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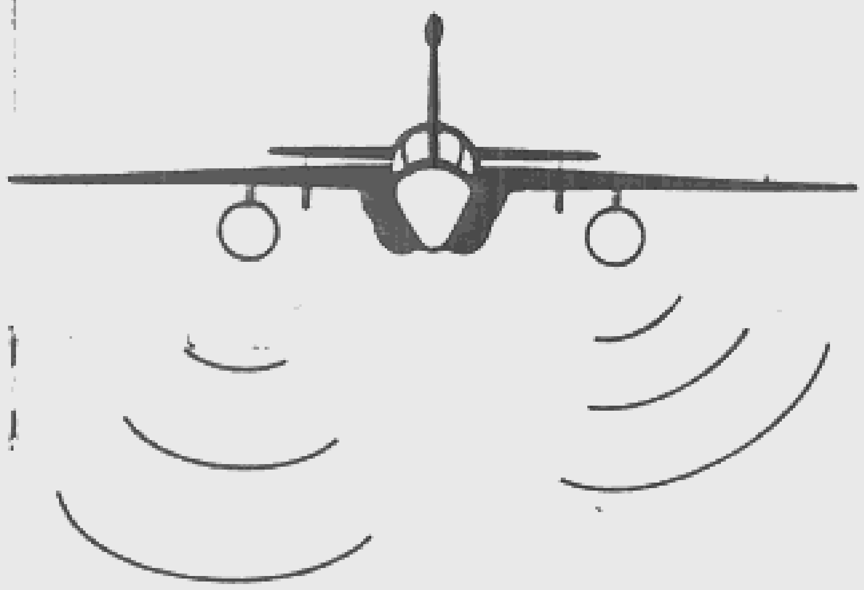
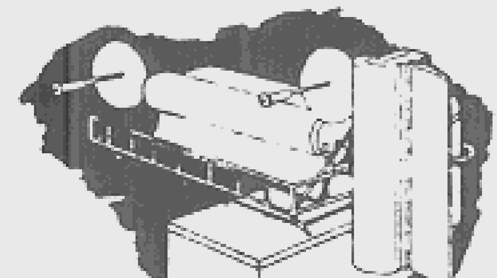
VX-5 ADVANCE EVALUATION NOTE



EWJT (ELECTRONIC WARFARE JOINT TEST)



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DEPARTMENT OF THE NAVY
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Ref: (a) COMOPTEVFORINST 3930.1G

1. (U) Publication of this AEN is authorized by Commander Operational Test and Evaluation Force by reference (a). The purpose is to provide the most recent information available on the results of the Electronic Warfare Joint Test and provide concepts used during the test.

2. (U) This is the first of a series of AEN's concerned with EWJT (Electronic Warfare Joint Test). Some background has been provided describing Phases I and II of EWJT. Red, White, and Blue forces operations and equipment are described in some detail, as well as how the tests were conducted. This is followed by a discussion of some operational considerations based on preliminary analysis of the data. Some pertinent information is also provided concerning ECM systems maintenance during the tests. Continuing analysis, including use of computer simulations, will produce more detailed results in the future. The concepts and results described are of a preliminary nature and will be supplemented by additional data when available.

3. (U) The contents were compiled by a special working group using direct inputs from the EWJT results and are not based on AIRTEVRON FIVE testing or evaluation. This AEN is to provide Fleet Commands tactical information for use in mission planning as a result of the EWJT and analysis completed to date.

R N Livingston

R. N. LIVINGSTON

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LIST VII, CASE A & B
EWJT, Rm 750, 1300 Wilson Blvd., Arlington, VA.

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Contents

Contents (Cont'd)

Acronyms and Abbreviations

ADWOC	Air Defense Weapons Operations Center
AMS	Area Monitor System
AMV	Area Monitor Van
CCI	Computer Control Indication
DECM	Deception Electronic Countermeasures
ECM	Electronic Countermeasures
ECCM	Electronic Counter-Countermeasures
EJ	Escort Jamming
EMCON	Emission Control
EMI	Electromagnetic Interference
EWJT	Electronic Warfare Joint Test
EXCAP	Expanded Capability
FIMA	Field Intensity Measurement Array
FTC	Fast Time Constant
GEIS	Ground Event Instrumentation System
IADS	Integrated Air Defense System
IFF	Identification, Friend or Foe
MTBF	Mean Time Between Failure
MTI	Moving Target Indicator
PBS	Portable Battery Set
PD	Pulse Repetition Interval Determination
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval

Acronyms and Abbreviations (Cont'd)

RMS-2	Range Measurement System
SOJ	Standoff Jamming
SPC	Self-protection Chaff
STC	Sensitivity Time Control
TFR	Terrain Following Radar
TFWC	Tactical Fighter Weapons Center
TOCC	Test Operations Control Center

References

(a) DDR&E Memo of 24 June 1972; Electronic Warfare Joint Test

(b) DDR&E Memo of 27 November 1972; Charter for Test Director of Joint Electronic Warfare Test Program

(c) WSEG (C) Report 223; Design of the Phase II Electronic Warfare Joint Test, March 1974

(d) Test Plan for Electronic Warfare Joint Test, Phase II (C), 1 August 1974

(e) Naval Missile Center Report; Maintenance of Navy ECM Systems During the Electronic Warfare Joint Test, 14 February 1975

Definitions

Blue Forces: All aircraft, crews, equipment and operations associated with the airborne strike force.

Red Forces: All equipment, personnel and operations associated with the simulated hostile air defense ground environment.

White Forces: All personnel, equipment and operations associated with test control, test monitoring, instrumentation, data reduction and analysis of results.

Test Area: The area defined by a radius of approximately 150 NM from the midpoint of the target areas in which position data on the strike force and air defense facilities will be collected.

Terminal Defense Area: The air space including the theoretical kill zone of SAM and AAA weapons systems employed for defense of two target complexes of regiments.

[redacted]

SECTION 1

INTRODUCTION

101. (U) Scope. The EWJT (Electronic Warfare Joint Test) program was the most extensive electronic warfare operational test since the end of the air war in Vietnam. Its purpose was to determine the relative effectiveness of various combinations of U.S. electronic warfare equipments. In this test, for the first time, large airborne strike forces attacked target complexes heavily defended by simulated Soviet SAM (Surface-to-Air Missile) and AAA (Anti-aircraft Artillery) systems. The range was instrumented to record aircraft positions and certain aircraft and ground events. Analysis work now underway will evaluate the relative effectiveness of EW (Electronic Warfare) mixes in terms of their ability to degrade performance of the ground air defenses and to reduce strike force attritions. Since the test did not include the lethal effects of strike force or air defense weapons, computer simulation models are being used in the analysis of attrition effects on both air and ground forces.

102. [redacted] Phase I/II Background. The Office of the Secretary of Defense initiated EW Joint Testing in June 1972, requesting joint participation by the Navy, Army and Air Force, reference (a). The Navy was assigned as the executive agency, reference (b). Under the direction of COMOPTEVFOR (Commander, Operational Test and Evaluation Force) Norfolk, Virginia, the Joint Test Staff was formed in late 1972.

a. [redacted] While tests were being developed, replicas of defense radars were updated (using the latest intelligence) instrumentation needs were determined, and the necessary equipments were procured. Field testing was divided into two main phases. Phase I conducted in the summer and fall of 1973 at the NWC (Naval Weapons Center), China Lake, California, to validate the feasibility of instrumenting and conducting large scale electronic warfare tests. The general objectives of Phase I were as follows:

(1) Demonstrate that both airborne and ground events data could be collected in an EW environment involving large number of aircraft.

(2) Determine the feasibility of reconstructing a model of a Soviet air defense command and control network.

[redacted]

(3) Demonstrate the compatibility of simultaneous operation of air defense, instrumentation and airborne electronic warfare systems.

(4) Identify and study problem areas that may restrict follow-on tests.

b. [redacted] Due to the success of Phase I, confidence in test procedures and equipment warranted proceeding with Phase II full scale testing.

c. [redacted] Phase II operations were conducted in and around the R-4800 series restricted airspace north of Nellis AFB, Nevada. A complete IADS (Integrated Air Defense System) was established to defend two target complexes, one near Tonopah, Nevada and the other near Springdale, Nevada. Air defense headquarters staffs, through the regiment level, were set up at Nellis AFB.

d. [redacted] In both areas, there were a total of 22 simulations of Soviet early warning, acquisition, SAM and AAA radars. These were tied into the simulated Soviet Manual Command and Control System, headquartered at Nellis AFB, Nevada. In addition to the IADS, a network of instrumentation and communications systems was established throughout the test range area connected to a Test Control Center located at Nellis AFB.

e. [redacted] Phase II testing commenced in early fall 1974. Navy aircraft were deployed to NAS Lemoore, 200 NM southwest of the range, for operations under the direction of COMLATWINGPAC. Air Force aircraft were positioned at Nellis AFB, 120 NM southeast of the range, under the direction of TFWC (Tactical Fighter Weapons Center). Aircraft of both services were equipped with the latest operational ECM (Electronic Countermeasures) equipment.

f. [redacted] In October 1974, pretest, range calibration, checkout and personnel training were completed. Flight testing began on 10 October and concluded on 22 November 1974. Approximately 2,000 personnel and over 1,800 sorties were involved.

g. [redacted] The general objectives of Phase II were as follows:

(1) To determine the degree of effectiveness of electronic warfare equipment in preventing or delaying the engagement of strike aircraft and in preventing accurate tracking of strike aircraft by SAM and AAA battalions in an IADS. The following areas of interest were investigated.

(a) Degradation in detection and tracking of strike aircraft by early warning, acquisition, and SAM/AAA radars (i.e., delays in detection and reduced periods of tracking).

(b) Delays in command and control functions resulting from degradation in IADS radar performance.

(c) Reduction in SAM launches or AAA fire resulting from delays in target assignment, reassignment, or degraded target track information.

(2) To determine the incremental improvements in effectiveness of a strike force employing various ECM mixes compared to a strike force employing no ECM. A total of nine EW mixes were evaluated using the no ECM case as the baseline by:

(a) Comparing strike force with no ECM against a strike force employing self-protection (onboard) ECM.

(b) Adding to the strike force, separately for each EW mix, IRON HAND, standoff jamming, escort jamming, standoff jamming and IRON HAND, escort jamming and IRON HAND, chaff corridor seeding and lastly, chaff corridor seeding without employing self-protection ECM, references (c) and (d).

103. [redacted] Limitations to Scope. The following limitations apply to the scope of EWJT:

a. [redacted] The damage inflicted on assigned targets by strike aircraft was not considered.

b. [redacted] Since the test could not include the actual lethal effects of air defense weapons (SAMs and AAA), laboratory and computer models are being used after the test to derive estimates for these effects.

c. [redacted] Since damage to an element of the air defense system would affect air defense capability and subsequent attrition and since no estimate of target damage was to be made in this test, only targets such as airfields, maintenance facilities, and oil tanks were assigned as targets for strike aircraft.

d. [redacted] Defense suppression was limited to the simulated employment of ARMs (Anti-radiation Missile) in direct support of strike aircraft. Estimates of the destruction of radars that would result from ARM launches and the subsequent effect of this destruction on the capability of the air defense system during the strike is to be determined after the test by the use of laboratory and computer models.

e. [redacted] The air defense complex was limited in the following manner:

(1) The tactical air defense system consisted of a simulated threat command and control (zone level), and early warning acquisition, SAM, and AAA radars.

(2) No communications jamming was employed against the aircraft.

(3) No height finder radars were included in the air defense complex.

(4) Red Force interceptors were not employed as part of EWJT.

(5) The IFF (Identification, Friend or Foe) capability normally available to hostile air defense forces was not included as part of the EWJT Red Force capability.

f. [redacted] The strike force operations were limited in the following manner:

(1) No live or inert ordnance was carried. Captive ARMs were carried on IRON HAND and WILD WEASEL aircraft.

(2) EA-6B ECM support aircraft were not allowed to employ missile downlink jamming.

(3) Strike force missile evasive maneuvers were not used.

g. [redacted] Strike planning by each service was constrained in the following manner:

(1) Employment of 12 strike aircraft in each strike force (to provide a common reference for effectiveness comparison).

(2) Simulated standard quantity and type of ordnance loads (such as iron bombs) on all strike aircraft in each strike, with fixed tactics employed during delivery maneuver on assigned target (to minimize variations in results from non-ECM mission factors).

(3) Strike aircraft speeds and maneuvers prior to weapon delivery appropriately limited to reflect reduced aircraft performance when carrying ordnance.

(4) No low-altitude profiles outside the target areas (to maintain reference tracks with available instrumentation on all test aircraft).

(5) Communications jamming was not employed.

h. (C) The principal constraints on the realism of the test were as follows:

(1) The numbers of available threat type radars and weapon systems limited the ground test environment to a small part of an integrated threat air defense system.

(2) An additional limitation on test realism was based on the limited knowledge of particular threat air defense procedures, command and control doctrine, and ECCM (Electronic Counter-countermeasures) doctrine, techniques, and tactics.

(3) The optical/electro-optical modes of the SAM and AAA systems were not employed.

(4) Friendly air superiority was assumed. Therefore, RED FORCE interceptors were not employed as part of EWJT.

(5) Accurate EA-6B position determination was not available due to incompatibility between aircraft jamming systems and position locating instrumentation systems.

(6) AAA radar systems were not instrumented. Data from these systems was collected on operator and observer logs.

SECTION 2

OPERATIONAL CONSIDERATIONS

201. [redacted] Summary. This section contains test observations and some preliminary considerations for employing several of the EW mixes flown during EWJT. Comments are also made regarding future analysis efforts.

a. [redacted] The relationship of EWJT to other scenarios is discussed briefly. Several comments are made about EA-6B employment in both the standoff and escort roles. Some observations are made concerning employment of self-protection chaff and the inter-relationship of the ALQ-126 DECM and self-protection chaff. Additionally, considerations are outlined for employment of the new ALE-41 chaff pod including chaff corridor planning, strike aircraft positioning, seeder aircraft positioning, seeder vulnerability and use of the ALQ-126 in conjunction with chaff corridors.

b. [redacted] Considerable information was collected during EWJT. Efforts are continuing to reduce and analyze each mission in depth. As work progresses, supplements to this basic document will be published providing detailed information about each test mix. Items to be covered will include ranking the value of each mix against others, numbers of missile engagements, miss distances, defense reaction delay times induced by ECM and recommendations concerning current and future strike tactics.

202. [redacted] EW Joint Test in Relation to Southeast Asia and Other Air Defense Environments. The EWJT resembled the ground air defense environment found in North Vietnam at the close of the air war in terms of surveillance, command and control, and weapons density. Notable differences between EWJT and Southeast Asia were the exclusion of optical SAM/AAA tracking and hostile fighter aircraft. In many ways, however, the EWJT environment could be considered more sophisticated than Southeast Asia since both the FAN SONG B and E radars, SA-3, SA-6 and GUNDISH AAA were included. An important point to remember regarding other environments such as those found in the Middle East is that infrared, optical and radar controlled weapons as well as enemy fighters will be encountered. EWJT was oriented towards evaluation of equipment effectiveness and not tactics development. The enemy tactical air defense posture is going to be lethal, diverse and highly mobile. Each threat scenario must be individually analyzed and the appropriate air wing tactics chosen. The testing discussed here

investigated ECM against land-based weapons in the RF spectrum only. The lessons learned in EWJT are of substantial value to current planning because the early warning/acquisition process, command and control, long and short range radar controlled weapons are essentially the same regardless of potential geographic areas of conflict.

203. [redacted] Support Jamming Considerations. EA-6B aircraft were involved in four of the nine mixes tested during EWJT. EWJT provided an opportunity to reconfirm several previous EA-6B test results and to observe the employment of these aircraft in a multiple ground defense multiple strike aircraft environment.

a. [redacted] Jammer Position (EW and ACQ). The test demonstrated the need for main beam alignment of standoff aircraft and the strike group with the hostile radars. The EA-6B should position itself to keep the strike group between the jamming and the radar in both azimuth and elevation. Control of this geometry is not as critical when jamming EW and ACQ radars since the relatively wide vertical beam width and large side lobes of these radars allow SOJ to continue to degrade performance when the strike aircraft move out of jammer-radar alignment in the vicinity of the target.

b. [redacted] Jammer Position (SAM and AAA). Control of the geometry for jamming SAM and AAA radars from a standoff position is more difficult than jamming EW and ACQ radars. Elevation is definitely a factor and the relatively narrow beamwidth and small side lobes of these radars seriously reduce jamming effectiveness when the strike aircraft move out of jammer/radar main beam alignment. SAM elevation beam jamming effectiveness deteriorates rapidly as the strike aircraft moves away from the EA-6B and toward the SAM radar. As SAM elevation is raised to track close targets, the alignment angle required for effective jamming rapidly exceeds the altitude capability of the EA-6B. This situation was demonstrated regularly during the tests especially on deep penetration scenarios. At the maximum SAM range, both azimuth and elevation channels would be effectively jammed. As strike aircraft approached the SAM radar, the elevation channel jamming would continue to fade until targets were clearly visible. This caused engagements to occur despite the fact that azimuth channel jamming can remain effective from standoff orbits. The result is to force the system to operate in the degraded Manual tracking mode using elevation and ranging from one channel and attempting to read through jamming strobes on the azimuth display.

c. [redacted] Jammer Effect. Preliminary analysis indicates that early warning radar detection range was reduced over 55% when confronted by EA-6B standoff jamming. In addition, strike aircraft were able to penetrate SAM coverage further before initial engagement. This was due to effective jamming of the acquisition radars and to reduction of information and time available to the RED FORCE because of the cumulative effect of EA-6B jamming against all radars. The overall effect on missile miss-distance is yet to be accomplished.

d. [redacted] Multiple EA-6B Jamming. Both in the standoff and escort profiles flown, jamming from the multiple EA-6Bs created numerous false alarms onboard the EA-6B aircraft, thus degrading the ability of the EA-6B to use the ALQ-99 TJS in the Threat Alarm mode. The use of attenuation and direction stripping techniques could not overcome the problem. It is suspected that jamming also created multiple track-words opening several PRI Determination gates. This caused significant degradation in jamming effectiveness particularly against the high data rate, narrow beamwidth missile and fire control radars. Very slow system response time was encountered in scanning through the frequency bands when EMI was present. Since CCI assignments were the primary system technique employed, the Acquisition mode was often selected to prevent jamming degradation due to the formation of look through gates during initial periods of strike vulnerability.

e. [redacted] EA-6B Escort Formation Position. The positioning of the EA-6Bs 1000 feet below and slightly behind the last two strike group divisions had an adverse effect on the DECM of the strike aircraft. The ALR-45s depicted strobes in the 6 o'clock position and some erroneous missile alert/launch ALR-50 indications resulted. Early in the test, the ALQ-126s were employed in Repeat mode and in the presence of jamming were responding constantly with their various routines. This caused the ALQ-126 to overload and occasionally to trip to inoperative. When it was learned of the EA-6B jamming effects on the DECM, procedures were adopted to place the ALQ-126 in Receive mode, except in the threat envelope when it was switched to Repeat mode. Optimum placement of the escorting EA-6B within the strike to minimize interference with strike group DECM, while maintaining the necessary geometry to provide adequate screening should be thoroughly investigated. The procedure of maintaining an assignment and manually steering the antenna, as often used in the EA-6B ground simulator 15E22, proved very useful in the escort missions. It minimized operator workload, enabled better crew lookout procedures and is especially useful against short range (not overlapping) fire control systems.

f. [redacted] Airborne Spectrum Analysis. An airborne spectrum analyzer was employed in the standoff aircraft which jammed early warning/acquisition radars. Nonsweeping subcarriers and hops in pod spectrums would not have been discovered except for the airborne and ground analyzer use since all cockpit indicators were normal. Several enemy emitters could have been ineffectively jammed on repeated missions without the aircrew or maintenance personnel having any knowledge of the pod malfunction without use of the spectrum analyzer.

g. [redacted] EMI (Electromagnetic Interference). Band 2 interference with the UHF on selected frequencies (243.0-Guard, 341.2-squadron tactical) was still prevalent and rendered them almost useless. Band 4 jamming caused the aircraft TACAN to be inoperative and the IFF to be unreliable.

204. [redacted] SPC (Self-Protection Chaff). Each USN strike aircraft had self-protection chaff capability and carried an ALE-29 dispenser. Dispension of chaff and dispense rate were at the discretion of the individual pilots as they monitored their ALR-45/50 RHAW gear.

a. [redacted] Observed SPC dispension and dispense rates varied considerably. The tactic of allowing individual pilots to dispense at will following a RHAW indication typically resulted in some SPC being dispensed but there were instances of failure to dispense SPC when it would have been beneficial. The random dispersion of SPC by pilots was probably a net plus. There was no simple pattern in the use of SPC that SAM operators might have been able to identify and exploit. Thus, the potential benefits to be gained by any highly coordinated use of SPC are probably outweighd by the benefits achieved by randomness and by the extra crew workload such coordination would impose.

b. [redacted] At times the combined individual aircraft dispense rates were great enough to make the SPC radar return appear to be a chaff corridor instead of discrete, separate chaff returns. Additionally, the emergence of any chaff has a disruptive effect on the SAM radar operators who usually have to shift tactics as soon as chaff is seen. This shift can mean that they must reinitiate searching for targets and tracking to achieve an intercept.

c. [redacted] In the more frequently observed cases where the dispense rates did not result in a chaff corridor being generated, SPC was still effective in confusing radar operators particularly when multiple aircraft were present on the radar operator's display. As each chaff cartridge blooms, the radar operator must rapidly decide whether or not to track that new radar return. Even a skilled operator requires some time before he can recognize that the chaff return is not moving and thus represents a false target. During that time the dispensing aircraft has the opportunity to fly out of that SAM radar coverage. The time required to fly out of coverage depends on the radar beamwidth and current aircraft/radar boresight relative motion.

d. [redacted] For a system with a display such as the SA-2 or with a well trained crew of radar operators, the use of SPC will not guarantee the decoy of the operators. However, aircraft in trail of the dispensing aircraft benefit considerably from the trail of individual chaff returns left by the dispensing aircraft. Operators find it difficult and time consuming to decide if a new radar return represents SPC or a new aircraft coming into field of view.

e. [redacted] During EWJT, radar operators were able to maintain track on an aircraft dispensing SPC if they were tracking before he began dispensing. While one SAM system may be able to maintain track of the SPC dispensing aircraft and not be decoyed, other SAM systems that come up after the aircraft has started to dispense chaff will still be faced with the initial confusing problem of distinguishing the aircraft from the chaff. It may take the operators of these systems some time to understand the pattern and time evolution of the SPC returns and thus to determine that a lead aircraft is the dispensing aircraft.

f. [redacted] SPC and use of the ALQ-126. As discussed more fully in paragraph 205, the use of the ALQ-126, particularly with chaff and support jamming, has both benefits and drawbacks. In particular, an ALQ-126 in Repeat mode returns a signal so strong that the general aircraft position is obvious to the radar operator. SPC still is an effective decoy even when the ALQ-126 is operating in Repeat mode. The net effect presents to the radar operator three types of targets, one from the aircraft, one from the ALQ-126 and one from the chaff. This multiple target effect was enough to increase radar operator workload and uncertainty and frequently to lead to actual decoying.

205. [redacted] Corridor Chaff Missions

a. [redacted] Chaff Dispenser Settings. The AN/ALE-41s were loaded with three sets of two rolls each of RR-171 multi-frequency chaff covering 2.65 to 18.0 GHz. This chaff covers the frequencies of all current threat AAA and SAM radars, but does not cover the frequencies of the SPOON REST and FLAT FACE SAM acquisition radars. Chaff dispenser settings were 4 inches per second rate, 0.5 second pulse interval and 1 second pulse duration. These settings produced sufficient chaff volume in each radar resolution cell to effectively screen A-6 and A-7 size aircraft. See VX-5 Chaff AEN, 20 December 1974, for assistance in determining dispenser settings for various applications. Since only one setting was used throughout these tests, it is not known at this time what the minimum settings are which still provide good screening and permit seeding of longer corridors or decrease pod/seeder requirements. Testing is being conducted by VX-5 to expand knowledge of dispenser settings and formation spacing. It is important to note that maintaining position inside the chaff corridor is essential if screening is to be successful. The strike leader used airborne radar in an attempt to maintain a centered position in the chaff cloud by acquiring and following the cloud on the radar display. This requires considerable practice to perfect. Details of this procedure will be provided by VX-5 when current testing is completed.

b. [redacted] Corridor Positioning of Strike Aircraft. It was observed that SAM radar operators could not determine positions of aircraft inside the chaff corridor. Operators would repeatedly scan along the sides and front of the corridor searching for out-of-formation aircraft. If an aircraft was detected at the edge of the corridor, considerable attention was immediately focused on this target. It should be noted that one aircraft out-of-formation can attract SAM launches into the strike force area thus causing other aircraft to break formation while performing evasive maneuvers. Once these maneuvering aircraft break out of the chaff screen, additional SAM launches can be anticipated. Maintaining proper formation is essential to exploit chaff corridor screening.

c. [redacted] Chaff Seeder Aircraft. It was also observed that while SAM operators know the seeder aircraft are at the head of the chaff corridor, the rapid blooming of the chaff from the ALE-41 prevents the aircraft from actually being seen by the radar operators. In addition, it appears at this time that the FAN SONG B and E radars automatic tracking circuits cannot lock-on to the seeder aircraft, but continue to transfer back to the chaff. This observation is substantiated by USAF experience with the very similar ALE-38 chaff dispenser in Southeast Asia. VX-5 will explore this in greater detail during current tests. Since no hostile fighters were simulated in EWJT, their effect on chaff corridor tactics cannot be evaluated. Nevertheless, consideration must be given to protecting the seeder aircraft from air attack since proper dispensing of the chaff corridor depends on seeder aircraft maintaining formation spacing throughout the dispensing run.

d. [redacted] Strike Force Egress. Both seeder and strike aircraft attempted to use the corridor on egress from the target. Detailed mission planning, particularly regarding winds aloft, is essential to successful use of chaff corridor screening on both ingress and egress. Several important points were noted in this regard during the tests. On at least one mission the seeder aircraft delayed start of the drop until they were about 20 NM inside the SAM envelope. This resulted in at least six simulated SAM engagements against the seeder aircraft. It is possible that all seeder aircraft could have been lost before the drop started, or at least the seeder aircraft would have had to take missile evasive action upsetting the formation geometry required for proper corridor dispensing.

e. [redacted] Corridor Planning. It is apparent that current intelligence on SAM coverage and accurate navigation are required for determining the corridor start point. When in doubt, early start is better than late start. Wind direction and velocity also are important factors. It was noted on one mission that winds aloft were causing the chaff corridor to drift away from the target. At TOT the corridor was over 5 NM from the target. This resulted in the strike aircraft flying out of the side of the corridor and traversing to the target prior to roll-in leaving them vulnerable to engagement considerably longer than necessary. By the time the strike force was regrouping for egress, the chaff corridor had drifted more than 10 NM away from the preplanned egress route. The strike force egressed without support from the chaff screen allowing several more SAM engagements than would not have otherwise occurred. Wind drift and chaff fall rate must be accounted for in mission planning. Dispensing of ALE-29 self-protection chaff appears desirable in conjunction with chaff corridors. Since the chaff corridor does not extend vertically into the target, random dispensing of ALE-29 chaff during the dive out of the corridor can add confusion at the ground radar and further delay acquisition during weapon delivery.

f. [redacted] Chaff Corridor Spacing. For a strike of twelve aircraft, a minimum of four chaff seeders is required. Aircraft and division spacing can be tightened over that used during EWJT to keep aircraft inside the effective portion of the corridor and to get the divisions into the corridor as soon as possible. Since chaff bloom is almost immediate with the ALE-41 dispenser, there is no need for an extended gap between the seeding aircraft and the first division of strike aircraft to allow the chaff corridor "to grow." Such an extended gap keeps the strike aircraft from making full use of the chaff corridor as it first develops and probably contributes to the difficulty of individual aircraft staying in the chaff corridor.

g. [redacted] <u>Chaff Seeder Vulnerability</u>. Red Force firing doctrine assigned a higher priority to strike and ARM aircraft than to chaff seeders. Consequently, there were significantly more opportunities to fire at chaff seeders than there were actual firings. Chaff seeders employing active ALQ-126's were distinguishable to radar operators. In this case, radar operators are able to vary scope gain and scope scale so that ALQ-126 returns are not concealed despite the rapid bloom of the chaff from ALE-41's. To the radar operators, the leading edge of the chaff corridor is not a smooth front. There are discernable "spikes" or strings of chaff centered about each chaff seeder that spread out and merge to form a solid corridor. The spikes serve as a general locator of the seeder aircraft. The sharpness of the spikes depends on the relative location and motion of the SAM tracking radar and the aircraft.

h. [redacted] <u>Use of ALQ-126 in a Chaff Corridor</u>. If a strike aircraft is properly positioned in a chaff corridor with the ALQ-126 in Receive mode, there is a high probability its location cannot be determined by SAM and AAA radars. With the ALQ-126 in Repeat mode, the jamming signal will burn through the chaff screen. This will provide approximate location to SAM and AAA radars, but offers the advantage of missile miss-distance caused by the ALQ-126 if a SAM is launched into the corridor. The ability of the pilot to determine if he is properly positioned in a chaff corridor is not easily accomplished considering current A-7 and A-6 airborne radars and chaff frequency response. As noted in Paragraph 205b above, radar operators tended to search the edges of the chaff corridor looking for aircraft out of formation. If any doubt exists about position inside the chaff screen, employment of the ALQ-126 offers obvious advantages. It is also clear that the ALQ-126 and ALE-29 should be employed when departing the chaff corridor during weapon delivery.

SECTION 3

ECM SYSTEMS MAINTENANCE

301. (U) Introduction. EWJT provided a unique opportunity to measure ECM systems suitability (reliability, maintainability, etc). A comprehensive data collection effort was conducted by Naval Missile Center Support personnel deployed to NAS Lemoore. This included recording and analyzing all EW equipment failures, aircraft wiring, EW antennas, use of ground support equipment, aircrew and maintenance procedures. Details of this effort are contained in reference (e) and outlined below.

302. (U) ALQ-126 Aircraft Installation. Provided here are specific ALQ-126 problem areas on points of interest to both flight crews and maintenance personnel of A-6 and A-7 squadrons.

a. (U) The aft mid-band antenna of one A-6 aircraft was found filled with water. Upon investigation it was found that weep holes which are provided in the antenna to drain liquids out had been in the up position, preventing drainage. Investigation revealed that another mid-band and one high-band antenna were also mounted with the weep holes up. The quality assurance check of the installation must ensure that the weep holes are oriented downward.

b. (U) Water intrusion was also found in the A-7 aircraft. The aft high-band run had a high insertion loss which was found to be due to water in the waveguide system. This points out the problem of the aft waveguide system being exposed while the tail cone is removed from the aircraft. Standard procedure is to cap this waveguide with a plastic cap while disconnected, but in several instances during the EWJT it was noted that there was no cap in place, so that the systems were open to water intrusion or to corrosion.

c. (U) Loose waveguide joints at the tail cone disconnect point caused many problems in the A-7 aircraft aft high-band waveguide system. Proper connection of the waveguides is hampered by the inaccessibility of some of the screws which hold the waveguide together. With only a single access panel it is extremely difficult to get to the flange screws on both sides of the waveguide.

d. (U) A coaxial cable problem was found in the A-6 aircraft manifold area where the set of coaxial lines runs from connectors in the avionics bay to the forward ALQ-126. Several failures of the ALQ-126 connectors were encountered and it is believed that these resulted from the difficulty of aligning the coaxial cables to those connectors. Care must be taken to ensure that the alignment of the coaxial cables is maintained while tightening the connectors onto the unit.

e. (U) Another reccurring problem with the A-7 aircraft was the routing and alignment of the RF cables to the ALQ-126. Several different routing approaches were encountered in the same type of A-7B aircraft and A-7E aircraft. The result of non-standard routing was that, in several cases, RF output connectors and input connectors on the ALQ-126 were damaged and wires broken. Additionally, cable connections are made difficult by the clamping of the RF lines in the avionics bay. These are clamped during the initial installation and the lengths were found to be either too short or too long to make a correct connection to the ALQ-126. This means that undue pressure must be applied on the RF line to get it into position for connection to the ALQ-126. This results in damage to the ALQ-126 connectors and to the RF line.

f. (U) A problem encountered in both the A-6 and A-7 aircraft was ALQ-126 Connector 3J15 and the wire bundle to it. This wire bundle contains the tagging and blanking signals as well as the CLG (Command Link Guidance) signals from the ALR-45 Homing and Warning Receiver and ALR-50 Radar Guidance Receiver. Several cases were found in which pins in the connector had not been adequately seated in the connector body so that there was no electrical contact between the pins and the ALQ-126. Another recurring problem was wire breakage in the wire bundle at the connector. This was due to the size of wire used and the tight routing and bending of the wire bundle required when making the connection to the ALQ-126. Care should be taken that the connection is adequately made at the initial installation and that all the pins are seated. Additional problems were found in the wiring bundles in which wires were either not connected or were routed to the wrong equipment. These are initial problems which should be corrected during a quality assurance check of the initial installation.

g. (U) Times Wire & Cable right-angle connectors, are used to connect the coaxial cables to the ALQ-126 in the A-7B aircraft and in the aft installation of the A-6 aircraft. These right-angle connectors are of the replaceable front-end type which can be disconnected from the cable. In several cases the connectors were found to be unscrewing at the wrong junction in the connector body. This resulted when the back-end coupling nut was screwed onto the coaxial cable so tightly that pressure on the right-angle connector caused rotation at the incorrect junction. This degraded the RF performance of the coaxial line and therefore the overall effectiveness of the system. In one aircraft the connector was completely missing and assumed lost in the aircraft. This connector problem was not as serious in the A-6 aircraft due to the physical constraints of the installation, but since it does use the same type of connector the problem could occur there also.

h. (U) An A-6 aircraft problem was with BNC connectors in the CLG video lines from the ALR-50 Radar Guidance Receiver to the ALQ-126. Due to vibration the bayonets on these connectors had been worn to the point that the mating connectors would not stay in place causing loss of the CLG signal.

i. (U) A recurring problem on the A-7 aircraft was loosening of connectors on RF hardlines in the low and mid-band radome area. In all instances in which the connectors were found loose there were no safety wires on the connectors. Safety wire must be used on all RF connectors, especially those in the low and mid-band antenna radome area. Otherwise, vibration during flight loosens the connectors which degrades effectiveness of the ALQ-126.

j. (U) Several control box problems were found, especially on the A-7 aircraft. With the ALQ-126 control box in the OFF position and the REPEAT button depressed, the ALQ-126 still operates. This does not cause damage to the unit; however, a significant amount of maintenance effort may be expended in troubleshooting the problem if this condition were not known to exist. Another problem experienced was reversed wires in one of the control boxes between the INOP and the REPEAT light indicators. Although not affecting performance this would be confusing to the pilot. The relay assemblies through which the control functions pass also caused several problems that were corrected simply by reseating the relay assembly into its card holder.

303. (U) ALQ-126 Test. The following paragraphs discuss points of interest in the use of the ALQ-126 self-test and the ALM-141 Organizational Level ALQ-126 Test Set.

a. (U) Self-test fail indications experienced during the EWJT have exhibited some erratic characteristics. Standard procedure was for the pilot to perform a self-test for the ALQ-126 before and after a mission. In several instances of reported self-test failures, the support personnel subsequently repeated the self-test and found that the system was "go." Probably other systems in the aircraft (e.g., radar altimeter) were being operated during the self-test of the ALQ-126 causing a "no go" for the system. In some cases the ALQ-126 may not have been allowed to time-out on the initial turn on before self-test was initiated thus causing erroneous self-test no go's. The time-out cycle may be inadvertently reinitiated if the AC power in the aircraft fluctuates during operation. Whenever this happens the pilot must turn the equipment off and then recycle through the turn-on procedure, allowing the time-out cycle to complete before attempting self-test of the unit. Several of the self-test failures could have been caused by failure of the pilot to follow these procedures.

b. (U) The maintenance philosophy developed and implemented by support personnel during EWJT was intended to provide sufficient numbers of fully operational ECM equipments to support the exercise schedule. The initial efforts of using the ALM-141 were directed to completely checking installed ALQ-126s to verify the total interface with the ALR-45/50 RHAW receives and other aircraft systems providing blanking to the ALQ-126. Once the initial checks were accomplished, use of the ALM-141 was scheduled to verify continued integrated system performance. A schedule was established such that no aircraft went longer than 5 days without an ALM-141 check. The ALM-141 was used every time there was a suspected failure and each time an ALQ-126 was replaced in the aircraft.

c. (U) Repeated checks with the ALM-141 indicated that even after the initial problems were solved, there were subsequent failures continuing to occur at a rate which did not decrease during the exercise. This points to the need for continued periodic checks with the ALM-141 Test Set to maintain the total installation performance. Testing with the ALM-141 will increase the inflight reliability of the ALQ-126.

d. (U) A reduction in test time was attained by the use of antenna couplers. The ALM-141 test times with the antenna couplers were approximately fifty minutes per aircraft to complete the power out, sensitivity, technique, and interface checks. The use of the antenna couplers has proven to be an effective approach for ensuring the complete RF performance of the system and interface with the other systems in the aircraft.

304. (U) <u>ALE-29 Chaff Dispenser</u>. The ALE-29 experienced very few failures during the exercise. The A-6 aircraft experienced no failures in any of the systems with the exception of two

wiring problems. The actual A-7 aircraft failures included three dispenser failures, four programmer failures, four control box failures, and four wiring failures for a total of fifteen actual failures with five reported failures that were A-799's. Seven failures occurred due to improper reset during system loading.

305. (U) ALE-41 Chaff Dispenser Pod

a. (U) The performance of the ALE-41 during the EWJT was very good. Ten pods were repeatedly used during the length of the EWJT with two reported hardware failures. A program control chassis wire problem was discovered initially with one pod and was corrected. A broken take-up reel on one chaff cartridge was discovered halfway through the exercise with no repair possible due to a lack of spare components. The operational failures were defined in terms of how many chaff cartridge per pod did not properly dispense chaff. These were rated from zero to six failures per pod.

b. (U) Chaff dispenser failures included cases where individual cartridges in a pod failed and cases where all six cartridges failed. Failures of a single cartridge were generally caused by a chaff roll jammed in its cartridge or a torn polyester film in the roll. Failures of all six cartridges were caused by:

(1) Power or control problems in the aircraft preventing the application of electrical power to the pod or,

(2) Inadvertent application of power to the pod before flight, completely jamming the pod with chaff. Of the one-hundred-four pod flights during the EWJT, 21% experienced at least one cartridge failure per pod.

c. (U) The primary maintenance action required on the ALE-41 is the reloading of the pod with chaff after a mission. This requires unloading the six cartridges from the pod; cleaning the pod, loading chaff rolls into the cartridges, and then reloading the cartridges into the pod. This procedure was performed with the pod either on or off the aircraft. The reloading was much easier with the pod off the aircraft and this also minimized chaff spillage near the aircraft. Average time to reload a pod off the aircraft was thirty minutes for a two-man team. Rapid turn-around requires a sufficient number of trained personnel. Very rapid turn-around results if six cartridges are preloaded with chaff rolls before the pod reloading operation starts. To do this, an adequate inventory of spare cartridges is required. Special tools are required including a chaff cartridge stand and hand tools to adjust the chaff rolls and cartridges in the pod.

306. (U) Conclusions

a. (U) The reliability of the ALQ-126 appears to be quite high. The mean-time-between-failure of fifty-nine hours, while not equal to the factory-demonstrated MTBF of one-hundred and fifty hours, derives from a real operational (nonshipboard) and maintenance environment and as such may be more realistic. The failure rate appeared comparable to other ECM systems.

b. (U) The Self-Test function of the ALQ-126 must be used carefully because several variables affect the outcome. Primary power fluctuations, timer status and the operation of other aircraft systems may each cause an incorrect no-go and possibly cause unnecessary maintenance effort to be expended.

c. (U) Testing of ECM systems by using system level tests which require no aircraft interface disconnects is a desirable testing technique. This is particularly true because system status may be radically degraded during interface reconnects after testing is completed. This technique also reduces test time drastically.

d. (U) The maintenance philosophy for the ALQ-126 should require a complete system RF and aircraft interface test conducted after any maintenance affecting the ECM systems and on a periodic schedule. The test schedule should be based upon discovering the installation failures versus unit failures.

e. (U) ECM system maintenance conducted during the EWJT met rather stringent requirements for the operational systems and aircraft. This was evidenced by the fact that few inflight failures occurred. The majority of failures were found during the established ground maintenance procedures which provided a high reliability during the operational flight situation.

[redacted]

SECTION 4

CONDUCT OF THE TEST

401. [redacted] Description of EW Mixes. The flight tests were conducted to determine the relative effectiveness of nine air-to-ground electronic warfare mixes employed in support of tactical strikes into SAM and AAA defended areas. The basic strike force consisted of three divisions of four aircraft. Four IRON HAND, four chaff corridor and/or three EA-6B aircraft were added, as required, for each EW mix. The nine mixes were the following:

a. [redacted] Twelve strike aircraft without the aid of ECM or chaff. This was the baseline, or no ECM condition, established to evaluate other mixes.

b. [redacted] Twelve strike aircraft employing self-protection ALQ-126 ECM and ALE-29 chaff. USAF strike aircraft used ALQ-119-10 pod.

c. [redacted] Twelve strike aircraft employing self-protection chaff and ECM plus four IRON HAND (ARM) aircraft.

d. [redacted] Twelve strike aircraft employing self-protection chaff and ECM plus three EA-6B SOJ (Standoff Jamming) aircraft.

e. [redacted] Twelve strike aircraft employing self-protection chaff and ECM plus four IRON HAND and three EA-6B SOJ aircraft.

f. [redacted] Twelve strike aircraft employing self-protection ECM and chaff plus two EA-6B aircraft escorting with the strike force and one EA-6B SOJ. (This mix was not flown by the USAF.)

g. [redacted] Twelve strike aircraft employing self-protection ECM and chaff plus four IRON HAND, two EA-6Bs escorting with the strike force and one EA-6B SOJ. (This mix was not flown by the USAF.)

h. [redacted] Twelve strike aircraft not employing self-protection ECM or chaff, but accompanied by four chaff corridor seeding aircraft.

i. [redacted] Twelve strike aircraft employing self-protection ECM and chaff and accompanied by four chaff corridor seeding aircraft.

[redacted]

402. [redacted] Attack Scenarios. Two types of attack scenarios were used. One assumed a deep penetration into hostile territory requiring overflight of one defended area to reach a target in the other, then egressing back through the first area. The other scenario assumed a shallow penetration, a target in one defended area, with egress essentially by the shortest route out of defended airspace. In either scenario attacking aircraft simulated delivery of conventional ordnance. See Figure 4-1 for examples of each scenario. This figure also shows IPs used by USN and USAF attack forces. Test planning required four strike missions per flying day, two by each service. To minimize sorties and save fuel, a concept was devised to complete two strikes on the target for each strike group launch. USN aircraft carrying sufficient external fuel were able to restrike without air refueling. USAF aircraft inflight refueled either prior to the first strike or between the two strikes.

403. [redacted] Blue Force Tactics. This section presents a summary of USN and USAF Blue Force tactics. There were no joint USN and USAF missions.

a. [redacted] USN. Strike formation composition depended on the EW mix/scenario being flown. All formations used the standard Alpha strike formation with sections employing a cruise separation initially and moving into an Alpha configuration inbound to the terminal threat area from the IP. Figure 4-2 shows individual aircraft positions within the strike force formation.

(1) Alpha Configuration. The Alpha strike formation positioned aircraft in a balanced finger four within a division with the division in staggered trail. During appropriate EW mixes, IRON HAND sections paralleled the strike group leader on either side of the lead division. When escort was used, the two EA-6Bs paralleled the strike group, one on each side, in trail and below. The Alpha section formation positioned the wingman 200 feet aft, 400 feet abeam and 600 feet below his leader.

(2) Chaff Formation. The chaff corridor seeding formation positioned the seeding aircraft 750 feet abeam each other at staggered altitudes and 6-7 NM in front of the strike leader, as shown in Figure 4-3.

(3) Standard Ingress. The strike force departed the IP at 18,000 to 20,000 feet MSL at 390 KTAS, division in Alpha strike formation, with onboard DECM in Receive mode. Approaching the SAM envelope ECM was placed in Repeat mode or left in Receive mode depending on the type of EW mix being flown.

[redacted]

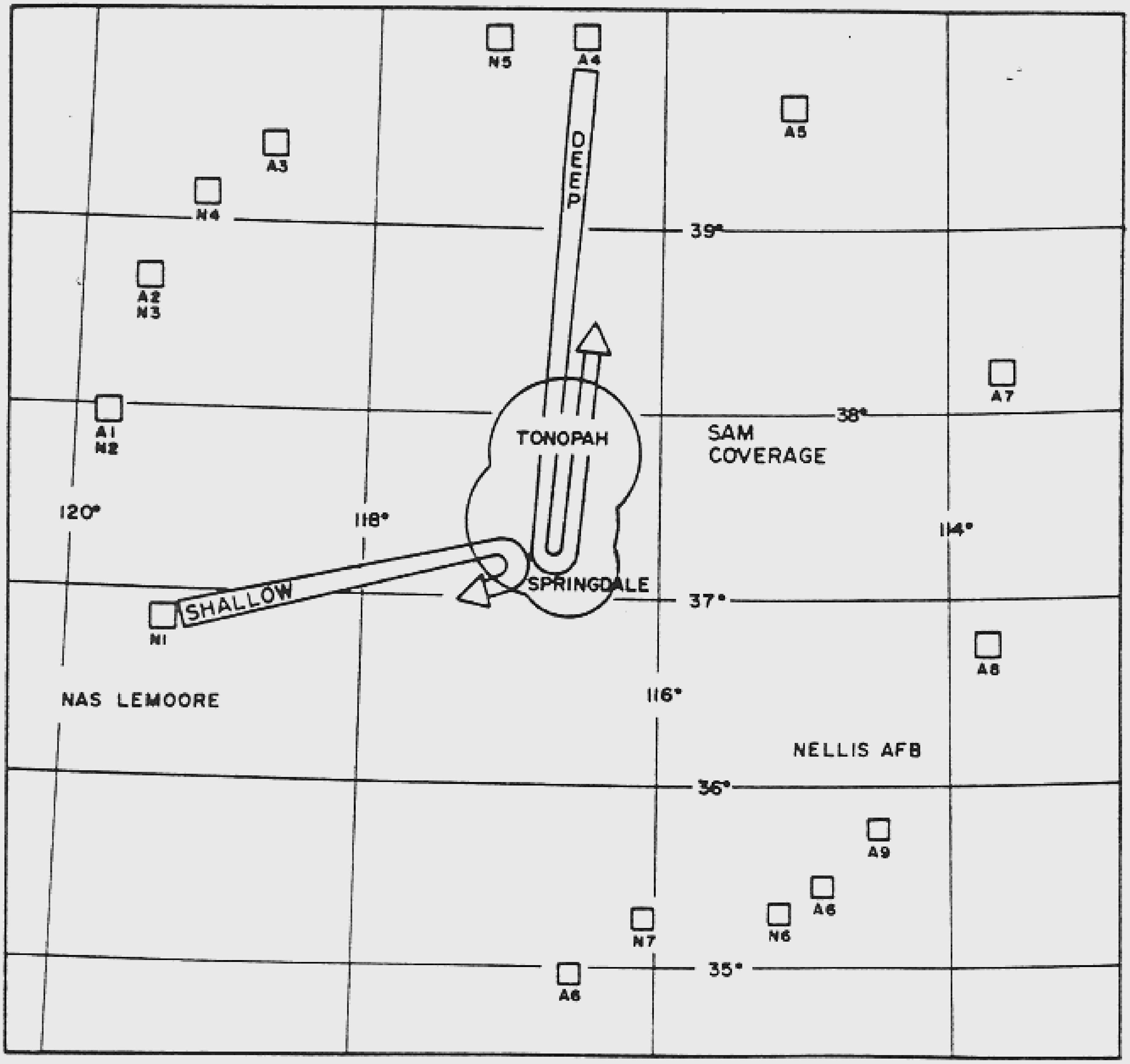

Figure 4-1 [redacted]

USN and USAF Penetration and Initial Points (U)

 [redacted]

[redacted]

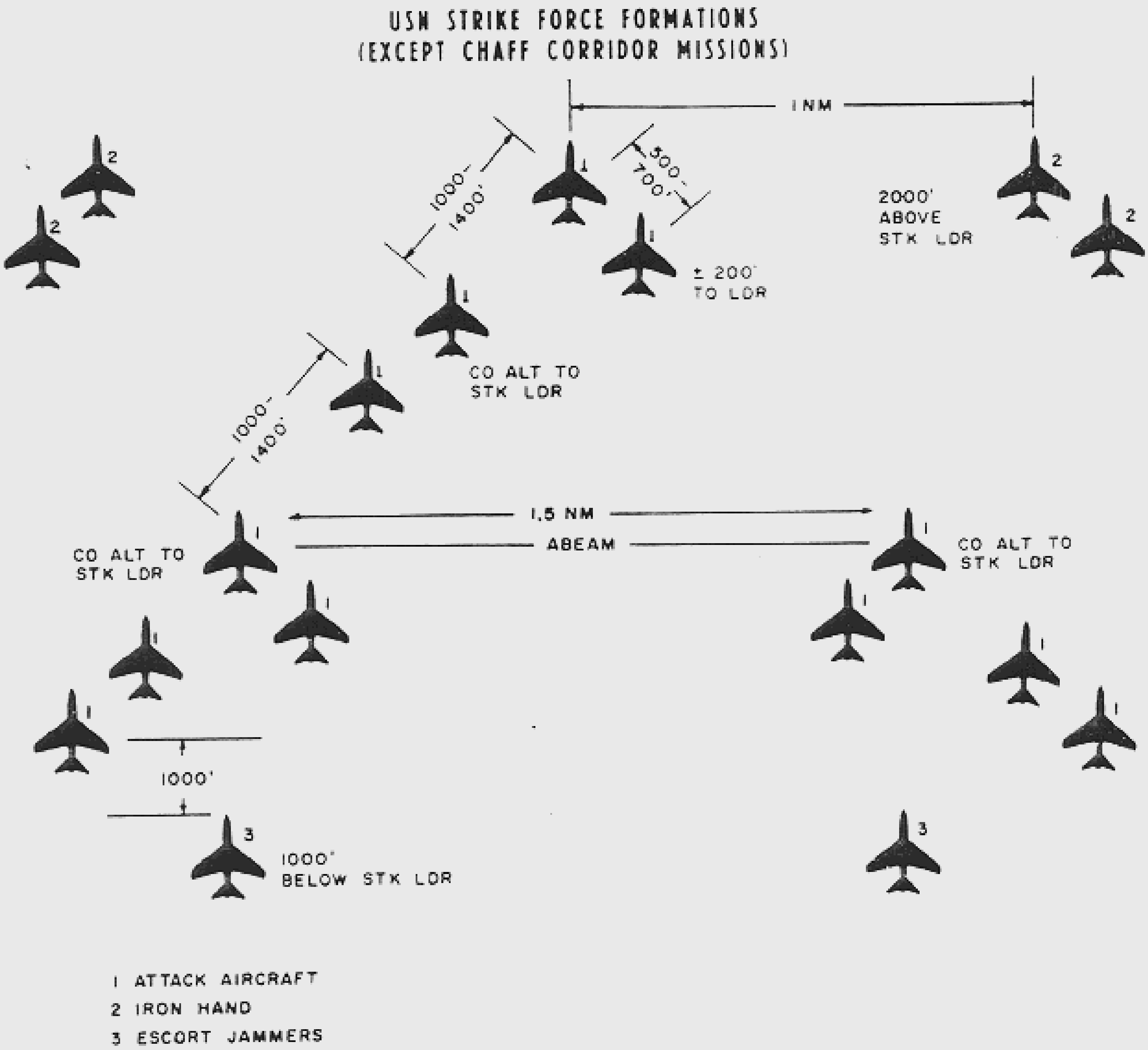

Figure 4-2 [redacted]

USN Strike Formations (U)

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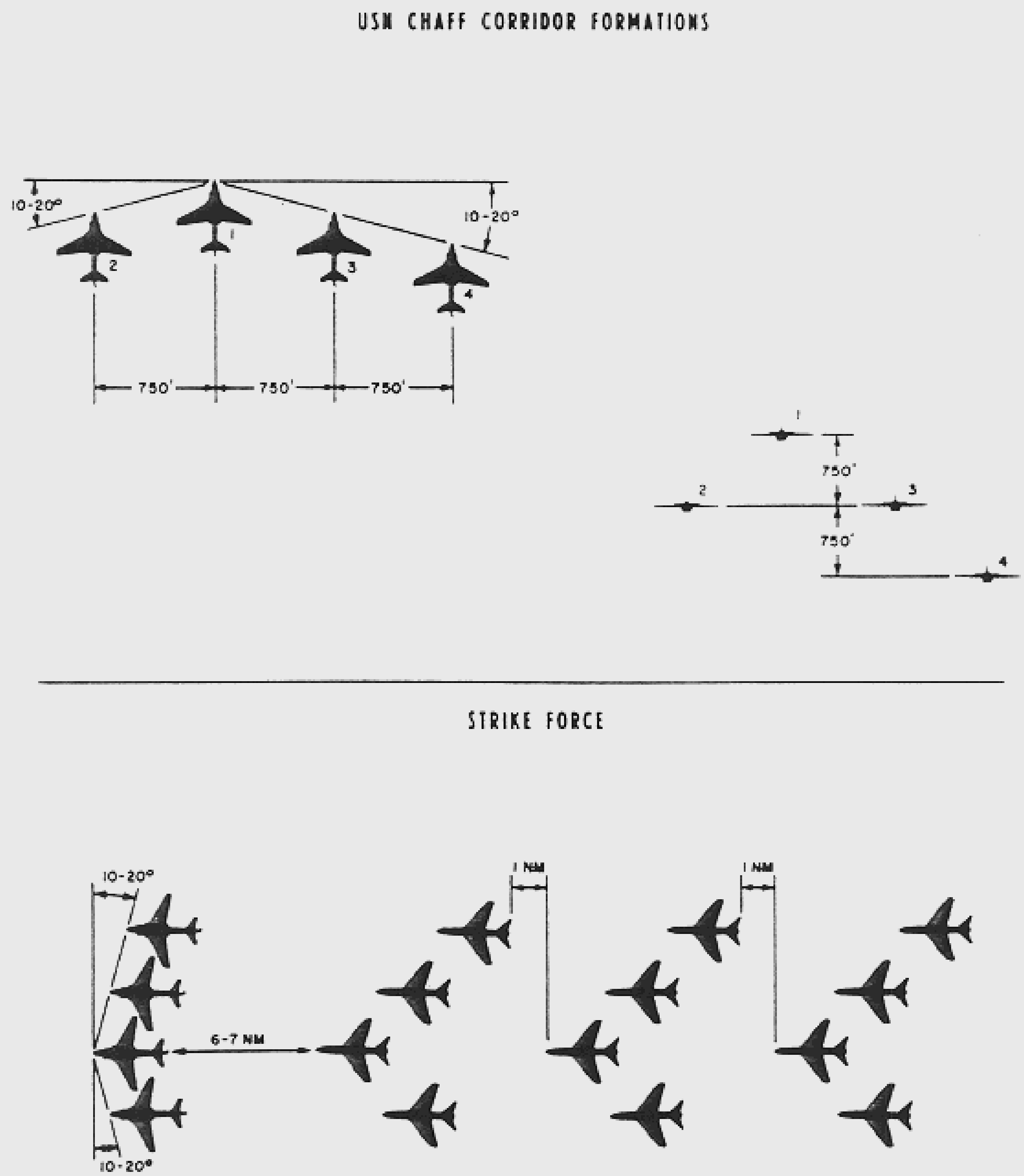

Figure 4-3 [redacted]

<u>USN Chaff Corridor Formations (U)</u>

[redacted]

Divisions maintained a staggered formation with mild jinking but no weave. Divisions did not accelerate prior to roll-in. Airspeed was based on maximum range fuel considerations applicable to the test and is not considered optimum for penetration of any actual threat area.

(4) Chaff Ingress. On chaff corridor missions the strike force entered the SAM envelope in trail Alpha formation with the strike leader 6-7 NM in trail of the chaff seeders. The strike force maintained position inside the chaff corridor using onboard radars to aid in determining corridor boundaries.

(5) Target Area. In the target area and when appropriate to the EW mix being flown, once inside the SAM envelope individual aircraft dispensed ALE-29 burst chaff at pilot option based on RHAW indications. In the target area the strike force executed division roll-ins on prebriefed individual aiming points. Delivery simulated conventional ordnance dive toss using 45° dive and 500 KIAS. Minimum recovery altitude was 3500 feet AGL.

(6) Egress. Section integrity was maintained at all times with division integrity maintained if possible. Division leaders were responsible for maintaining the strike leader in sight and rejoined their divisions with the lead upon exiting the target area. Speed was then reduced to 390 KTAS. The mission terminated upon exiting the SAM envelope.

(7) IRON HAND. Tactics used by IRON HAND aircraft are usually in response to ground air defense actions and do not lend themselves to a specific description. The information provided here describes the general situation.

(a) Ingress: Approaching the SAM envelope IRON HAND aircraft would simulate preemptive AGM-45 launch and then maneuver to positions most advantageous for reaction against possible threats to the strike force. IRON HAND aircraft also provided threat warnings to the strike force on type and bearing of emitters.

(b) Target Area. IRON HAND aircraft would continuously reposition for most advantageous AGM-45 launches against weapons in the target area. Launches were continued preemptively and in response to radiating emitters. Section integrity was maintained. No simulated delivery of ordnance was made other than AGM-45.

[redacted]

(c) Egress. IRON HAND aircraft remained in the target area until the last strike aircraft was outbound and then attempted to maintain advantageous firing positions during retirement with the strike force.

(8) Chaff Seeders. Chaff corridor aircraft employed the following tactics during the mission.

(a) Ingress. After departing the IP, the chaff corridor division maintained a loose cruise formation 6 to 7 NM ahead of the strike force until directed by the strike leader to assume seeder formation, as shown in Figure 4-3. Approaching the preplanned chaff corridor commencement point, the chaff leader directed his division to start drop. All eight ALE-41 dispensers were in operation simultaneously.

(b) Egress. After passing the target, the chaff flight maintained section integrity to the boundary of the SAM envelope, then proceeded to home base as a division.

(9) EA-6B. Each EA-6B ECM support aircraft equipped with five jamming pods flew two types of missions.

(a) Standoff Jamming. Prior to IP time, three aircraft would proceed to 40 NM racetrack orbits aligned along the strike force ingress route remaining outside the SAM envelope. Altitude differential between the EA-6B flight and the strike force was varied between 3000 to 10,000 feet above in an attempt to maintain alignment with the fire control elevation beams. At IP time, the aircraft would commence jamming and would continue until the strike force had departed the SAM envelope on egress. The three aircraft were employed as follows:

1. Aircraft One. The ALQ-99 system on this aircraft was employed against the following early warning and acquisition radars.

BAR LOCK - Two Band 7 pods were used in false target (12 CW subcarriers sweeping at 0.5 MHz/µ sec) covering 150 MHz per transmitter to jam the twelve beams of the two BAR LOCK radars.

FLAT FACE - One Band 4 pod was used with both transmitters using narrow false target (sweeping at 1.5 MHz/µsec) covering 15 MHz per transmitter centered on the two FLAT FACE frequencies. FLAT FACE radars were restricted to two fixed frequencies and the EA-6B to narrow modulations to prevent inadvertent jamming of the RMS-2.

[redacted]

One aircraft assumed an SOJ position just outside the SAM envelope. Modulations employed were basically unchanged from those described for the SOJ missions. CCI assignments and rate slewing were used extensively.

b. (S) USAF. The formations used depended on the EW mix/scenario being flown and the distance of the strike force from the threat area. The four following basic formations were used:

Fluid Four. The standard fluid four formation was flown by each strike flight from IP to a point 5 NM outside the known SAM envelope for all EW mix/scenarios. The flights were spread line abreast for optimum lookout capability as shown in Figure 4-4.

Fluid Weave. At a point 5 NM from the known terminal defense area, each flight of the strike force would assume a weaving formation which provided continuous 360° visual cross coverage and acceptable ECM resolution cell defense against threat radars. This formation, Figure 4-5, was not used for chaff corridor penetrations.

Resolution Cell Weave. This formation was used exclusively in chaff corridors since the 0.5 NM width of the corridor did not provide adequate maneuvering room for the fluid or wingman weave formations without losing the protection of the corridor. Resolution cell weave provided acceptable protection against tracking AAA and SAM threats while allowing the flight to remain within the confines of the chaff corridor, as shown in Figure 4-6.

Wingman Weave (also called the Element Weave). This formation was an additional option to the fluid weave and would also be employed inside the terminal defense area. This formation also provided acceptable ECM resolution cell defense against threat radars, but did not provide continuous 360 degree visual cross coverage. This formation, Figure 4-7, was not used for chaff corridor penetrations.

(1) Tactics

(a) Ingress. The strike force departed the IP at 18,000 feet MSL, 420 KTAS, with flights in staggered trail in fluid four formation with ECM pods in standby. At 5 NM from the known terminal defense area, strike force lead would call "accelerate, pods on/standby." All strike crews selected the appropriate ECM pod transmit position for the ECM mix to be flown as the lead flight accelerated to 500 KTAS. The subsequent two flights delayed acceleration slightly to establish the separation required for the appropriate formation, and began to weave.

[redacted]

USAF STRIKE FORCE FLUID FOUR FORMATION

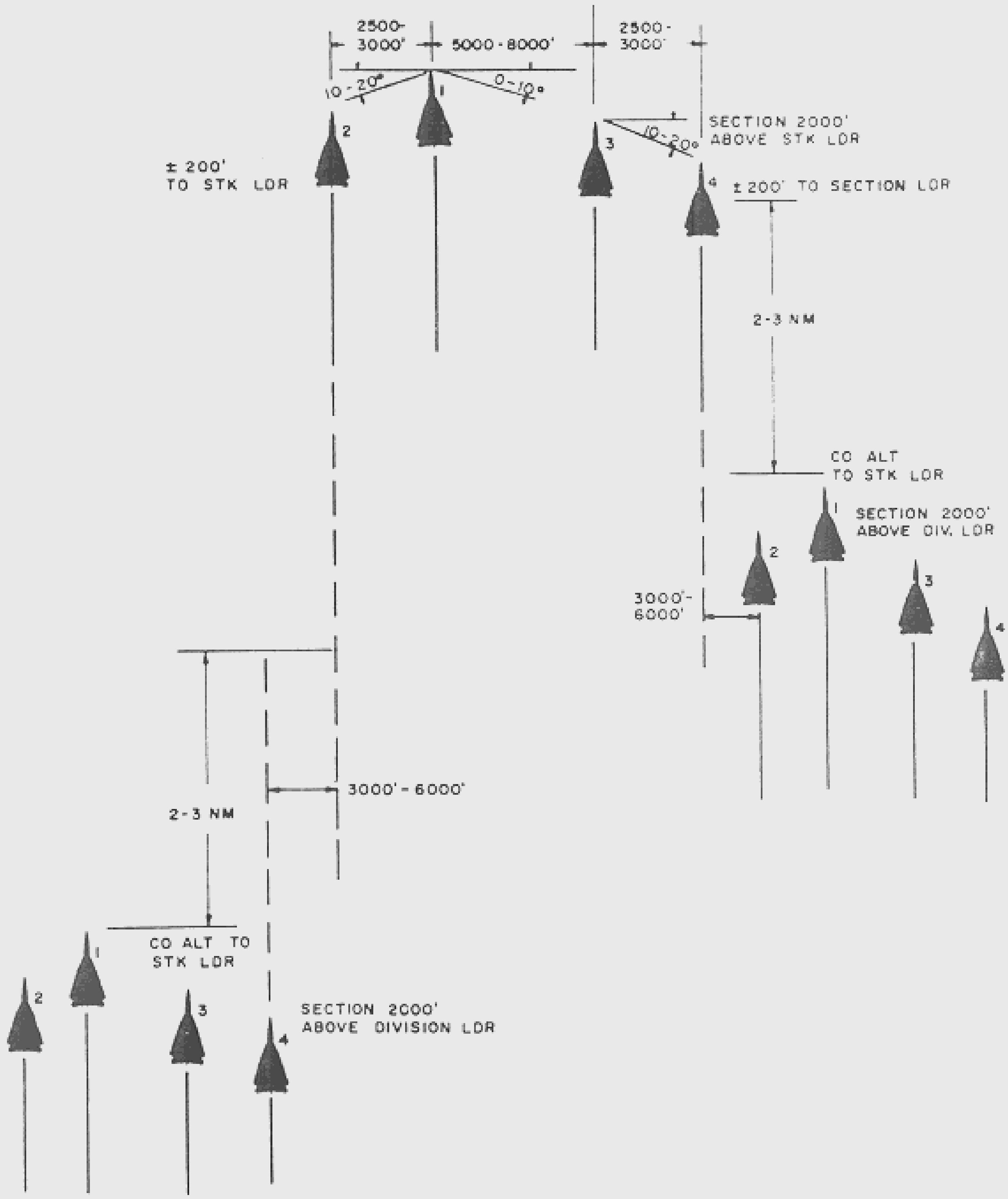

Figure 4-4 [redacted]

USAF Strike Force Fluid Four Formation (U)

[redacted]

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USAF STRIKE FORCE FLUID WEAVE FORMATION

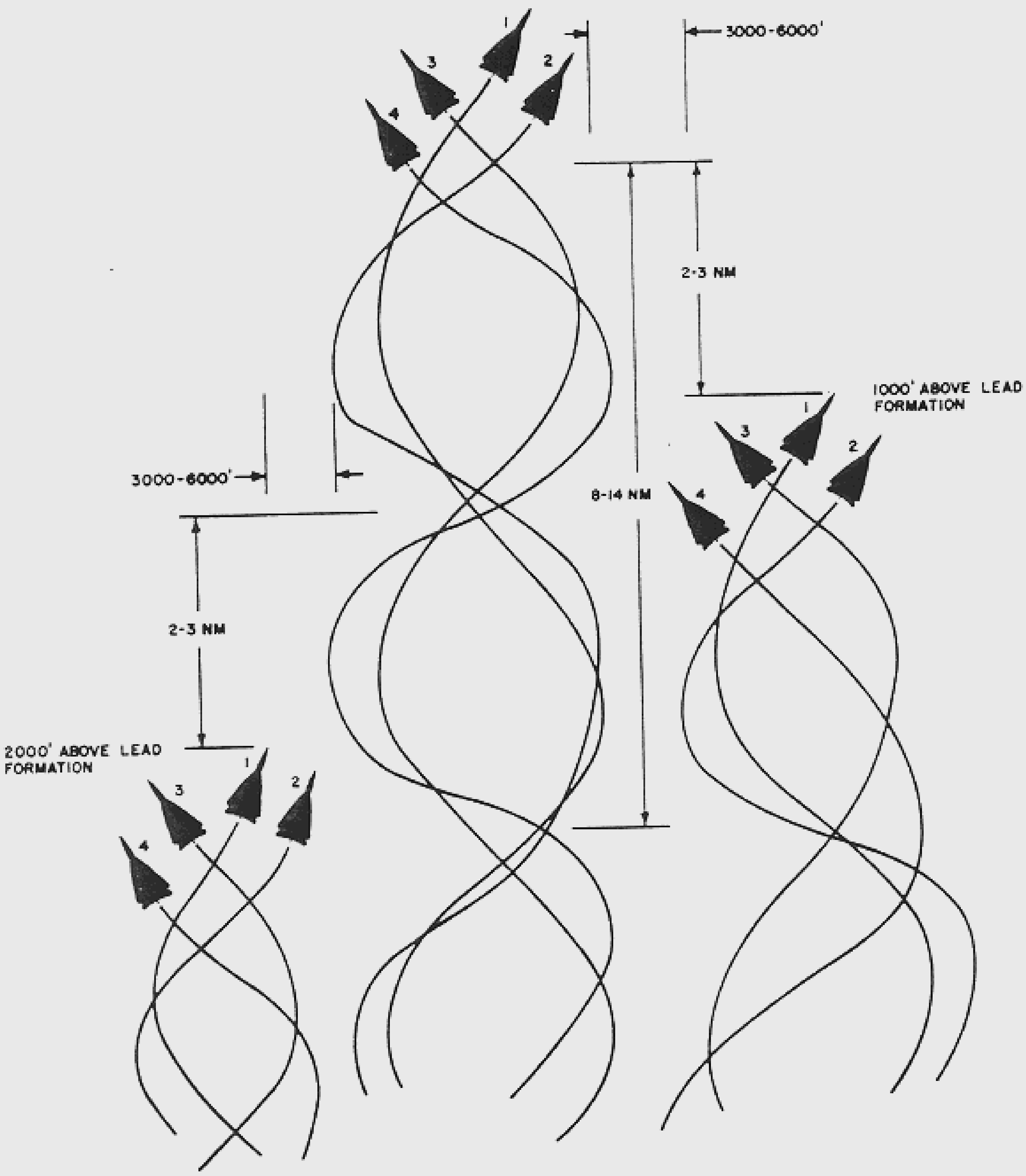
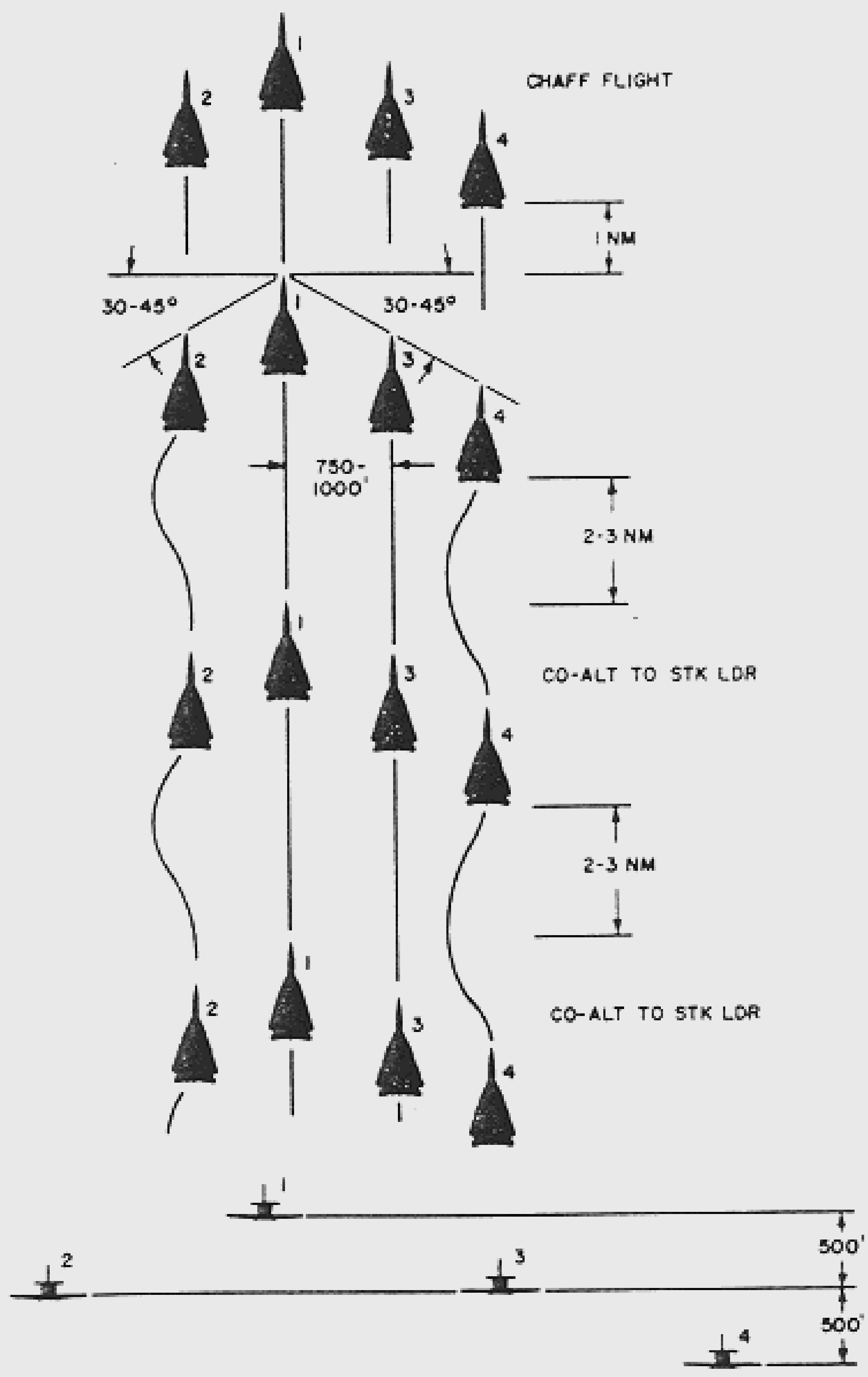


Figure 4-5 [redacted]

<u>USAF Strike Force Fluid Weave Formation (U)</u>

 [redacted]

USAF RESOLUTION CELL WEAVE
CHAFF CORRIDOR PENETRATIONS
FLIGHTS IN TRAIL



NOTE: SECTION LEADERS (1 AND 3) IN STRIKE DIVISIONS HOLD ALTITUDE AND HEADING.
WINGMEN (2 AND 4) INDEPENDENTLY VARY ALTITUDE ±500' AND HEADING TO ACHIEVE RANDOM LATERAL SEPARATION FROM 1 AND 3 RESPECTIVELY OF 500-1500'.

Figure 4-6 [redacted]

USAF Resolution Cell Weave (U)

[redacted]

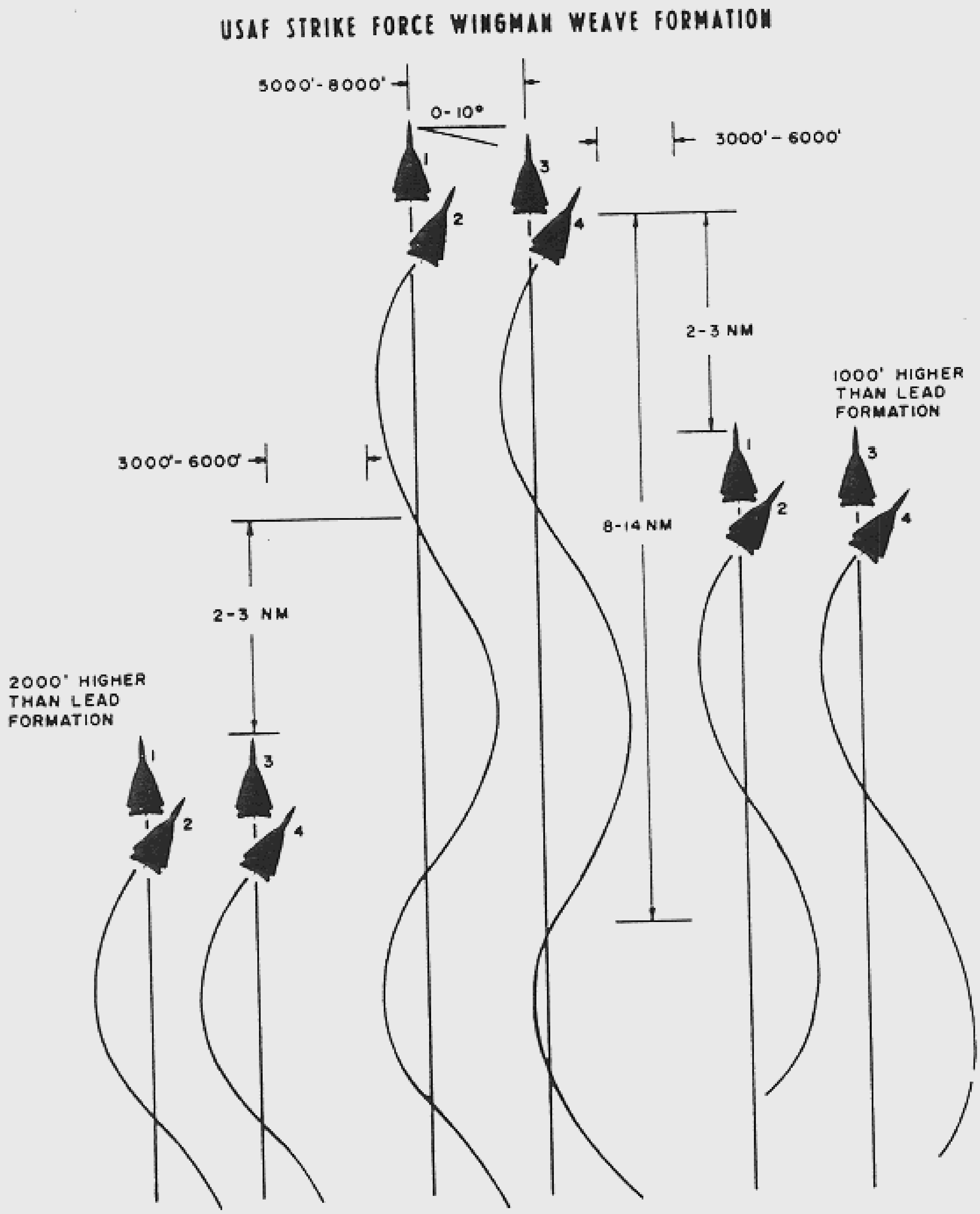


Figure 4-7 [redacted]

<u>USAF Strike Force Wingman Weave (U)</u>

 [redacted]

1. For all EW mixes except the chaff corridor penetration, the strike force entered the threat terminal defense area as flights in staggered trail with each flight using the fluid weave.

2. For chaff corridor penetrations, the strike force entered the terminal defense area as flights in trail with the first strike flight 6,000 feet behind the chaff laying flight.

NOTE

Separation between the chaff flight and the lead strike flight is based on maintaining the strike force within the chaff corridor for test purposes, and should not be considered optimum spacing for other strike force chaff corridor penetrations.

Each flight used the resolution cell weave once inside the chaff corridor and attempted to maintain position until required to exit in the target area.

(b) Target Area. During the penetration of the SAM envelope, flight leaders called for individual aircraft within their flight to employ chaff contained in their speed brakes, for RWR indications of a valid missile launch. Sixty seconds before roll in, strike force leader called "60 seconds." Regardless of the penetration formation used to this point, all aircraft then maneuvered to echelon away from the target, stacked at 500 foot intervals. Each flight used a pod roll in with individual aiming points. Delivery simulated a 520 KCAS, 45 to 50 degree dive toss ripple release at 14,000 feet MSL (8,000 AGL) pickle, a 5g recovery, and a 4,500 feet AGL minimum altitude. Each flight planned a target pull off jinking maneuver to facilitate rendezvous and present random maneuvers to ground defense.

(c) Egress. The same formations and tactics employed during ingress were used for egress. When deep penetrations into high threat areas were simulated, the strike force was required to egress along the same route as ingress with the target as the turning point. Egress formation to the exit point was flight line abreast fluid four. After exiting the terminal defense area, all aircraft in the strike force decelerated to 420 KTAS and aircrews returned ECM pod settings to STANDBY (if applicable).

[redacted]

404. [redacted] Chaff Dispensing Aircraft. The chaff dispensing flight used four basic formations:

a. [redacted] Fluid Four. The chaff flight departed the IP in standard fluid four formation for optimum visual lookout capability until reaching the terminal defense area.

b. [redacted] Chaff Dispensing Formation. At the strike force leader's call of "accelerate, pods on/standby," the chaff flight closed to the formation as shown in Figure 4-8.

c. [redacted] Fluid Weave. Inside the terminal defense area after chaff was depleted, the chaff flight used the fluid weave formation until the chaff corridor was re-entered or until exiting the terminal threat area outside the chaff corridor.

d. [redacted] Resolution Cell Weave. This formation was flown when exiting the terminal defense area inside the chaff corridor.

(1) Tactics

(a) Ingress. The chaff flight departed the IP at 18,000 feet MSL at 420 KTAS, and maintained fluid four formation 1 NM ahead of the strike force from the IP until the strike force leader called "accelerate, pods on/standby." At that call, the chaff flight closed to the dispensing formation, accelerated to 500 KTAS, began dispensing chaff, and selected the appropriate position on the ECM pod control panel. At 500 KTAS, the predicted length of the chaff corridor was 60 NM. When simulating deep penetration profiles, chaff dispensing began 60 NM from the deepest target. For shallow penetrations, chaff dispensing began at the terminal defense area ingress point and continued along the egress route until chaff depletion.

(b) Egress. After passing the target on a deep penetration, the chaff flight would have expended its chaff and would break in the opposite direction of the strike force lead flight roll in, passing the inbound strike force before re-entering the chaff corridor for egress. Once inside the protection of the chaff corridor, the chaff flight would fly the resolution cell weave formation until clear of the terminal defense area. If the chaff flight could not re-enter the chaff corridor, the fluid weave formation was flown until clear of the terminal defense area. Once outside the terminal defense area, the chaff flight would egress in fluid four formation. Because of fuel limitations, chaff seeders in EWJT turned off target and proceeded on the most direct flight route to home base.

[redacted]

[redacted]

USAF CHAFF DISPENSING FORMATION

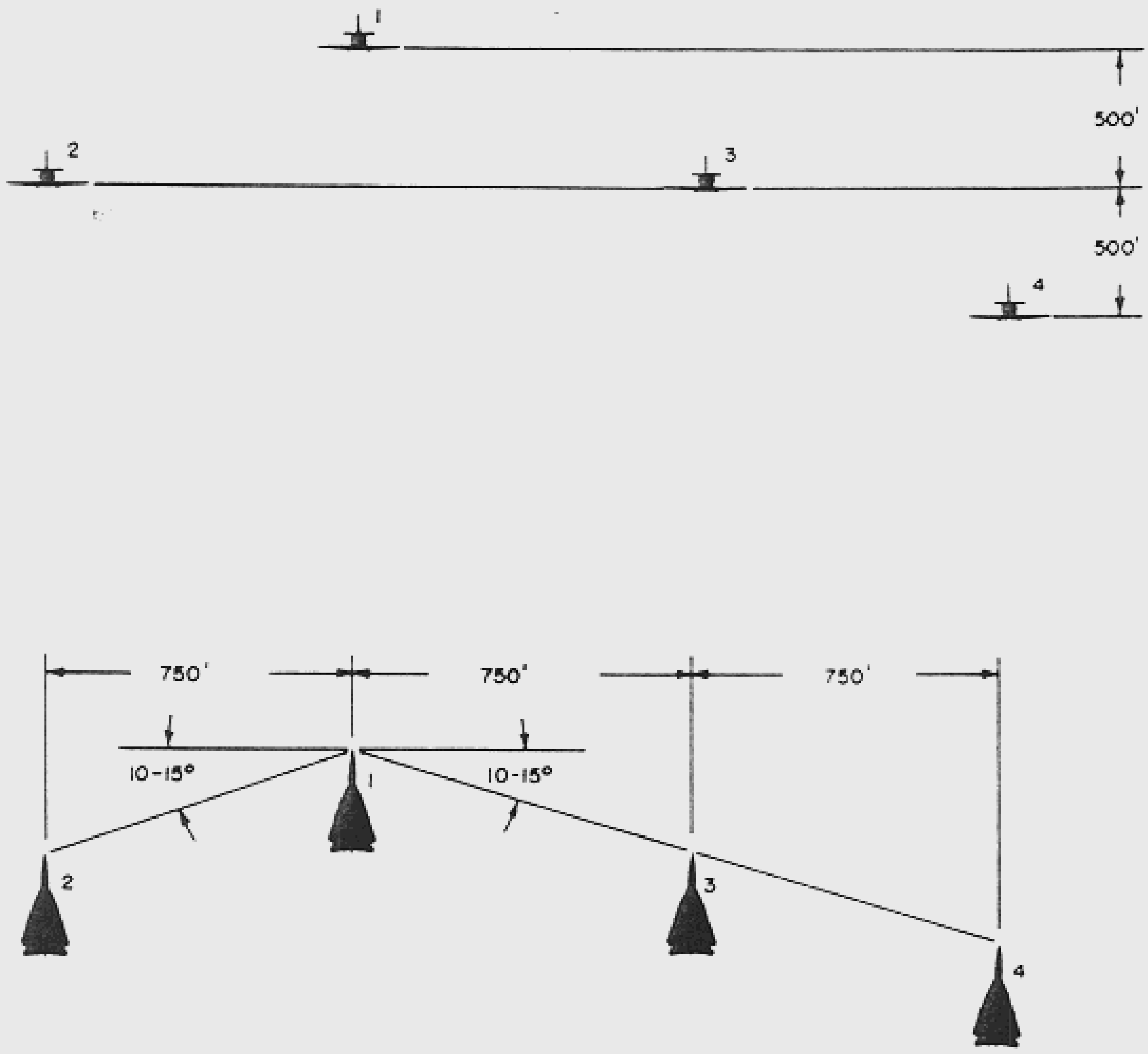


Figure 4-8 [redacted]

<u>USAF Chaff Formation (U)</u>

[redacted]

405. [redacted] WILD WEASEL Aircraft. The WILD WEASEL aircraft maintained a fluid four formation from the IP to the terminal defense area positioned below and in visual contact with the strike flight. Inside the terminal defense area, the WILD WEASEL aircraft maintained element integrity.

Tactics. WILD WEASEL tactics were reactive in nature and cannot be predicted except in general terms, as follows:

(a) Ingress. One element ingressed slightly ahead of the strike force and the second element ingressed with the strike force. Each element attempted to maintain positions between the strike force and the threats. The WILD WEASELs also served as threat warning aircraft for the strike force providing information on the type and relative locations of threat signals.

(b) Target Area. Simulated SHRIKES and AGM-78 STANDARD ARMS were fired either preemptively (AGM-45 only) or at radiating threat radars. Simulated CBU release was performed on visually identified radar sites. Inside the lethal SAM envelope, WILD WEASEL elements attempted to fly in opposite directions to facilitate rapid reaction to the threats. Onboard noise jamming was used to mask simulated ARM launches. The radio call used to indicate simulated ARM launch was "SHOTGUN."

(c) Egress. WILD WEASELs were normally the last aircraft to egress the target area. They continued to launch simulated ARMs and CBU-58 munitions until ordnance depletion for maximum possible simulated threat destruction and suppression. To the maximum extent possible, WILD WEASEL aircraft continued attempts to maintain an optimum position between the strike force and the simulated threat while providing the strike force with threat warning information.

406. [redacted] Red Force Tactics. Red Force doctrine and tactics were formulated from best available intelligence and represented, within test confines, actual methods of operation.

a. [redacted] ADWOC Target Assignment. The ADWOC was responsible for deciding which SAM regiment would engage hostile aircraft. Targets were normally assigned to regiments using the following priority:

Strike Aircraft

IRON HAND

Chaff Seeders

EA-6B

The ADWOC coordinated the handoff of hostile aircraft from one regiment to the other.

b. [redacted] Regiment Target Assignment. Upon receipt of assignment from the ADWOC, the regiment would assess the availability and engagement status of subordinate battalions and then direct one or more battalions to engage the target(s). Normally, battalions were directed to engage at maximum range. Regiment assignments to battalions usually contained firing instructions such as:

(1) Number of missiles and/or AA rounds to be expended.

(2) Range for radar turn-on or AAA open fire.

(3) Corridor within which engagement is to be limited.

c. [redacted] EMCON (Emission Control). Because of the possible ARM threat, EMCON was closely adhered to by all SAM battalions. Fire control radars did not transmit before they were assigned a target unless acquisition data was degraded due to ECM support aircraft jamming. Under these conditions the fire control radar would turn on, search a predetermined sector for 10 to 20 seconds and return to dummy load if no target was detected. This routine would continue every 5 to 10 seconds until a target was detected or battalion directed otherwise.

d. [redacted] ANTI-ARM Procedures. When ARM aircraft were detected in the area, fire control radars would strictly adhere to EMCON plus the following:

(1) If the fire control radar was subjected to ARM attack while engaging a target and simulated SAM's were in flight, the SAM guidance officer would determine if sufficient time existed for SAM impact prior to possible ARM impact. If not, the radar was switched to dummy load.

(2) The SAM radar was switched to dummy load upon notification from another source (i.e., collocated AAA, ACQ radar, Regiment) that the radar was under ARM attack. This procedure was used when the radar was unaware of imminent ARM attack.

407. [redacted] Summary of Blue Forces Sorties and Flying Hours. The following is a summary, by service and aircraft type, of the Blue Forces sorties and flying hours.

a. [redacted] Pretest range calibration, Red Forces and White Forces training missions (3 Sep 1974 thru 9 Oct 1974)

	Sorties	Hours
USN		
A-7B/E	76	217
A-6E	20	65
EA-6B	22	56
KA-3	7	14
Subtotal	125	352
USAF		
F-4D	77	230
F-4E	31	54
F-105G	16	22
KC-97	19	58
Subtotal	143	364
USA		
UH-1B	N/A	811
Total	268	1527

b. [redacted] EWJT Phase II Main Test (10 Oct 74 - 22 Nov 74)

	Sorties	Hours
USN		
A-7B/E	487	1161
A-6E	163	417
EA-6B	123	249
KA-3	17	38
Subtotal	790	1865
USAF		
F-4D	464	1242
F-105G	60	77
KC-97	124	380
Subtotal	648	1699
USA		
UH-1B	N/A	564
Total	1438	4128
Grand Total	1706	5655

[redacted]

SECTION 5

DESCRIPTION OF MATERIEL

501. [redacted] Blue Forces Aircraft. The following Blue Force aircraft were used in the roles and numbers per mission indicated:

a. [redacted] Strike Force

USN - 8 A-7B/E and 4 A-6E
USAF - 12 F-4D

b. [redacted] IRON HAND or WILD WEASEL (ARM)

USN - 4 A-7E
USAF - 4 F-105G

c. [redacted] Chaff Corridor Seeders

USN - 4 A-7B/E
USAF - 4 F-4D

d. [redacted] Support Jamming

USN - 3 EA-6B [SOJ and EJ (Standoff Jamming and Escort Jamming)]
USAF - 3 USN EA-6B (SOJ only)

502. [redacted] Aircraft EW Equipment. Airborne ECM equipment used by the Blue Forces was as follows:

a. [redacted] Strike Force

USN A-7B/E

1 ALQ-126 DECM, ALE-29 with RR-129 chaff, ALR-45/50 RHAW

USN A-6E
2 ALQ-126 DECM, ALE-29 with RR 129 chaff, ALR-45/50 RHAW

USAF F-4D

1 ALQ-119-10 DECM noise pod, 1 APS-107 RHAW

[redacted]

b. [redacted] IRON HAND or WILD WEASEL (ARM)

USN A-7E	Strike configuration plus two captive ATM-45 SHRIKE. Each aircraft was allowed to simulate four SHRIKE firings.
USAF F-105G	1 ALQ-105 DECM/noise blister 1 APR-35 radar acquisition and analysis system 1 ALR-46 RHAW 2 captive ATM-45 SHRIKE. Each aircraft was allowed to simulate four ARM firings. Two aircraft simulated AGM-45 and AGM-78. Two aircraft simulated AGM-45 only.

c. [redacted] Chaff Corridor Aircraft

USN A-7B/E	Strike configuration plus 2 ALE-41 chaff dispensers with 6 rolls each of RR-171 chaff
USAF F-4D	Strike configuration plus 2 ALE-38 dispensers with 2 rolls RR-156, 2 rolls of RR-167B and 2 rolls RR-163 chaff in each dispenser

d. [redacted] <u>EA-6B Support Jamming Aircraft</u>. ALQ-99 jamming pod configurations are provided below.

(1) Standoff Jamming Only (one aircraft).
Two Band 7 track receiver pods (E/F Band)
One Band 7 exciter pod
One Band 4 pod (C band)
One Band 2 pod (A band)

(2) Escort and/or Standoff Jamming (Two aircraft).

Aircraft One
- Two Band 9 pods (I band)
- One Band 8 pod (G band)
- Two Band 7 exciter pods

Aircraft Two
- Two Band 9 pods
- Two Band 8 pods
- One Band 7 exciter pod

503. [redacted] Red Forces Radars. Listed below are descriptions of simulated threat radar equipments. Figure 5-1 gives geographical locations.

a. [redacted] Early Warning. Two BAR LOCK type radars were used as the primary source of early warning information to the Integrated Air Defense System. Each of these radars has six separate beams on six different frequencies from 2700 to 3100 MHz. Medium altitude detection range of an A-7 size target is about 175 NM.

b. [redacted] Acquisition

(1) AN/MSQ-T8. This is a simulation of the Soviet SPOON REST A aquisition and early warning radar operating at about 150 MHz. Medium altitude detection range of an A-7 size target is about 90 NM. This system served as the aquisition radar for the Springdale Regiment FAN SONG B and E SAM systems and provided a backup early warning function if needed.

(2) AN/MPQ-T7. This is a simulation of the Soviet FLAT FACE acquisition and early warning radar operating from 830 to 890 MHz. Medium altitude detection range of an A-7 size target is about 125 NM. This system served as the acquisition radar for the Springdale Regiment LOW BLOW with a backup early warning function when needed.

(3) AN/MPS-35. This is a simulation of the Soviet FLAT FACE with the same operating characteristics as the MPQ-T7. This system served as the acquisition radar for the Tonopah Regiment LOW BLOW with a backup early warning function when needed.

(4) Two additional SPOON REST type acquisition radars were located in the Tonopah area and provided inputs to the Tonopah Regiments FAN SONG B and E SAM systems.

c. [redacted] Surface-to-Air Missile Radars

(1) AN/MPQ-T1

(a) This system has the capability of simulating the Soviet FAN SONG B, E, or LOW BLOW systems. Two systems were used to simulate FAN SONG B operating from 2900 to 3100 MHz with a maximum tracking range of 50 NM. The maximum missile range for this system is 19 NM and minimum missile range is 6 NM. One system was located in the Tonopah area and the other in the Springdale area.

[redacted]

RADAR SIMULATIONS

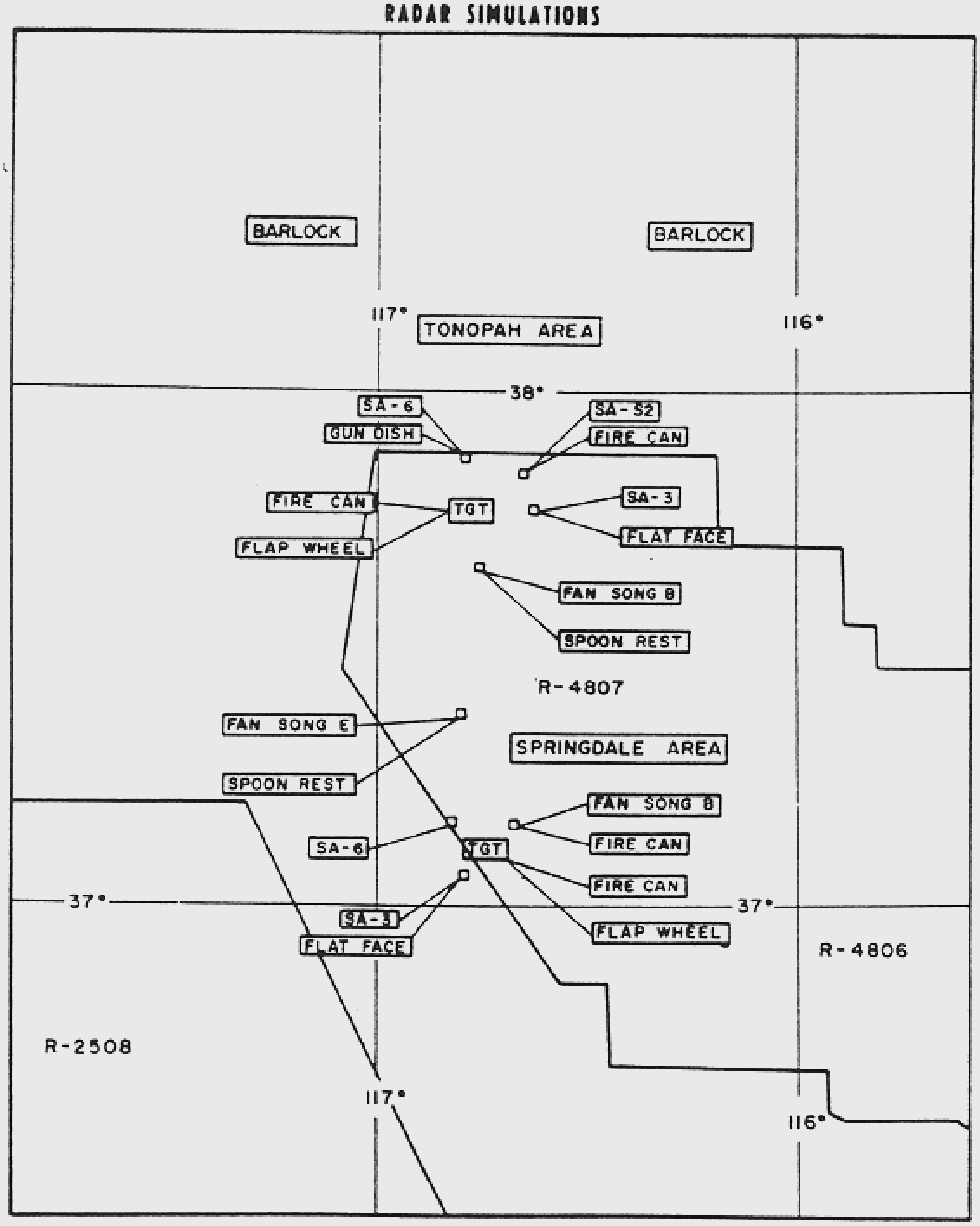


Figure 5-1 [redacted]

Simulated Threat Radar Locations (U)

[redacted]

[redacted]

(b) One system was used to simulate the FAN SONG E operating from 4900 to 5100 MHz with maximum tracking range of 35 NM. The maximum missile range for this system is 27 NM and minimum missile range is 5 NM. This system was located in the Springdale area.

(c) One system was used to simulate the LOW BLOW (SA-3) operating from 9100 to 9400 MHz with a maximum tracking range of 20 NM. The maximum missile range for this system is 12 NM and minimum missile range is 3 NM. This system was located in the Springdale area.

(2) AN/MPQ-47E. This is a simulation of the Soviet FAN SONG E SAM system. Comments apply from AN/MPQ-T1/FAN SONG E above. This system was located in the Tonopah area.

(3) AN/MPQ-52. This is a simulation of the Soviet LOW BLOW (SA-3). Comments apply from AN/MPQ-T1/LOW BLOW above. This system was located in the Tonopah area.

(4) MPQ-XX. Two of these systems were built by the Naval Weapons Center to simulate tracking and missile guidance radars associated with the Soviet STRAIGHT FLUSH (SA-6) with a maximum tracking range of 17 NM. The maximum missile range for this system is 12 NM. The minimum missile range is 2 NM. One system was located in the Tonopah area and the other in the Springdale area. A NIKE acquisition radar was used to simulate the acquisition portion of the STRAIGHT FLUSH. No tracking or missile miss distance data is available from this simulation. It is to be considered as a signal radiating in space.

d. [redacted] Anti-aircraft Gun Control Radars

(1) AN/MPS-9. This is a simulation of the Soviet FIRE CAN fire control radar used with 57 mm, 85 mm, and 100 mm anti-aircraft guns. This radar operated from 2700 to 2900 MHz with a maximum radar tracking range of 20 NM. Two MPS-9s were located in the Tonopah area, one near the target complex and the other collocated with the FAN SONG E. Two other MPS-9s were located in the Springdale area, one near the target complex and one collocated with the FAN SONG B.

(2) AN/M-33. This is a simulation of the Soviet FLAP WHEEL fire control radar used with 57 mm anti-aircraft guns. This radar operates from 8500 to 9600 MHz with a maximum tracking range of 24.7 NM. Two M-33s were used, one near the Tonapah target complex and one near the Springdale target complex.

[redacted]

(3) One special system was built by the Naval Weapons Center to simulate the Soviet GUN DISH fire control radar used with track vehicle mounted quad 23 mm guns (ZSU-23-4). This radar operates from 14,500 to 15,300 MHz with a maximum tracking range of 10.8 NM.

504. [redacted] Red Forces Command and Control. The following is a summary of the Red Force Command and Control structure.

a. [redacted] Early Warning Net. The early warning radar net was responsible for maintaining surveillance of all aircraft operating within and around the boundary of the defended area. Each radar was assigned an area of responsibility for tracking and reporting all aircraft activity to the filter center.

b. [redacted] Filter Center. The filter center received, consolidated, and evaluated the early warning data and provided the air situation picture to the ADWOC (Air Defense Warning and Operations Center). Identification of friendly and hostile tracks was accomplished and formed into a composite air situation manually plotted in the filter center. Tracks of hostile targets were passed to the ADWOC and an air situation broadcast was made to field units.

c. [redacted] ADWOC. The ADWOC was responsible for operational control of air defense. Target assignment and the decision to commit weapons systems were made by the ADWOC.

d. [redacted] Air Defense Regiments. Two regiments, one defending the Tonopah area and the other defending the Springdale area, received assignments from the ADWOC and delegated targets to SAM battalions and AAA batteries in their area of responsibility. Four SAM battalions in each target area received assignments from the appropriate regiment and were responsible for engaging all assigned ingressing and egressing hostile aircraft. Seven AAA batteries were responsible for point defenses and a barrier defense function when required. AAA batteries were subordinate to the SAM battalions.

505. (U) White Forces Instrumentation. The instrumentation systems used during Phase II EWJT were divided into the following general tabulation:

Reference Tracking Systems	- Long and short range
Event Recording Systems	- Ground radar event data - Aircraft event data - Audio recordings - Scope photography - Meteorological recordings
Field Intensity Measurement Array	

a. (U) Reference Tracking Systems

(1) Long Range Reference Tracking. These systems provided a record of Blue Force aircraft flight paths from IPs (Initial Points) to penetration of the terminal defense area. The area covered was donut shaped with approximately inner and outer radii of 25 and 150 NM. Two systems were used, the AMV (Area Monitor Van) and the AMS (Area Monitor System). Both systems consist of an AN/TPX-46 IFF interrogator set, an aircraft position recorder, and a visual track data display capable of handling 40 targets simultaneously. Both systems transmitted data to the TOCC (Test Operations Control Center) at Nellis AFB, Nevada. Data transmitted was aircraft range, azimuth, height, identity and time of day. In addition to the AMV and AMS, IFF inputs were received from several FAA sources in the test area.

(2) Short Range Reference Tracking System. Blue Force aircraft position recording inside SAM coverage was accomplished using the RMS-2 (Range Measurement System). RMS-2 uses multilateration techniques to obtain precise position data for 30 or more aircraft fitted with a special pod discussed in a subsequent paragraph. The system will determine position from ground level to above 20K AGL in X, Y, and Z coordinates with an accuracy of approximately 3 meters in X and Y and 10 meters in Z. The EA-6B did not carry an RMS-2 pod due to EMI and station limitations.

(a) RMS-2 Operational Elements. The RMS-2 system consists of the following elements:

1. One C-station (Control Station) containing the central computer and operating equipment. The C station exercises command and control of the RMS-2 system.

2. Eighteen to twenty-three A stations positioned at known ground locations. On command of the C station, selected A stations interrogate airborne pods, receive the pod response and relay pod data to the C station. The A station

transmits a range pulse to a specific aircraft pod and measures the elapsed time until the pod response is received. This time interval, translated to distance, is sent to the C station. Distances from three or more A stations to an aircraft pod are then used by the C station computer to determine precise aircraft position. Update and recording of position information was accomplished every quarter-second on each Blue Force strike aircraft.

3. The third RMS-2 element is the MICRO-B pods hung on individual aircraft. One small, solid state MICRO-B unit is mounted inside a USN APX-82 pod shell. Receiving and transmitting is accomplished by an antenna similar to that used for TACAN mounted on the bottom of the pod. The unit can be suspended from any bomb rack (14 inch suspension) and requires 28 volt DC aircraft power. The basic function of the MICRO-B pod is basically a transponder which reacts to pulses sent from ground A stations.

(b) Use of RMS Data. The RMS-2 was the primary system used to determine true aircraft position. After certain computer techniques are applied to the data, the RMS-2 and the fire control radar target position will be virtually the same in a no ECM environment. Measurement of target position differences between RMS-2 and the fire control radar in an ECM environment can be used in evaluating the effectiveness of ECM systems and tactics.

b. (U) Event Recording Systems. Six different types of event recording systems were used in addition to meteorological data provided by USAF weather personnel at Nellis AFB, Nevada.

(1) GEIS (Ground Event Instrumentation System) and PBS (Portable Battery Set). These two systems perform essentially the same function. The GEIS is the newer of the two and is the primary system used to collect and record data on the performance of early warning, acquisition and tracking radars as well as human events that occur at these radars and other points in the command and control chain. The system collects and records the following data:

(a) Mission identification code

(b) Real time

(c) Up to thirty-two different radar and ECCM functions or switch positions such as mode of operation (search or track), guidance on, high or low PRF, use of FTC, STC, MTI, etc., and radar on and off times.

(d) Target position data from SA-2 and SA-3 radars.

(e) Received signal strength, both average and peak, from up to four radars.

(f) Entries from up to five Automatic Event Recorder (AER) units. The AER unit is discussed below.

(2) AER (Automatic Event Recorder). The primary purpose of these units is to input data to the GEIS concerning human functions occurring at all levels of command and control. An observer uses a keybox to enter codes for RED FORCE decision making, manual tracking, assignment of track numbers, assignment of targets, weapon status and other elements of the human functions in a manual air defense system.

(3) Audio Recordings. Multichannel voice recorders were used to record the early warning radar and the communications nets for fire control radar, air/ground, and test operations control. One track of each recording contained range time. Portable voice recorders were used to record pilot/crew comments in selected aircraft not normally equipped with audio recording systems.

(4) Scope Photography. Thirty-five millimeter still cameras were used to photograph the displays at all radars not equipped with video recorders. Photographs, containing range time, were made every 10 seconds. Video recordings of SAM radar displays, also showing range time, were made at radars so equipped.

(5) F-105 (WILD WEASEL ARM) Airborne Recorder. F-105G aircraft are equipped with the AYH-1 (ARRS-100) recording system. Thirty separate items of information are collected from the aircraft flight instrumentation, navigation systems, communications equipment, AGM-45 system, RHAW, and ARM (Anti-radiation Missile) acquisition receivers.

c. (U) EA-6B EXCAP Airborne Recorder. EA-6B EXCAP aircraft are equipped with the UNIVAC 1540 MOD 6 recording system. Information is collected from the aircraft navigation systems and ALQ-99 tactical jamming systems. Navigation information extracted from the recorder was used as the primary source for aircraft position rather than data from the RMS-2 pod carried on other strike force aircraft. This was done primarily because the EA-6B ALQ-99 Band 4 pod jamming severely degrades RMS-2 pod performance. In addition, employment of five ALQ-99 pods on the EA-6B leaves no open stations for external carriage.

d. (U) FIMA (Field Intensity Measurement Arrays. These systems were used to monitor and measure the RF radiation level over the test area. One site was located in each target area equipped with RF signal analysis equipment to measure frequency from 150 to 15,000 MHz, determine bearings to the signal source and measure relative signal power levels and modulation type. When necessary FIMA systems were used to troubleshoot simulations and effect expeditious repair. Information was recorded on magnetic tape and scope photography.

506. (U) Communications. A combination of mobile and fixed leased facilities and government equipment was used to link the two target areas on the Nellis ranges with the TOCC at Nellis AFB, Nevada. In addition, intra-site and intra-TOCC communications were provided. A total of over 68 voice circuits and 14 high-speed data circuits were used.

a. (U) Long Line Communications. A microwave system was used to transmit voice and data between the target areas and the TOCC.

b. (U) Intra-Site Communications. The microwave system also provided intra-site communications in the Tonopah area. U.S. Army field communications equipment and personnel provided intra-site communications in the Springdale area.

c. (U) TOCC Internal Communications. All data and voice circuits were terminated and distributed within the TOCC at Nellis AFB. A leased key system was used for inter-communications inside the TOCC.

207. (U) Data and Collection Reduction. The data reduction effort was divided into three main areas: data collection, real-time processing, and monitoring and postmission processing. The Xerox Sigma 9 computer with associated high speed printers, plotting equipment and real time displays, all located at Nellis AFB, was used for data reduction work.

a. (U) Data Collection. Automatic data collection was accomplished using the equipment described above. Manually collected data was logged using White Force observer personnel at all radars, command and control areas and at Blue Forces operating bases.

b. (U) Real Time Processing and Monitoring. Real time displays of textual data and graphics were not available for the major portion of the test. The ability to maintain quality control of incoming data and report quick-look mission results in real time would have been desirable. Subsequent to completion of live testing, the real time capability, including the capability to replay EWJT missions, is now in operational use and can be used for limited analysis.

c. (U) Post Mission Processing. Two forms of data are produced for each mission. First, a series of tables are produced showing all events which occurred during the mission. These contain information such as aircraft position, number of SAM engagements, ECM/ECCM actions, radar tracking data and reference system data. Second, a series of color coded plots show aircraft tracks as taken from reference systems and Red Force radars.

SECTION 6

SUPPORTING ACTIVITIES

601. (U) USN Tactical Units. All aircraft, aircrews, ground support equipment and personnel, except KA-3 tankers, operated from NAS Lemoore, California, under the direction of COMLATWINGPAC. Tanker operations in support of the EA-6B were conducted from NAS Alameda. The following units participated:

VA-34, NAS Oceana - 5 A-6E

VA-46, NAS Cecil Field - 4 A-7B

VA-52, NAS Whidbey Island - 4 A-6E

VA-72, NAS Cecil Field - 4 A-7B

VAQ-134, NAS Whidbey Island - 5 EA-6B

VA-192, NAS Lemoore - 8 A-7E

VA-195, NAS Lemoore - 8 A-7E

CVWR-20 and CVWR-30, NAS Alameda - KA-3 as required.

602. (U) USAF Tactical Units. Strike and chaff aircraft, aircrews, ground support equipment and personnel operated from Nellis AFB, Nevada. ARM aircraft, home-based at George AFB, California, staged from Nellis AFB as required. Air National Guard KC-97 tankers operated from Salt Lake City Airport under direction of the parent wing. Other units were under direction of the Tactical Fighter Weapons Center at Nellis AFB. The following units participated:

8 TFS, Holloman AFB, New Mexico - 24 F-4D

561 TFS, George AFB, California - 6 F-105G

136 ARW (ANG), NAS Dallas, Texas - KC-97 tankers as required

603. (U) U.S. Army Tactical Units. The 10th Aviation Battalion, Fort Lewis, Washington, provided UH-1B helicopters for movement of personnel and supplies throughout the Nellis Range Complex. Operations were conducted on a daily basis from Nellis AFB, Indian Springs AFB and Tonopah Airport. Helicopter airlift provided the only support to numerous remote instrumentation and radar sites inaccessible to land vehicles.