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STAFF STUDY
BY
SYSTEMS ANALYSIS TEAM
OF
SEARCH OPERATIONS

PREPARED FOR
MAJOR GENERAL DELMAR E. WILSON
COMMANDER, 16TH AIR FORCE

[redacted]

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RELATED FACTORS

I. The B-52 and the weapons all experienced deceleration as a result of the break-up of the aircraft. The amount and kind of decelerations the B-52/weapons experienced during break-up significantly affects the resulting trajectories of all weapons.

II. The MK28FI weapon employs a series of chutes. Determination of which chutes (if any) retarded the weapon's fall, the condition of the chutes and when they deploy, is critical to the prediction of the resulting trajectory.

III. An HE explosion sometime prior to the weapon's impact would have a significant effect on the weapon's trajectory. An explosion coupled with possible variation in chute deployment could result in a wide variation (miles) in impact location of weapon parts.

IV. The tail cover assembly from Weapon 4 was located and appeared to have failed in a manner signifying that pressure from within the case could have forced it from the weapon afterbody.

V. Testimony of Fernando Simo Orts, Ship Master of the fishing vessel MANDELLA ORTS SIMS, observed a very large chute with an object approximating the size of a weapon descending and sinking in the sea.

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VI. No. 3 engine from the KC-135 and the horizontal stabilizer of the B-52 showed evidence of contamination.

VII. The weapon rack from the B-52 bomb bay and the 1 weapon were not contaminated.

VIII. The best available information places the B-52 flight conditions immediately prior to collision at:

Altitude - 30,500 ft.

KTAS - 405

Knots Ground Speed - 365

True Course - 256 Deg

True Heading - 262 Deg

Wind at Altitude - 305/60

And in a 300 ft/min Glide

IX. The impact Location of items of interest are:

ITEM	LATITUDE (N)	LONGITUDE (W)
Weapon No. 1	37° 14' 25"	1° 46' 47"
Weapon No. 2	37° 14' 37"	1° 48' 47"
Weapon No. 3	37° 14' 52"	1° 47' 33"
Weapon No. 4 Tail Plate	37° 15' 14"	1° 46' 43"
KC-135 Engine No. 3	37° 14' 58"	1° 48' 25"
B-52 Tail Section	37° 15' 00"	1° 46' 53"

X.

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violent motion of the fuselage, they have only a minor change in vertical velocity. However the 1/2 g deceleration along the flight path is significant, and the B-52 fuselage (and weapons) probably decelerated to a velocity of 200 to 400 ft/sec less than the B-52 velocity prior to collision. In addition, the B-52 fuselage lost an undetermined amount of altitude prior to weapon separation.

II. Release Point Location

A. Based on the previous analysis, the weapon release conditions were postulated. The next step was to locate the release point in space. The violent release conditions and the marginal stability of this weapon in free fall makes it almost a certainty that the weapons began to tumble. The tumbling, or the violence of the breakaway from the bomb bay, sheared the tail-cover thru the designed shear point at the 8 each 1/4 inch retaining bolts of weapon number 1 and 3 in the same manner as the normal tail-cover release, since the tail cover is designed to fail in the bolt holes. Weapon numbers 2 and 4, however, did not fail in this manner. Therefore, we are reasonably certain that number 2 was tumbling while numbers 1 and 3 were beginning to deploy chutes in the first few seconds after release.

B. To establish a release point, the three known weapon impact points, along with the available wind data, the

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5000 ft diameter circle the center of which is located at latitude 37°15.5'N and longitude 1°47.9'W. The collision point is estimated to be approximately one half to one nautical mile farther toward the ocean. This places the collision point and release point over land. This verifies the crew statements as well as the testimony of several ground observers. Several additional verification checks were made. The Boeing representative had calculations made for a KC-135 engine trajectory, a B-52 engine trajectory, and an ejection seat trajectory. These Boeing calculations substantiated the release point calculations.

III. Analysis of Tail Cover Plate Failure

Having established with reasonable accuracy, how and where weapon no. 4 separated from the aircraft then the next step is to look at the evidence concerning the weapon no. 4 tail plate cover failure.

A. The most solid evidence is the recovered no. 4 weapon tail-cover plate and forged ring assembly. The part number of this assembly has been matched with the factory record of assembly of no. 4 weapon. Further verification is provided, by the presence of the forged rings with weapons 1, 2, and 3.

B. It was noted that the rivets attaching the ring forging to the weapon outer skin were sheared uniformly around the circumference of the ring. There are at least four theories as to how the tail plate assembly separated in this manner:

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their statements since weapon 1 was descending by a 16 ft white ribbon chute (and had shed a 4 ft chute with the 16 ft chute-bag) and weapon 3 was similarly descending, although its chute was damaged, in addition four orange and white personnel chutes were deployed. Thus 8 chutes are known to have been in the air although the inflated condition of the 4 ft chutes (with 16 ft chute-bag) after separation from weapons 1 and 3 is unknown. One observation was, however, quite definitive and informative, but like all eye witness observations, it leaves much to be desired. The testimony and comments on it follow.

A. Francisco Simo Orts, ships master of the fishing boat. MANUELLA ORTS SIMO stated in his written statement that he saw the collision, called the coast guard cutter, and observed six chutes, four orange and white, one white and one darker. He then stated that a "half body" landed in the water near his boat 25 meters away and sank immediately. He stated that 3-4 minutes later, a "whole body" landed in the water 80 meters from his boat. This is the extent of his initial written statement.

B. Captain Joe Ramirez provided a verbal statement of the follow-on interviews in which Senor Orts indicated that the first chute was on the shore side of the ship and was the "dark" chute. He described what he meant by the phrase "half body,"

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winds on 17 Jan 66 were of such intensity at the surface that only four fishing boats were able (or willing) to operate. Two of the four were the boats owned by Senor Orts. His entire livelyhood depends on an intimate knowledge of the waters in this area and his ability to sail them, therefore his testimony, supported by his crew members, seems valid.

F. As a result of this meeting the deployment of the 64 ft chute had to be considered as the most likely possibility. His description of the chute, its oscillation, its size, and denial of the ribbon construction makes it seem quite likely that the number 4 weapon deployed its 64 ft chute and that the weapon case at least was in the water off the coast at the point indicated by Senor Orts. His sketch of the "half man" was so detailed that, when shown to anyone who had ever seen one, it appeared to be a sketch drawn with the knowledge that it was a chute and chute-bag. The "head" is the straps connecting the 4 ft pilot chute to the bag, the "torso" is the bag and the "entrals" are closing flaps and dangling tie lines. The only part of his descriptions which is inadequate for reasonable speculation is the shape of what is presumably the weapon 4 case. If they had been able to define the shape of the case as either longer or shorter than their phrase of a "stout whole body," a more definitive assumption would have been

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possible. However, at the follow-on interview, Senor Orts drew a picture which is equally vague, being a little too long for only a chute section of the weapon case and a little too short for the entire weapon.

V. Weapon 4 Impact Predictions

A. As a result of the previous analysis the probable release point and release conditions were established with reasonable accuracy. Thus trajectory calculations for weapon 4 can be initiated if subsequent events affecting the weapon's trajectory can be inferred from available evidence.

B. Impact predictions for weapon case with chute.

The evidence appears to be overwhelming that Senor Orts and his crew did observe a 64 ft chute with weapon 4 or a portion thereof impacting in the sea about 5 miles off shore, therefore, trajectories were backtracked from this impact position. Initial trajectory calculations indicated that if the 64 ft chute were deployed shortly after weapon separation, the weapon would impact at sea well beyond the 5 mile sighting. Therefore, the 64 ft chute must have been deployed sometime after the weapon separated from the B-52. The winds were strong. The accident occurred at 1022 Zulu and wind data were available from Metro stations at Gibraltar and Palma at 0000 Zulu and 1200 Zulu. From these

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wind readings 16th Air Force meteorologists estimated a probable wind structure for the vicinity and time of the crash. These predicted wind data are as follows:

Altitude, Ft	Direction, Deg.	Velocity, Knots
30,000	305	60
25,000	300	55
20,000	290	50
15,000	290	45
10,000	280	30
5,000*	270	25
Sea Level*	270	20

* - These winds were estimated from fisherman's testimony.

An average wind of 68 ft/sec from 300° was used for most of the trajectory calculations. The trajectories of systems supported by large chutes (such as the 64 ft chute) are almost entirely controlled by the wind. Note that the sink or vertical velocity of the complete weapon (weight 2248 lbs) with the 64 ft chute at sea level is only 30 ft/sec whereas the horizontal wind velocity on the sea surface is about the same. The possible impact area for the location of no. 4 is within a triangle with the apex on land and the weapon release point (37°15.45'N and 1°47.9'W) with azmuth lines extending in directions of 110 and 130° from the apex and with the base of the triangle about 18.6 miles from the release point to base of triangle.

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The sink velocity of the 64 ft chute with unit remnants would be approximately 15 to 20 ft/sec.

2. Senor Orts indicated that the chute was white and larger than the crew personnel chutes he observed. Personnel chutes are 28 ft in diameter and are orange and white in color.

3. Senor Orts sketch of the chute resembled a 64 ft solid canopy and not 16 ft ribbon chute as his sketch showed the maximum inflated diameter as being above the skirt section. In addition, the chute passed over the fisherman's boat and he indicated that the chute was a solid canopy.

4. Senor Orts and his crew indicated that the chute was oscillating approximately ± 30 degrees. Solid canopy chutes oscillate about that much whereas ribbon chutes are more stable, and exhibit oscillations usually less than ± 10 degrees.

5. In the estimate of Senor Orts the chute stayed on the surface of the water for 30 seconds. A solid canopy chute might trap some air at impact and keep the system buoyant for a short period.

6. The position of the coverplate assembly relative to the location of other debris and the estimated release point of weapons 1, 2, and 3 indicates a different phenomena occurring on #4 than on weapons 1, 2, and 3.

7. The uniform shearing of the rivets which hold the forged ring of the tail cover assembly to the weapon skin

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indicated an abnormal failure. The tail cover plate is designed to separate from the ring forging and weapon by failing eight counterbored holes using a mild detonating fuze. The weapon 2 tail cover plate failed in the manner designed.

8. The KC-135 No. 3 engine with pylon attached was highly contaminated.

9. The B-52 horizontal stabilizer upper surface had four scratches which were made by a contaminated object.

10. The forward bomb bay was recovered essentially intact. The bomb bay, the vertical support pedestal of the recovered rack and weapon 1 were not contaminated.

B. Arguments Against:

1. It should be noted that the 64 ft chute was not deployed from weapons 1, 2, and 3. Therefore, some different anomaly must be presumed for weapon #4 to explain deployment of its 64 ft chute.

2. The probability of weapon 4 colliding with debris becomes more remote the farther the weapon falls.

3. It is difficult to explain how the B-52 tail section became contaminated in the air due to the separation distance at ground impact between the KC-135 #3 engine and the B-52 tail section.

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the KC-135 #3 engine and the B-52 tail section."

4.

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III. Solution 3. The aft section of the No. 4 unit was damaged in the bomb bay during aircraft structural breakup by collision with weapon 1 and other debris. This damage weakened the tail plate assembly attachment which subsequently failed due to tumbling or collision with other debris. The parachutes deployed successively around 25,000 ft. altitude. The intact weapon (weight approximately 2100 lbs) drifted out to sea with the 64 ft chute and impacted in the area of Señor Orts' sighting.

A. Arguments For:

1. Same as A1 for Solution 1 and 2, i.e., "Señor Orts and his crew observed for 6 to 8 minutes, a large chute descending with a stout man attached. The sink velocity of the 64 ft. chute with unit remnants would be approximately 15 to 20 ft/sec."

2. Same as A2 for Solution 1 and 2, i.e., "Señor Orts indicated that the chute was white and larger than the crew personnel chutes he observed. Personnel chutes are 28 ft. in diameter and are orange and white in color."

3. Same as A3 for Solution 1 and 2, i.e., "Señor Orts' sketch of the chute resembled a 64 ft. solid canopy and not 16 ft. ribbon chute as his sketch showed the maximum inflated diameter as being above the skirt section. In addition, the chute passed over the fisherman's boat and he indicated that the chute was a solid canopy."

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2. Same as Item 6 in Arguments for:, i.e., "The position of the coverplate assembly relative to the location of other debris and the estimated release point of weapons 1, 2 and 3 indicates a different phenomena occurring on #4 than on weapons 1, 2, and 3."

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X. The best estimate of the case position at impact is the position estimated by Mr. Francisco S. Orts.

RECOMMENDATIONS

It is recommended that:

I. The Navy search be concentrated in the area indicated by the visual sighting of Senor Orts.

II. Careful investigation of the weapon case or remnants found in the sea should be made before it is raised.

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IV. The systems analysis team of Messrs. Bachman, Bennett, Campbell, and Maydew should be returned to Torrejon AB, Spain, and thence to their respective home duty stations, and that they continue to serve in an analytical and advisory capacity from there. The recommended mode of operations would be for "Search Operations" to send an action message containing description of any new information deemed significant by Search Operations and/or the Sandia Representative at the site. This information should be addressed to Sandia Corp,

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SEG, and DAD at the addresses noted on the signature page of this document. Discussions, calculations and/or other actions necessary to interpret and analyze the significance of the information would be conducted and immediate reply made regarding the significance of the information and its effect on search operations.

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bag goes floating off separately. This mode results in 3 chutes in the sky.

C. The normal operation of the 30 inch stabilization chute system is as follows: After the unit separates from the aircraft, a set of timer-actuated mild detonating fuzes blow the tail plate off and release the 16 and 64 ft chute shroud line attachment plates. The 4 ft chute pulls out the 16 ft chute which pulls out the 64 ft chute which deploys the 30 inch stabilization chute. Recall that the 30 inch chute is packed on the front of the 64 ft chute bag. Note that the 4 ft chute attached to the 16 ft chute bag, the 16ft chute attached to the 64 ft chute bag and the 64 ft chute canopy then floats off separately from the weapon. The 30 inch chute then stabilizes the weapon during the balance of the trajectory. This mode results in four chutes in the sky.

D. Spurious electrical signals or damage to unit No. 4 during the accident or during the trajectory could result in parachute and/or deployment system damage. Hence, a very large number of parachute drag area combinations are possible for unit #4. An exact prediction of which of these many possible drag area combinations occurred is not possible.

II. Description of Weapon Tail Assembly:

The shape component or tail assembly of the MK28FI Bomb consists essentially of two concentric cylinders. The inner cylinder houses the parachutes and the outer cylinder forms

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the skin of the tail assembly. The two cylinders are tied at the aft end to a forged ring with a single rivet pattern. The estimated longitudinal failure load for rivet shear (which occurred on No. 4) is 88,000 lbs. The ring also provides a mounting surface for the aft feet of the four fins and the cover plate. The aft feet of the fins are bolted to the ring directly, (the bolts do not go thru the outer skin) with two bolts per fin foot. The cover plate is bolted to the ring at eight places. Counterbored holes in the cover plate retain the plate until an MDF system on the forward surface of the plate is fired. At this time, the counterbored holes fail, at a load of approximately 22 thousand pounds. The forward feet of the four fins are riveted to an intermediate ring assembly, the concentric cylinders (after body case and parachute container) are terminated at the forward end at another ring assembly. A bulkhead, to which the parachute shroud lines are attached, thru other plates, is bolted to this forward ring assembly. The 30 inch parachute shroud line attachment plate is cantilevered aft to the bulkhead. The 64 ft parachute shroud line attachment plate (spider) is attached to the aft surface of the bulkhead with explosive bolts (MDF). The 16 ft parachute shroud line attachment plate (spider) is attached to the 64 ft release spider with explosive bolts. During normal operation of the chute, the timer-activated MDF on the 16 ft spider fires (3.5 seconds after the tail plate leaves) which releases the 16 ft chute shroud lines

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allowing the 16 ft chute to deploy the 64 ft chute. During normal operation of the free-fall option (30 inch chute deployed) a timer-activated MDF fires which separates the 64 ft chute spider (plate) from the bulkhead thereby allowing the 16 ft and 64 ft chutes to separate from the weapon.

Submitted by the Systems Analysis Team

Camp Wilson, Sixteenth Air Force, Spain 7 February 1966

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