terrain that requires many bridges and if they can be eliminated it would virtually paralyze their supply line. Heretofore the local defenses of these bridges have been such that they could be hit at low altitude but now it is becoming increasingly costly to make these attacks and I believe we will rely more on high altitude bombing. I believe we can utilize radio bombing equipment on all future heavy bombardment aircraft received in this theater and I am making such a request of General Giles.

I appreciate your personal interest in our situation here and will be pleased to have you keep me posted on future developments that may be of assistance to us.

Cordially Yours,

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(AFR 11-30)

C. L. CHENNAULT,
Major General, U.S.A.,
Commanding.

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20 VB-3

ATSC Form No.

ROUTING AND RECORD SHEET — AIR TECHNICAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters. | Use authorized office symbols to designate addressor and addressee. | Place initials of dictator and typist, telephone number and location to right of signature.

Use entire width of sheet, both sides. | Number all comments consecutively. | Separate comments by horizontal lines across page.

SUBJECT: Fuse and Flare Requirements for VB-3 Tests at Wendover. [redacted]

TO: TSORE-1 Attn: Capt. R.H. Vandenberg | FROM: TSEPL-314 | DATE: 7 APR 1945 | COMMENT NO. 1

1. The fuse and flare requirements for the pending tests with VB-3 units fabricated by Gulf Research & Development Company for the purpose of collecting ballistic data have been covered by correspondence to your office dated 14 February 1945, subject "Fuse Requirements for VB-3," and 4 March 1945, subject "Request for Guide Flares for Project MX-591". It is estimated that such tests will begin approximately 15 April 1945.

2. Additional tests at Wendover Field, Utah using early production VB-3 units fabricated by Union Switch & Signal Company are planned to immediately follow the above ballistic drops. Approximately 25 each units will be dropped in this second group of tests, estimated to begin 23 April 1945. It is requested that your office take suitable action to make available at Wendover Field a sufficient quantity of nose and latest tail fuzes, and T6E1 flares to cover the additional drops.

WHH/mep
35316 192

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C.O. French, Jr. f
C. O. FRENCH, JR.
LT. COL., AIR CORPS
for D. R. STEWART
Colonel, Air Corps
Chief, Equipment Laboratory
Propulsion and Accessories Subdivision
Engineering Division

1945 APR 14 ... CAGSA

WF 00 471.623

To: TSEPL-314 | From: TSORE | Date: 12 April 1945 | Comment No. 2

1. With reference to paragraph 1, Comment No. 1, Ordnance Items for ballistic tests have been ordered shipped to Wendover Army Air Field, Wendover Utah.

2. With reference to paragraph 2, Comment No. 1, and confirming telephone conversation between Lt. Fess and Captain Vandenberg, request has been initiated to make available at least ten T752E2 tail fuzes for preproduction tests which are to begin on 23 April 1945 at Wendover. The T752E2 tail fuze is to be used as a production tail fuze and is the tail fuze which will accommodate the mounting adapter furnished by Union Switch and Signal Company on production items of VB-3. This mounting adapter as furnished by Union Switch and Signal Company is indicated on their drawing which was furnished this office as an inclosure to R&R from your office dated 6 April 1945.

[redacted]

Wm. C. Oleson
WM. C. OLESON — RFV/faw
Lt. Col., Ord. Dept. — 3-6317
Executive Officer — Bldg. 190-T
Aviation Ordnance Engineering Office

X- 95071

(CONTINUE ON OTHER SIDE)

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File VB-3

HHS:ved

Cc: Col. Tash, Col French Col Paymonville

9 April 1945

Office, Assistant Chief of Air Staff, M&S
Materiel Division, Research Liaison Section
Washington 25, D. C.

Attention: Colonel H. S. Brown

Dear Colonel Brown:

Preproduction models of VB-3 are shortly to be tested at Wendover Air Base, prior to releasing a considerable number to the Air Forces Board for evaluation.

It seems to us desirable that representatives of the Air Forces Board should be present during some of the tests which are scheduled to start approximately 25 April.

We understand that Colonel Tash, Major Neff, and Captain Bishop are the officers who would be most interested in witnessing this work. We feel sure that the presence of at least some of them there would generally expedite the work of the Air Forces Board when this weapon is turned over to them.

Very truly yours,

Hugh H. Spencer
Chief, Division 5, NDRC

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[redacted]

Mass. Institute of Technology
Building 23
Cambridge 39, Mass.

13 April 1945

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

Attention: Lt. Col. V. A. Stace
Pentagon Bldg., Room 5D-871

Dear Colonel Stace:

In response to your inquiry this morning as to the precision of VB-3 and VB-6, I am able to give you the following information which I should like to have you consider as somewhat preliminary as the people on whom I would rely for more formal data are not at the moment available.

VB-3 should have a probable error of approximately one mil in azimuth and around ten mils in range. Actually the record made on tests thus far have been rather better than this, but I think the foregoing figures could be relied on with confidence as representing what "well steadied" bombardiers could be expected to do under conditions of good visibility and not too much enemy observation.

In regard to VB-6, the situation is perhaps a little more complicated since the nature of the target plays a great deal more important role than in the case of VB-3. Interpreting from our results at Tonopah, it seems probable that for a strong concentrated target with a reasonably uniform background a probable error of about 90 feet ought to be attained from all operational altitudes. As you know, this weapon will be turned over to the air Forces Board during the current month for evaluation and more complete data should be available at the conclusion of their work.

As just indicated in the foregoing, the nature of target and background in regard to VB-6 is most important. At the moment, I am not able to discuss this adequately in a letter; however, the findings submitted in a report by the Heat Research Laboratory, which is in the hands of the Air Communications Officer, represents a conservative estimate.

I expect to be in Washington on 23 April and shall be glad to disucss this further with you at that time.

Very truly yours,

Hugh H. Spencer
Chief, Division 5, NDRC

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ATSC Form No. 16

ROUTING AND RECORD SHEET

AIR TECHNICAL SERVICE COMMAND

Use this form for inter-office correspondence within headquarters. | Use authorized office symbols to designate addresser and addressee. | Place initials of dictator and typist, telephone number and location to right of signature.

Use entire width of sheet, both sides. | Number all comments consecutively. | Separate comments by horizontal lines across page.

SUBJECT: Noise Suppressors for VB-3.

TO: TSEPR3H1 Attn: Capt. Dungan | FROM: TSEPL-314 | DATE: [illegible] APR 1945 | COMMENT NO. 1

[redacted]

1. There is a chance that the lack of noise suppression items may seriously hold up the production schedule of VB-3. Each unit requires 12 each FA-125, 4 amp. noise filters and 2 each CA-275X, 50 Volt D.C., 4 microfarad condensers.

2. It was learned from Dr. Grondahl of U.S.&S.C. that the results of an order placed with Solar indicates that delivery for these filters and condensers cannot start within four months. The reply they received was verbal and as soon as written confirmation is available the form ASF 16 will be submitted. However, the Specialized Depot No. 804, Cleveland, Ohio has on hand a considerable number of both filters and condensers under class numbers 03C and 03E respectively.

3. It is recommended that some action be taken to procure for the VB production quantities, sufficient filters and condensers in order that the production schedule can be met for both the U.S.&S.C. production of which 125 units remain and the Army Air Forces production. It should be noted that the U.S.&S.C. production of 125 will be used for service and evaluation tests and must be available to the Army Air Forces Board by 1 June 1945. It should also be noted that of the two manufactures Solar and Sprague, Solar's units are preferred; however, either is satisfactory.

JHL/mep
35316 192

W. H. Barlow, Capt. AC
for S. R. STEWART
Colonel, Air Corps
Chief, Equipment Laboratory
Propulsion and Accessories Subdivision
Engineering Division

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(AFR 11-30)

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TSEPL314 | TSEPR3H1 | 5 May 1945 | 2

1. Lt. Adams, Commications Section, Supply Division, Area "A", has informed this office that 1800 each of the noise filters and 450 of the condensers are being shipped immediately to Union Switch and Signal Company, Swissvale, Pennsylvania.

Capt. [signature]
W. A. SHEPARD
Colonel, Air Corps
Acting Chief, Production Section
Procurement Division

GRS:ejt
3-9219
Bldg 16

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TO | FROM | Project MX-591 | DATE | X-112601 COMMENT NO.

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OFFICE FOR EMERGENCY MANAGEMENT
NATIONAL DEFENSE RESEARCH COMMITTEE
OF THE
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

HHS:ved

2 May 1945

Commanding Officer
Special Weapons Unit
Wright Field
Dayton, Ohio

Attention: Lt. Colonel C. O. French

Dear Colonel French:

We have requested Union Switch and Signal Company to send you two preproduction proto-types of VB-3 as soon as they can be made available.

It is suggested that they be throughly tested in your laboratory so that any defects that may still persist in the design can be ironed out rapidly.

If we can be of assistance in design or conducting of these tests, please call upon us.

Very truly yours,

Hugh H. Spencer

Hugh H. Spencer
Chief, Division 5, NDRC

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Carbon
Range + Files VB-6
ACO-81

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① WLM
② File VB-6

Operational Planning for Guided Missiles

(1) AC/AS, OCR, Requirements Division
(2) AC/AS, Intelligence, Joint Target Group

8 May 1945

AC/AS, Plans, Operational Plans Division

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HHH/lg/71137

1. It is agreed that development of VB-3 (Razon) and VB-6 (Felix) has reached a point where these two guided missiles are operationally valuable. Present evidence indicates that each of these weapons has attained sufficient reliability and accuracy to justify the statement that one aircraft bombing targets peculiarly suitable for attack with these guided missiles can be expected to do the work of two aircraft bombing such targets with standard missiles.

2. Targets peculiarly suitable for attack with VB-3 (Razon) are described in APPENDIX A attached. Targets peculiarly suitable for attack with VB-6 (Felix) are described in APPENDIX B attached. The basis for this information was furnished yesterday by the Joint Target Group, in accordance with paragraph 4 of Comment No. 5.

3. Since these targets include many of high priority, it can be seen that, if these missiles were available today to the XXI Bomber Command, the effect, against these specified targets, would be equivalent to doubling the bombing force.

4. It is therefore recommended that an immediate requirement be established for VB-3 (Razon) and VB-6 (Felix) in sufficient quantities to provide adequate stocks of each missile at all present and prospective VHB, MB and MH bases.

5. It is further recommended that information sheets, such as APPENDIX A and APPENDIX B, be distributed by the Joint Target Group to using units for their information and guidance in planning the optimum use of these special weapons.

2 Incls
APPENDIX A and
APPENDIX B

HENRY H. STOKER
Colonel, U. S. C.
Acting Chief, Operational
Plans Division

Coordinated with:

Engineering Branch
Material Division, AAF

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OFFICE FOR EMERGENCY MANAGEMENT
OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT
1530 P STREET NW.
WASHINGTON 25, D. C.

File VB-6

May 10, 1945

Dr. Robert L. Stearns, Chief
Operations Analysis Section, 20th Air Force
Army Air Forces Headquarters
The Pentagon
Washington 25, D. C.

Dear Dr. Stearns:

In accordance with our conversation on Tuesday I have prepared the following material and collected some inclosures covering the three guided missiles available or about to become available for combat use. This information will, I think, be of interest to your personnel with the 21st Bomber Command.

VB-1 (1000 lb. Azon)

This missile has been comprehensibly described in a report of the Air Forces Board of 2 March 1945, No. 4386-B-471.6 entitled, "Preliminary Report on Test VB-1 (1000 lb. Azon Bomb)." In addition, reports of its use in combat have been made by Mr. David Mayer, Operations Analysis Section of the 10th Air Force, and motion pictures of its use by that Air Force have been widely circulated. I believe the headquarters of the 21st Bomber Command has a copy.

This bomb is designed for operation against important targets which are relatively long and narrow. A flare on the tail makes the bomb visible throughout its flight and it is guided in the azimuth direction by remote radio control. The results from the first 459 bombs used by the 10th Air Force resulted in the destruction of 27 bridges, an expenditure of 17 bombs per bridge.

In using this bomb it is necessary for the airplane to continue its flight over the target. A moderate climb or a dive is permissible, however, for the purpose of evading opposition. As the following table shows, the most striking benefit from the use of this weapon occurs when they are dropped singly and individually guided. This has been the general practice in the 10th Air Force where the targets attacked have been bridges of approximately fourteen feet width. For wider targets the Air Forces Board recommends the use of close trains or salvos if repeated runs are not tactically practicable.

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Bombs Dropped:	Effectiveness:
Six 1000 lb. GP	1
One VB-1	4-8
One VB-1, plus five 1000 lb. GP in salvo	4.7-6.7
Six VB-1 in salvo	5.2-9.2

This weapon has been in production and is now in moderate production. Requirements of twenty-five hundred per month have been set up by the 10th and 14th Air Forces, and stocks on hand plus the present production will take care of this requirement. Production could be readily expanded.

<u>VB-3</u> (<u>1000 lb. Razon</u>)

This weapon is similar to the Azon except that it is visually guided in range as well as in azimuth. We are sending herewith a 16 mm sound movie describing this missile. The guiding is done by means of an attachment to the bomb-sight consisting of a small half-silvered mirror which projects the image of the flare on to the field of view of the bomb-sight at the point where the bomb would fall were no further control added. The accuracy in the range direction obtainable with the modified bomb-sight depends upon the accuracy of the estimated time of flight of the bomb. If a radio altimeter is used an average range error of 10 mils should be feasible.

Thus far the guiding has been done by two operators; one man guiding in azimuth as in Azon, the other guiding in range through the bomb-sight. Tests are now in progress to determine what effect on accuracy will be if the guiding is done by a single operator. Preliminary studies indicate that the effect will probably not be serious.

As in the case with Azon the bombing run must be continued and the test program just referred to will attempt to place limits on the amount of evasive action which can be taken between the point of release and the instant of impact. Preliminary analyses indicate that the turn resulting from a sixty degree bank and/or a ten degree dive or climb will be permissible without serious interference with accuracy.

The Razons tested so far have had a mean error of 190 feet in range and 16 in azimuth, compared with 580 and 384 for standard 1000 lb. bombs released simultaneously from 15,000 feet.

It is expected that the NDRC phase of the testing with this weapon will be complete before the end of May, and that the Air Forces Board will immediately start evaluation. Three thousand units are on order and delivery is expected to start in July.

<u>VB-6</u> (<u>Felix, 1000 lb. Heat Seeking Bomb</u>)

This bomb contains a thermo-sensitive element in the nose which scans a twenty degree conical field in front of the missile, and through a servo mechanism steers the bomb to the hottest spot in the field of view. We are

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transmitting with this letter a 16 mm film of tests made with Felix at Tonopah, and two copies of a report by the Applied Mathematics Panel on the operation of the heat seeking device over land targets.

Since the completion of this report a more extended survey of targets has been made in the vicinity of Birmingham and New Orleans, and the results of that survey have been applied to certain targets of high priority in Japan. A memorandum of the Joint Target Group is attached which discusses the effectiveness of this bomb and of VB-3 against these targets.

The Air Forces Board expects to complete its evaluation of this missile during the current month, and approximately one thousand should be available during July.

* * * * * * * * * * *

The form factor of VB-1 is such that it can be carried at any station which is satisfactory for the 1000 lb. GP bomb. The B-29 airplane will carry eight of either the VB-3 or VB-6, the control shroud preventing the use of all sixteen 1000 lb. stations on this airplane. In addition to the eight VB-3 or VB-6 bombs the B-29 could carry four 1000 lb. GP bombs or VB-1s. The plane power wiring is identical for VB-1, VB-3 and VB-6. For VB-1 and VB-3 a radio transmitter weighing thirty-five pounds is also required.

Instruction manuals on VB-3 and VB-6 are in preparation and we shall be happy to forward copies to you as soon as they are available. Presumably you will receive the AAF Board reports through usual channels. The completion of the manuals and reports may require some months and we should be pleased if action could be started, looking toward combat trials with these weapons in advance of this date.

Yours very truly,

Hugh H. Spencer
Chief
Division 5, NDRC

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encs

Memorandum: Japanese Targets Suitable for Attack with Mason and Felix
Report: Applied Mathematics Panel 112.1R, SRG-P 120
Film: Mason
Film: Felix

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JOINT TARGET GROUP

PHYSICAL VULNERABILITY SECTION

Japanese Targets Suitable for Attack with Razon and Felix. (1)

1. VB-6, or Felix, is a 1000 lb. GP bomb fitted with an electronic device which causes the bomb to home on a target which is giving off a sufficient quantity of heat. This may be due to internal heat as in the case of blast furnaces, coke ovens, etc. or may be the result of the reradiation of solar heat from large roof areas. The bomb is dropped by means of a Norden sight in the customary fashion and requires no control from the aircraft after release. Reliable estimates of its accuracy will not be available until current trials at the AAF Board are completed.

2. "Felix" is constructed in a fashion which causes it to home on the center of gravity of the heat radiation which comes into its field of view. The location of this point, known as the "heat center", depends upon the character of the target and its surroundings. If these are very similar from the point of view of their heat radiation, the performance of the bomb will not be reliable. This means that small to medium sized plants located in densely built-up urban areas are not suitable targets. In case the surrounding terrain is not homogeneous and includes substantial quantities of water, plowed fields, mountains, etc. difficulties arise owing to the deflection of the heat center from the target by the irregularities of the heat pattern radiated by the surroundings. In particular, targets within 2000' of a water front are doubtful targets (2) unless they are almost completely surrounded by water, in which case they are excellent targets. Targets located in the middle of a completely burned out urban area are not expected to be suitable because of the reradiation of the surrounding ashes.

3. No definite statements can be made regarding the size of target against which Felix will have the greatest comparative advantage over standard bombs. Small targets (without intense internal heat) will be unsatisfactory because they will reradiate too little heat to control the bomb. Against very large targets the comparative advantage of Felix will tend to be less because a higher proportion of hits will be scored with standard bombs. It is, however, possible that Felix will seek out buildings in large targets, in which case it would have an advantage even though all standard bombs can be placed in the target site area.

4. According to present information, eight Felix bombs can be stowed in a B-29. It is therefore necessary for Felix to be about twice as effective as standard bombs before any advantage accrues from its use unless standard bombs can be stowed in other stations. (3)

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5. An analysis of the more important target systems in Japan leads to the following remarks concerning the possible use of Felix in that theater:

a. Aircraft. All important aircraft plants are excellent targets except those near waterfronts. Of targets on which JTG Target Information Sheets have been prepared, only 90.20-194 is ruled out on this account. Most of the new plants are located in outlying regions and constitute ideal targets for "Felix". The older plants located in the cities are sufficiently large and concentrated to be good targets in spite of the urban background. Firebreaks cut by the Japanese around these plants increase their value as a target for Felix.

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b. Power. Since all steam plants are located on water, they are not recommended for "Felix" on the basis of present knowledge. A heat survey of some American steam plants will be carried out to obtain more precise information regarding this system. Hydro plants are located in mountainous regions which causes them to be excluded.

c. Arsenals. The quality of arsenals as a target depends almost entirely on their location: those in cities are generally poor targets, and those in outlying regions are good targets. Some, however, are so large and so well built-up that the relative effectiveness of Felix could not be great. By way of example the following may be cited:

Good	Doubtful to Bad	
93.3-46	90.20-197	surroundings too closely built-up
90.20-196	84.3-61	bad background
90.20-200	90.17-522	too near water
90.17-1686	90.36-546	bad background

d. Navy Yards. Cover is available only on the Yokosuka Navy Yard. Because they are almost surrounded by water, the concentrations of buildings centered around buildings 91 and 49 respectively are excellent daytime targets.

e. Steel. In general steel plants are good targets because of the large amount of internal heat present. A high concentration of hits could be expected on blast furnaces, and coke ovens. This makes them especially good targets for night attack. Of those in Japan and Manchuria, all are good except 90.34-165 which is too small and too near the water.

f. Electronics. These plants are too small and too similar to their surroundings to be good targets.

g. Machine Tools. These behave like Arsenals with regard to "Felix", except that many are too small to radiate sufficient heat. Of those for which photographs are now available in the Air Target System Folder only one, 90.17-1686, is considered good. The others are either too near the waterfront, or cannot be distinguished from their background.

h. Chemicals. The known plants are either too small, too similar to their background, or too near water. None are good targets. Others which are suitable targets may be found.

i. Petroleum. No targets of this sort have ever been surveyed, so their suitability is not known. There are no large roof areas present, and it is not known whether the internal heat is sufficiently intense.

6. VB-3, or "Razon", is a 1000 lb. bomb which is guided in both range and deflection toward its target by an observer riding in the aircraft which released the bomb. At the present state of development only one bomb can be controlled by each observer, which means that only one Razon can be released in a single pass by one aircraft. If the aircraft can carry eight 1000 lb. standard bombs, for example, this means that the accuracy of Razon against a given target must be at least eight times that of standard bombs before there is any advantage per aircraft-pass. If one takes into account the need for a definite advantage on the part of Razon before it can be recommended, this means that Razon should be used

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against only those targe[redacted] on which the percentage of Ra[redacted] hits is expected to be 15-20 times the percentage of hits with standard bombs. On the basis of present information, this will be true if the target lies within a square whose side is less than 200 feet. This figure, however, is subject to variation with the type of aircraft to be used and the accuracy of bombing. It should therefore be regarded as an order of magnitude rather than a precise figure.

7. Targets suitable for attack with Razon include the following:

a. Any target suitable for Azon. Targets included here are bridges, causeways, roads, and railroad lines. The improvement over Azon will be slight except for short bridges and overpasses (less than 500'), but there are many important bridges of this size in the main islands.

b. Power Plants. These all fall within the 200' square mentioned above, and consequently are recommended for Razon attack. In fact Razon is the only weapon which appears to be efficient against power plants when dropped from high levels.

c. Coke ovens, blower houses, boiler houses, rectifier buildings (in aluminum industry) and similar small, but critical components of larger plants are suitable targets.

d. Electronics Industry. The primary buildings in this industry are of the correct size for Razon, but would require numerous direct hits for significant damage by 1000 lb. bombs, and are all in heavily defended areas.

e. Ships should be good targets.

f. Gun positions sufficiently protected to justify use of large GP bombs, are excellent targets.

NOTES:

(1). This report is based in part on preliminary data or estimates, and should be evaluated accordingly.

Joint Target Group

(2). This sentence should read, "targets whose centers lie within 2000' of a water front are doubtful targets unless....." The surveys have shown GE's RiverWorks at Lynn, Mass., to be a good Felix target. It is adjacent to water, but covers a large area and its "heat center" is on its most important buildings more than 2000' from the shore.

Heat Research Laboratory, M.I.T.

(3). At Orlando eight Felix bombs have actually been loaded in and released from a B-29. Measurements showed room for four standard 1000 lb. bombs in addition.

Heat Research Laboratory, M.I.T.

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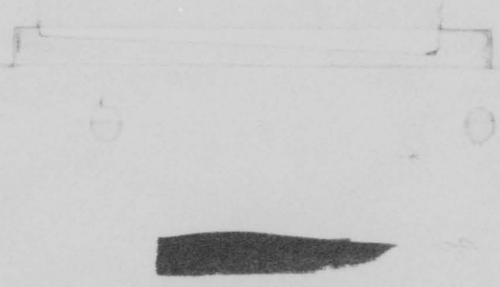

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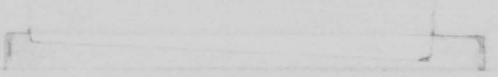

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PART II

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