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11-M-1009

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SECRET

1 October 1945

11-14

Air Documents Division, T-2
AMC, Wright Field
Microfilm No.
RC-14 F 2417

ABUSIVE PROJECT

ATI No. 2417

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1 October 1945

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Air Documents Division, T-2
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ABUSIVE PROJECT

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SUMMARY 11-14-1
1 October 1945

1. Description - The Abusive missiles are tactically obsolete airplanes which have been modified for use as guided missiles for employment against area or pin-point objectives. As now developed, the system employs B-17 and B-24 type aircraft as missiles, carrying approximately 15,500 pounds of explosives. Preset or remote control is used to maintain the missile on a collision course until impact with the target. This provides the equivalent of a suicide attack without the expenditure of personnel. There are eight (8) present types of control which may be employed, depending upon the type of attack desired. These control systems are broken down into three (3) types or phases of the ground control system which is now called "Cottongrass," three (3) phases of the air control system called "Corticated," and two (2) phases of Close Support Visual Control.

a. Phase 1 of the Cottongrass system provides for the use of a B-17 or B-24 as the world's largest "buzz bomb." In this phase the missile is placed on a preset course and at the end of a pre-determined time interval the time control cuts the ignition switches and arms the explosive load while the aircraft glides into the target. The accuracy of this system is roughly comparable to that of the JB-2. The C-1 automatic pilot, already installed in the airplane, is used to control the missile and maintain it on a pre-determined heading. Altitude is maintained at a preset value by a barometric altimeter operating in conjunction with the C-1 pilot. An electric time clock arms the fuses and cuts the ignition switches at a pre-determined time. To date, however, the automatic equipment has not been developed to the point where the missile may be taken off under preset control. The size and weight of the missile precludes, for the present at least, the possibility of employing a catapult. The missile is taken off by remote control or by a pilot and the desired heading for the missile is established, and the automatic timing device is started. If the airplane has been taken off by a pilot, he then bails out. If the airplane has been taken off by remote control, the remote control receiver is automatically turned off when the timing device is started. With either system of takeoff, enemy jamming is impossible.

b. The second phase of "Cottongrass" provides for increasing the accuracy of the missile by tracking it throughout the flight with radar and by making whatever corrections are necessary to the course, and by controlling the "dumping" of the missile by an FM radio link. This system improves the accuracy to the point where, at a range of 85 miles, it is estimated that a 3 to 4 mile square target can be hit consistently. This system requires, in addition to the equipment employed in phase 1, a ground control station with an AN/ARW-15 FM transmitter and an SCR-584 radar set with a plotting board. The missile is taken

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SUMMARY (Cont'd) 11-14-1
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off either by pilots who bail out or by remote control. The FM radio equipment used for control is susceptible to enemy jamming which may deflect the missile from its desired course. However, the maximum course change which can be made is limited by adjustable switches in the steering motor to prevent any possibility of the enemy returning the missile to friendly territory. As an added precaution, the time clock is again employed and is set to dump the missile 5 minutes after the calculated time of arrival over the target.

c. In order to reduce the possibility of enemy jamming, phase 3 of the ground control or Cottongrass system employs radar for controlling as well as tracking the missile. The accuracy of the system and all other features remain the same as phase 2 except the possibility of enemy jamming is reduced.

d. Whereas all 3 phases of the Cottongrass or ground control system employ the missile against an area objective, the air control or Corticated system includes a television camera in the nose of the missile, which becomes the equivalent of providing the remote control operator with an eye looking at the area toward which the missile is flying. In this way it is possible to use the missile against a pin-point objective and to gain the equivalent of a suicidal attack with no loss of life. Phase 1 of Corticated is an air control guided missile, controlled through the use of an FM radio link. The missile is navigated visually to within 10 miles of the target and the Block 3 television is then used during the final run. The visual navigation employed in this system requires good weather throughout the mission. The exact requirements for weather depend upon the type of mission planned, as this determines the distance at which the control airplane should remain from the missile in order to avoid enemy action. The possible accuracy of this system was demonstrated in October 1943 when a YPQ-12A airplane, equipped with the inferior Block 1 television equipment, was expended against a 30 foot square target. The point of impact was only 30 feet from the target.

e. The control airplane used in the Corticated system is a B-17 aircraft equipped with the necessary FM and television equipment. It is commonly known as a "Bluefish." The missile airplane is controlled by an FM radio link in a manner similar to that employed in Cottongrass phase 2. The FM radio equipment may be susceptible to enemy jamming. However, it is improbable anything could be done other than to deflect the missile momentarily. The transmitting station providing the strongest signal at the missile is the one having control. In the event that the BG-617 monitor in the control plane indicates

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enemy interference, the amplifier may be used to increase the power output in order to maintain control by supplying the stronger signal.

f. The weakest link in the phase 1 system appears to be the difficulties in navigation caused by adverse weather. Phases 2 and 3 of the Corticated system are successive improvements in equipment to provide more accurate navigation during adverse weather. The weather minimums at the target, however, remain the same for all phases, if television is to be used. In phase 2 and HZX radar search set is added to the control airplane to track the reply from an AN/APX-14 "Black Maria" radar beacon in the missile airplane. An alternate system for locating the missile is provided by the SCR-729 navigation equipment which, when used with an AN/TPM-1 beacon in the missile, will indicate the range of the missile from the control airplane. The bearing of the missile can be determined by the radio compass in the control airplane when tuned to the BC-375 liaison transmitter which can be turned on remotely in the missile.

g. Phase 3 of the Corticated system is designed for long missions on which varied weather condition will be encountered and blind flying will be required, including changes in altitude. It is identical to phase 2, with the exception that telemetering is installed in the missile airplane. Through the use of the instruments the remote pilot may fly the missile in instrument weather.

h. In phase 1 of the Close Support Visual Control system the missile is equipped with an FM radio control system and with a smoke tank. Two ground control stations are located within visual contact with the target. The missile is flown by a Bluefish Control airplane or by the bailout pilots to within sight of the ground control stations. Smoke is used as an aid in locating and identifying the missile airplane from the ground stations. The missile is flown directly over the ground station which controls it in azimuth. The ground station controlling the pitch angle or range is located as far as possible to one side of the line of flight.

i. Phase 2 of the Close Support Visual Control is identical to phase 1 with the exception that a television transmitter is carried in the missile and a television receiver is added to the master ground control station. With this system, the missile is flown toward the target just as in phase 1; as soon as the target is picked up in the screen of the television receiver, a control operator observing the screen takes over control of the missile from the visual control operators.

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SUMMARY (Cont'd) 11-14-1
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2. Dates - The work on radio controlled pilotless aircraft as guided missiles began in 1938. Work on the Abusive project itself began in the spring of 1944.

3. Types of Targets - Cottongrass systems are suitable for attack against area targets. Corticated systems are suitable for any easily recognizable pin-point targets. Close Support Visual Control systems are suitable for camouflaged targets which can be located from the ground.

4. Limitations - The Cottongrass, phase 1 is limited in accuracy by its preset nature, its accuracy decreasing directly with range. Cottongrass, phase 2 and 3, are limited to approximately 85 miles by the range of the control equipment. The Corticated systems are only limited by the requirement for good visibility within 2 to 3 miles of the target. Close Support Visual Control systems require visibility of 2 to 3 miles at the target.

5. Status of Development - The work on radio controlled pilotless aircraft as guided missiles has been a continuous development since 1938. The control systems and equipment developed for the early experimental projects and for the XBQ aircraft, simply grew into the Abusive systems and equipment. This equipment has now been developed to the point where various systems are available, any of which is capable of satisfactorily performing the specific type of mission for which it is intended. Further development of course is continuing, in order to improve the reliability and accuracy, to decrease the possibility of jamming and to reduce the weather limitations.

6. Availability - Prime equipment is available for approximately 480 kits to modify missiles for any of the six Abusive or two Close Support Visual Control systems.

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1 October 1945

1. Weights - The missile aircraft is normally flown at weights near its normal gross weight. B-17 and B-24 type aircraft are usually loaded to approximately 65,000 lbs. All unnecessary equipment is stripped from the airplane and the necessary control equipment installed. The remaining pay-load is utilized to carry explosives. The estimated weights of the control equipment to be added is as follows:

<u>System</u>	<u>B-17</u>	<u>B-24</u>
Cottongrass 1	60	50
Cottongrass 2	300	240
Cottongrass 3	220	180
Corticated 1	450	500
Corticated 2	500	550
Corticated 3	570	610
V.G. Control 1	300	240
V.G. Control 2	450	500

2. Airframe - When the B-17 and B-24 types of aircraft are used as Abusive missiles, the only modification to the standard airframe is the stripping of unnecessary equipment and the installation of the control equipment and explosives. No data is available on the number of man hours required to modify an aircraft in the field; however, from experience with experimental aircraft it was estimated that 700 to 900 man hours are required to complete the modifications of an Abusive missile aircraft.

3. Guiding System -

a. Stability Information System - All phases of both the ground and air control systems using B-17 and B-24 aircraft, employ the C-1 automatic pilot, which is already installed in the aircraft. If other types of aircraft are used a suitable automatic pilot must be installed if one is not already part of the equipment in the plane.

b. Position Information System -

(1) Cottongrass Phase 1 - This is a preset system and does not employ any means of tracking the missile. The altitude of the missile aircraft is determined by a barometric altimeter which functions to maintain the aircraft at a fixed altitude through the automatic pilot. The point of "dumping" is determined by an electric time clock preset for a dead-reckoned ETA over the target area.

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DESCRIPTION (Cont'd) 11-14-2
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(2) Cottongrass Phase 2 - In this system the path of the missile aircraft is followed by a plotting board attached to an SCR-584 gun-laying radar set which tracks either an AN/APN-21 or AN/TPN-2 radar beacon carried in the missile aircraft. The barometric altimeter is used to control the altitude as in phase 1.

(3) Cottongrass Phase 3 - This system employs the same position information system as phase 2.

(4) Corticated Phase 1 - In this system the missile aircraft is visually tracked from the control aircraft to within ten miles of the target after which time the AN/AXT-2 Block III television equipment, located in the nose of the missile, is used to transmit a picture of the area towards which the missile is flying. This picture is received in the control airplane by AN/AXR-1 television receiving equipment. Included with the AN/AXT-2 television transmitter is a repeat-back compass attachment in order that the picture received in the control airplane will include the compass heading of the missile aircraft. Either the barometric altimeter or an AN/APN-1 radio altimeter may be used to determine the altitude and initiate corrections to the automatic pilot.

(5) Corticated Phase 2 - This system employs two additional methods for determining the position of the missile enroute to the target area. In the first method, an AN/APN-14 "Black Maria" radar beacon in the missile aircraft is triggered by the pulse from the AN/APS-15 or AN/APN-13 radar search equipment (H2X). The response which is on a different frequency is received by the SCR-729 radar navigation set and is transferred to the PFI scope of the AN/APS-15 where it is superimposed on the radar picture of the ground. In the event that the AN/APS-15 is unable to locate the target, the second method may be used. The bearing of the missile, relative to the control airplane, is determined by tuning the radio compass of the control airplane on the BC-375 liaison transmitter which may be turned on in the missile remotely from the control airplane. The range of the missile from the control airplane may be determined by the SCR-729 navigation equipment used in conjunction with an AN/TPN-1 beacon in the missile aircraft. This navigation equipment used in phase 2 is installed in addition to all of the position information used in phase 1.

(6) Corticated Phase 3 - The position information system is identical to that used in Corticated phase 2 with the addition of telemetering. An AN/AXT-3 television transmitter installed in the missile airplane transmits a television picture of the following instruments in the missile: two dual manifold pressure gages, a compass, an air speed

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indicator, an altimeter and a rate of climb indicator. The telemetering is received in the control airplane by the same AN/AXR-1 television receiver which is later used to receive the television picture of the target area.

(7) Close Support Visual Control Phase 1 - The position information is obtained by optical sights at the ground stations.

(8) Close Support Visual Control phase 2 - The position information system is identical with Close Support phase 1, with the addition of television for the final part of the dive.

c. Command Transmission System -

(1) Cottongrass Phase 1 - This is a preset system involving no command transmission system.

(2) Cottongrass Phase 2 - This system uses an AN/ARM-18 frequency modulated transmitter with an AM-10 or AM-33 amplifier to transmit control signals. This transmitter can be used on any of ten channels. It transmits a carrier only when applying control and uses ten audio tones as control signals. These control signals are received by an AN/ARM-1 FM receiver.

(3) Cottongrass Phase 3 - This phase employs a modified SCR-584 gun-laying radar set which transmits control signals by varying its pulse recurrent frequency. These changes in PRF are detected by a C-212UP selector used in conjunction with the AN/APM-21 or AN/UPM-2 beacon. This equipment can be replaced by the AN/APM-1 radar control equipment developed for use in the JB-2.

(4) Corticated - All phases of Corticated at present employ the same frequency modulated radio link that is used in Cottongrass phase 2.

(5) Close Support Visual Control - Both phases at present employ the same system as is used on Corticated phases.

d. Command Execution System -

(1) Cottongrass Phase 1 - The automatic barometric altimeter operates through the RE-20 relay unit, the trim board, and the

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C-1 automatic pilot to control the altitude of the missile. The directional gyro in the C-1 pilot controls the heading of the preset missile. A time clock automatically cuts the ignition of the missile's engines after a predetermined time, and the missile glides to its target.

(2) Cottongrass Phase 2 - The altitude of the airplane is controlled in the same manner as in Phase 1. Signals received on the AN/ARW-1 FM Receiver operate a steering motor on the directional gyro to make course changes. The ignition on the engines is cut by signals from the AN/ARW-1 Receiver at the desired point in space to enable the missile to glide to its target.

(3) Cottongrass Phase 3 - This is identical to Cottongrass Phase 2 except that the signals are received by a C-212 UP selector and a radar beacon.

(4) Corticated Phase 1, 2, and 3 and Close Support Visual Control phase 1 and 2 - The signals received by the AN/ARW-1 Receiver operate the trim board which controls the C-1 automatic pilot. By means of the RC-20 relay box, the automatic barometric altimeter or the radio altimeter may be remotely selected and connected to the trim board in order to obtain automatic flight at constant altitude or at constant height above the ground. The signals from the FM Receiver can also be used to operate a throttle motor to control the power of the engine.

4. Propulsion - No change is made to the propulsion system already installed in the airplanes. For low altitude missions the turbo blowers may be removed if desired.

5. Warhead - The abusive missile carries an explosive load which is usually packed in boxes or other convenient containers. It may consist of Torpex, TNT, or gelgas and white phosphorous. The exact weight of explosive carried depends upon the particular target being attacked. However, approximately 18,500 pounds are usually employed in either the B-17 or the B-24 missile.

6. Fusing and Arming System - The Arming relay may be actuated either by the electric time clock in Cottongrass Phase 1 or by the appropriate control signal in any of the other phases. This arming relay in turn operates an electric motor which arms the T-83 fuses. Even when armed, these fuses require an acceleration of 9g before detonation will occur.

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7. Launching System - Two launching systems are available. The aircraft may be taken off by remote control or by pilots who bail out. If the aircraft is taken off by pilots, they remain in the aircraft until they have adjusted the automatic pilot and turned on the remote control equipment. Launching by remote control will require approximately 30% longer runways than are required for pilot takeoff and will probably not be done if there are obstructions or friendly installations near the end of the runway.

8. Modifications and Installation of Controlling Vehicle - The same modifications in the control airplane are required for use with either phase 2 or 3 of Corticated. For phase 1 the radar equipment is not required; but, since this equipment is usually already installed in the control airplane before it is modified, the complete installation is usually used with all three phases. The airplane is modified by the removal of the ball turret and the installation of the following equipment:

AN/APS-15 or AN/APQ-13	Radar search equipment
SCR-729	Radar set
AN/AXR-1	Television receiving equipment
AN/ARW-18	FM transmitting equipment
AM-10 or AM-33	Amplifier equipment
BC-617	Monitor receiver equipment
Type A-1	Gyro Antenna Unit

The total weight added amounts to 600 lbs. It is estimated that 800 to 1,000 man hours will be required to modify the airplane.

If a control plane is used with Close Support Visual Control modifications required are the same as for Corticated Phase 1.

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TESTS AND OPERATIONAL USES 11-14-4
1 October 1945

1. Developmental Tests - Developmental tests were conducted at Wright Field during the spring and early summer of 1944. Previous work on guided missiles, which lead to the development of the control components employed in Abusive aircraft was originated in 1938 with the initiation of a remote control program for airplane targets.

2. AAF Board Tests -

a. In AAF Board Report of 17 January 1945, subject "Test of Continual Control from Air, Employing Television and FM Radio Link, it was recommended that radio and television alone should not be used in combat because of requirement for ideal weather and visual contact between the two airplanes. (Corticated Phase 1)

b. In AAF Board Report of 21 February 1945, subject "Development of Pilotless Aircraft," it was recommended that remote control from the ground not be used without an automatic plotting board and a secure control link.

c. In AAF Board Report of 23 March 1945, subject "Test of Continual Control from Ground Employing Radar and FM Radio Link," it was recommended that remote control by FM radio from the ground, as tested, should not be used because of jamming. (Cottongrass Phase 2)

d. In AAF Board Report of 24 March 1945, subject "Test of Continual Control from Air Employing Television and FM Radio Link in conjunction with AN/APQ-13 and 'Black Maria' Beacon," it was recommended that the equipment, with the exception of the beacon, was satisfactory and should be standardized. (Corticated Phase 2)

e. In AAF Board Test of 29 March 1945, subject "Test of Continual Control from Ground Employing SCR-584 for Radar and Radio Link," it was recommended that this system be adapted operationally. (Cottongrass Phase 3)

f. In AAF Board Report of 18 April 1945, subject "Test of Radar Dead-Reckoning," it was recommended that this system for controlling heavy bombardment aircraft projectiles not be used by the AAF because of poor accuracy.

g. In AAF Board Report of 26 April 1945, subject "Use of War Weary Heavy Bombers as Projectiles," it was recommended that bomb loading be used in B-24 aircraft and boxed explosives in B-17's. For optimum load and ease of preparation, B-17 type airplanes should be used in preference to B-24 aircraft.

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TESTS AND OPERATIONAL USES (Cont'd)11-14-4
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h. In AAF Board Report of 6 June 1945, subject "Final Report of Test of Willie (Baby) Aircraft Controlled from B-29's on Long-Range Missions," it was recommended that the equipment with the exception of the beacon be considered satisfactory and be standardized.

3. Theatre Tests - Under the supervision of ATSC personnel the following tactical tests were conducted in ETO in 1944. An early development of Corticated Phase II with Rebecca Eureka navigation was used for navigation purposes.

a. One missile aircraft B-17F, 230180, was dispatched to the sub pens at Heligoland 11 September 1944. This missile was shot down by concentrated anti-aircraft fire and exploded in the sea 1000 feet from the target. Total distance traveled was 320 miles.

b. Two missile aircraft, B-17F, 230363, and B-17G, 239827, were dispatched 14 September 1944 to an oil refinery at Hemmingetadt, Germany. Total distance was 376 miles. Due to an erratic television picture which forced the control pilot to dive the first aircraft visually, the target was overrun 1000 feet. The second missile was lost by the control aircraft. It is believed to have hit in the North Sea. The erratic television picture was caused by improper tuning of the television receiver by the radio operator.

c. Two missile aircraft, B-17F, 230039, and B-17G, 237743, were dispatched to the barracks and shops at Heligoland on 15 October 1944. Distance was 320 miles. The first missile was shot down approximately one quarter mile off shore and the second missile destroyed 2-1/2 acres of buildings in the target area. Visibility was extremely poor and television could not be used on either missile.

d. Two missile aircraft, B-17F, 23438, and B-17F, 230066, were dispatched to Heligoland 31 October 1944. The control aircraft could not find Heligoland due to bad weather. The first missile was dispatched on a compass heading for Berlin. The second missile was headed into the North Sea and abandoned.

e. Two missile aircraft, B-17G, 239824, and B-17F, 230353, were dispatched to Herford, Germany, 5 December 1944. Total distance was 336 miles. The first missile was shot down by anti-aircraft fire while turning on the target run. The other missile is believed to have iced up, both wings and carburetors, and made a perfect reduced power belly landing in Germany. The aircraft did not explode and was not destroyed.

f. All missile aircraft were loaded with 14,425 pounds of torpex and equipped with a 1,000 pound capacity smoke tank. FS smoke was used

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TESTS AND OPERATIONAL USES (Cont'd) 11-14-4
1 October 1945

on all missions. A gasoline load of 6,000 pounds and 144 gallons of oil was carried on all missions. The gross weight of one of the missiles (B-17F 230180) was 63,163 pounds.

4. Theatre Operational Use - There is no record of any operational use.

5. Future Testing Program - Additional tests are scheduled on new and improved sights for Close Support Visual Control. These tests should be completed by 1 February 1946.

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ABUSIVE PROJECT

AVAILABILITY 11-14-9
1 October 1945

1. All prime equipment is available (but not assembled) for all phases of "Cottongrass," Phases I and II of "Corticated" and phases 1 and 2 of Close Support Visual Control.

2. Installation items are available only for 75 kits for "Cottongrass," Phases II and III.

3. At the present time seventy-five (75) kits for Phases II and III of "Cottongrass" are ready for assembly except for bench-checking of two items (AN/AFN-21 and C-212):

<u>Missile Equipment Kits</u>		<u>Control Equipment Kits</u>
25	- Phase II -	13 for B-24 12 for B-17
50	- Phase III -	25 for B-24 25 for B-17

4. A total of forty-seven (47) kits for "Cottongrass," nine (9) ground control stations, and miscellaneous test equipment and spare parts, were shipped to the European Theater of Operations approximately 15 January 1945. This equipment has not been unpacked to date and the European Theater of Operations is awaiting disposition instructions for same. Approximately 20 kits for Corticated have been expended in engineering and tactical tests.

5. The balance of equipment necessary to complete a total of 550 kits, for all Phases of the Abusive Project, has been procured but not assembled.

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2417

SECRET

TITLE: Abusive Project

ATI- 2417

REVISION 1-10-45

AUTHOR(S): (Not known)

ORIGINATING AGENCY: Air Technical Service Command, Wright Field, Dayton, O.

ORIG. AGENCY NO.

AAF-MD-E 98-11-14

PUBLISHED BY: (Same)

PUBLISHING AGENCY NO.

(Same)

DATE
Oct '45DOC. CLASS.
Secr.COUNTRY
U.S.LANGUAGE
Eng.PAGES
18ILLUSTRATIONS
(None)

ABSTRACT:

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DIVISION: Guided Missiles (1)

SECTION: Operation (13)

SUBJECT HEADINGS: Missiles, Guided - Operation (63137);
Aircraft - Guided missile use (05700); Missiles, Guided -
Control systems (62800)

ATI SHEET NO.: 8-113-3

Air Documents Division, Intelligence Department
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Wright-Patterson Air Force Base
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SECRET

TITLE: Abusive Project

ATI- 2417

REVISION 1-10-45

AUTHOR(S): (Not known)

ORIG. AGENCY NO.

ORIGINATING AGENCY: Air Technical Service Command, Wright Field, Dayton, O.

AAF-MD-E 98-11-14

PUBLISHED BY: (Same)

PUBLISHING AGENCY NO.

(Same)

DATE	DOC. CLASS.	COUNTRY	LANGUAGE	PAGE	ILLUSTRATIONS
Oct '45	Secr.	U.S.	Eng.	18	(None)

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SECTION: Operations (13) 3

SUBJECT HEADINGS: Missiles, Guided - Operation (63137);
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ATI SHEET NO.: 8-1-13-3

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FT. BELVOIR, VA 22060-6218

MAR 31 2011

SUBJECT: OSD MDR Cases 11-M-1002, -1003, -1005, -1007, -1008, and -1009

We have reviewed the attached documents and have no objection to declassification in full. The information you requested is provided in the table below:

OSD Case Number 11-M-	Current Controlling Agency	Current Controlling Official	Current Distribution Control Statement	Current Overall Classification Level	Current Downgrading Instructions	Current Declass. Instructions
1002	WHS	OSD Records Official	A Release Unlimited	C	N/A	N/A
1003	WHS	OSD Records Official	A Release Unlimited	C	N/A	N/A
1005	WHS	OSD Records Official	A Release Unlimited	C	N/A	N/A
1007	WHS	OSD Records Official	A Release Unlimited	C	N/A	N/A
1008	WHS	OSD Records Official	A Release Unlimited	S	N/A	N/A
1009	WHS	OSD Records Official	A Release Unlimited	S	N/A	N/A

If you have any questions, contact me by phone at 703-696-2197 or by e-mail at storer.robert@whs.mil or robert.storer@whs.smil.mil.

Robert Storer

Enclosures:

1. DTIC request
3. Six documents

Robert Storer
Chief, Records and Declassification Division

SECRET

UNCLASSIFIED ~~Up to 1000 Attachments~~

