(C) It should be recognized that neither PLRS nor JTIDS was originally conceived or designed explicitly for the OAS mission. But the designs of both are sufficiently general and flexible--PLRS for ground combat control, and JTIDS for air superiority and air interdiction operations--that the adaptation of these systems for joint OAS operations can be accomplished without technical modifications. Moreover, the two systems can be made interoperable. Starting with a sketch of the OAS scenario, the operation of PLRS and JTIDS and their dual positioning/communications capability will be explored as applied to a CAS sortie regardless of whether this is accomplished by fixed wing or rotary wing aircraft.

(C) Sketch of the Engagement Phase of CAS. This description is concerned with the engagement part of the CAS scenario only, which is recognized to have been preceded by the resource allocation process described in the previous Section IIB. We begin with the OAS aircraft on strip alert. The pilot is in possession of information to take him to the general area of the forward observers in the combat zone, here designated as the Contact Point in Figure II-2-2.

(C) One may divide the mission into two parts:

(1) Travel from the airstrip to the combat zone, i.e., to the contact point.

(II) Travel from the contact point to target engagement.

(C) The major difference between the two parts is that the pilot is on his own and left to his own resources and instruments to navigate part I. In part II of the mission, the aircraft performs cooperatively with the resident supporting elements, the FAC-A, the FAC, and/or the FIST Chief.

(C) Based on information obtained from the FAC and/or the FIST Chief who are in visual contact with the target, the FAC-A designates to the pilot (by voice communication) the Initial Point (IP), the Pull-Up Point (PUP), and the bearing and range of the target relative to the PUP.

(C) OFFENSIVE AIR SUPPORT FINAL ENGAGEMENT MISSION PROFILE (U)

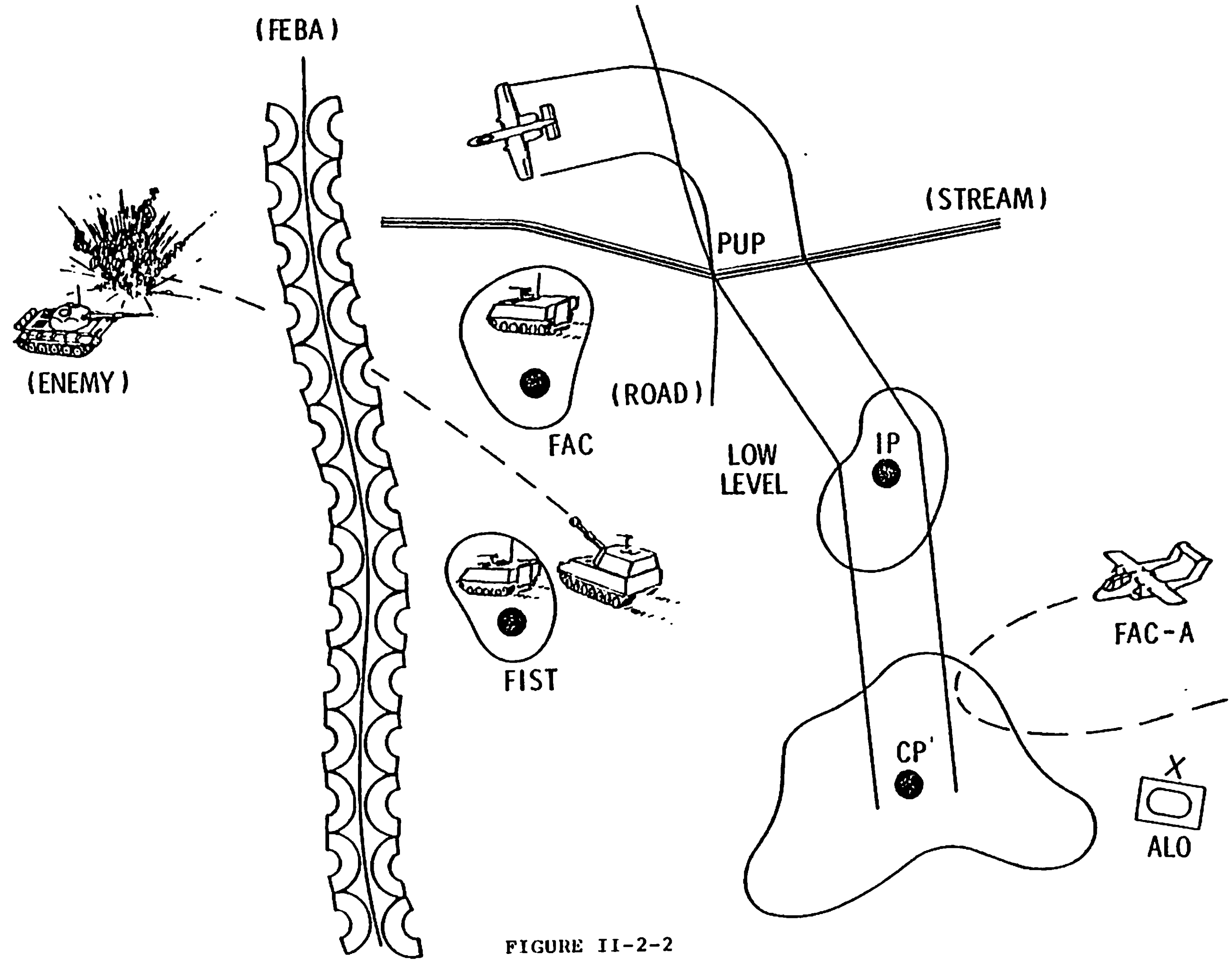

FIGURE II-2-2

(C) As the aircraft approaches the PUP, the FIST Chief designates the target location to the pilot either verbally with reference to terrain features, or by a marker, usually smoke; in either case the pilot must be given a clear description of the relative position of the target to the reference marker. Once the aircraft has pulled up and visually acquired the target or the attacker, and is headed in a direction safe for friendly troops, the FAC and/or the FIST Chief clears the pilot for weapon delivery.

(C) Figure II-2-2 depicts part II of the mission and shows the terminal engagement phase of the mission profile.

(C) An inherent difficulty of the engagement phase resides in the number of support participants: the FAC-A, FAC, and FIST Chief, all of whom have to coordinate among themselves and with the pilot with split-second timing relying entirely on voice communications. Since the strike aircraft radios are in some instances still incompatible with those on the ground and usually require line-of-sight, it is sometimes necessary for the FAC-A to act as intermediary relay. Interference or jamming at the wrong moment, communication outage, or human error brought about by natural distractions on the battlefield, can result in misunderstandings or lack of essential information that cause a miss or even failure to release the weapon.

(C) The communications problem is further aggravated by the lack of FM (i.e., Army standard) communications capability in the F-4 and F-16. Only the A-7, A-10, and A-37 are equipped with FM radios, the lack of which precludes direct communication with the FIST Chief, should he be required to carry out the ground control mission in the event that the FAC is unavailable. Figure II-2-3 shows the current communications interoperability for OAS.

(U) <u>Description of PLRS and JTIDS Operation and Capabilities</u>. To prepare the way for showing the improvements which a PLRS/JTIDS capability introduces into the OAS mission, we first review the essential characteristics and functional capabilities of these systems.

CURRENT COMMUNICATIONS INTEROPERABILITY FOR OAS

AIR FORCE [a,b]	AIR FORCE FIXED-WING AIRCRAFT [a,b] F-4 (4)	A-7 (2&4)	A-10 (2&4)	F-16 (4)	A-37 (2&4)	F-100 (4)	ARMY HELOS [c] SCOUT (1,2&4)	AAH (1,2&4)
FAC (1,2,3,4)	4	2&4	2&4	4	2&4	4	1,2&4	1,2&4
FAC-A								
OV-10 (1,2,3,4)	4	2&4	2&4	4	2&4	4	1,2&4	1,2&4
O-2 (1,2&4)	4	2&4	2&4	4	2&4	4	1,2&4	1,2&4
DASC (2,3&4)	4	2&4	2&4	4	2&4	4	2&4	2&4
ARMY [c] FIST (1&2)	-	2	2	-	2	-	1&2	1&2
FSE (1&2)	-	2	2	-	2	-	1&2	1&2

Radio Frequency & Modulation Codes: 1 - VHF/AM; 2 - VHF/FM; 3 - HF/SSB; 4 - UHF/AM

NOTES: a - Air Force air request net uses HF/SSB as the primary communications link.

b - Air Force air-to-ground communications are primarily UHF and VHF/FM.

c - Army air support requests use the local Army VHF/FM command net.

FIGURE II-2-3

(C) Both PLRS and JTIDS derive their position location capability through the principle of multilateration by measuring the TOA of signals among the multiple-interconnected user stations of the system. Synchronous TDMA techniques are used to transmit the distance measuring signals. Additionally, TDMA is used to superimpose message-carrying channels on the distance measuring signals.

(C) Both systems use spread spectrum, frequency hopping techniques to provide AJ and low probability of detection or intercept for both the TOA measurements and message transmission. Messages in both systems are transmitted in encrypted digital code to assure communications security. Figure II-2-4 depicts the common features of the two systems for the purpose of illustrating the possibility of integration. JTIDS is designed primarily for airborne use. It is a fully distributed system in the sense that the user units operate among themselves independently from a central control. As a result, JTIDS user units are more sophisticated technically and consequently more costly, than PLRS user units.

(C) By contrast, PLRS employs a central master control unit which provides the housekeeping function of routing signals and messages among users, in addition to providing a centralized computational function for the purpose of user unit position calculations. Since PLRS was designated as a battlefield control system, the information available to the user units is integrated in the central unit, and user positions can be centrally displayed and monitored. This capability provides the Division commander with a real-time picture, and facilitates control of his forces on battlefield.

(C) JTIDS and PLRS operate basically in their own relative coordinate systems. It is, however, a simple matter to transform these coordinates into any other reference frame (e.g., lat-long, UTM, map coordinates) for which a common fiduciary point and direction can be established. In the case of JTIDS, this can be accomplished by locating two stations on the ground to provide a properly surveyed-in baseline. In the case of PLRS, a baseline, defined by the absolute locations

CHARACTERISTIC	PLRS EDM	JTIDS	COMPARISON
BASIC CONCEPT	SYNCHRONOUS TDMA	SYNCHRONOUS TDMA	SAME
TIME SLOTS/SEC	512	128	PRECISELY 4 TO 1 RATIO SIMPLIFIES SYNCHRONIZING
PN CHIP RATE	5 MPPS	5 MPPS	ALLOWS COMMON CIRCUIT ELEMENTS
FREQUENCY SPACING	3 MHz	3 MHz	POTENTIALLY SIMPLIFIES TRANSLATION BETWEEN RF BANDS
USER TERMINAL DATA RATE	75 BITS/MSG X 2^n MSG/SEC	225 BITS/MSG X 2^n MSG/3 SEC	DATA RATE COMPATIBILITY (IE, 75, 150, 300 BPS.)

COMMON FEATURES OF PLRS AND JTIDS

FIGURE II-2-4

of the master unit and the auxiliary unit, can be surveyed-in to make the system operate in map coordinates. Consequently, not only coordinate commonality between the two systems is achievable, but this coordinate system can be chosen to correspond to standard coordinates used for all other operations, for example, artillery.

(C) CEP for station location for PLRS are shown in Figure II-2-5 classified by user unit type. While no test data are as yet available on JTIDS, CEPs corresponding to those of fixed-wing airborne units shown in Figure II-2-5 for PLRS are the design goals.

(C) Interoperability between PLRS and JTIDS is facilitated by the fact that both systems operate on the same physical principles. Important design features are common to both or are at least mutually compatible, as shown in Figure II-2-4. To achieve operational commonality, PLRS/JTIDS interface equipment together with the attendant communication gear has to be provided to the PLRS master units. Such modification will establish a common grid positioning system between Army and Air Force command and operating units and provide a secure and jam-resistant redundant path communication network accessible to and interoperable between the two forces.

(C) PLRS is well along in engineering development. Production start is projected for 1981. It is very probable that forward elements of the Army will be equipped with PLRS. OAS elements must be able to communicate with forward ground elements, whether by equipping OAS aircraft, FAC and FAC-A with PLRS terminals, or interfacing PLRS net and the Air Force units. Since a digital communications link to OAS aircraft is essential to every proposed handoff system, and JTIDS will not be available as soon as PLRS, it may well be that each aircraft assigned to OAS should be equipped with PLRS. The alternatives of communicating via PLRS interfaced with UHF/IDT, and later, PLRS interfaced with JTIDS must be carefully studied and compared--soon. Note that the position determination feature of PLRS (and after, JTIDS) would be an attractive addition to the present A-10.

(C) In summary, OAS aircraft or other elements which can communicate in the PLRS net are provided in the short term with:

COVERAGE AREA/VOL	USER UNIT TYPE	EDM REQUIREMENT (CEP)	DEMONSTRATED (CAMP PENDLETON) ACCURACY (X,Y)	
			LOS	NLOS
PRIMARY	MAN-PACK UNIT (MPU)	10-30 M	7 M	13-26 M
	SURFACE VEHICULAR UNIT (SVU)	10-30 M	NO TEST DATA	20 M
	AIRBORNE UNIT (AU)			
	ROTARY WING	25-100 M	17 M	16-44 M
	FIXED WING	25-100 M	28 M	NO TEST DATA
EXTENDED	AU	100-200 M		

LOS - LINE OF SIGHT NLOS - NON-LINE OF SIGHT CEP - CIRCULAR ERROR PROBABLE

*PER EL-NV0001-0001A, 12 JAN 1976

<u>PLRS EDM POSITION LOCATION ACCURACY REQUIREMENTS*/PERFORMANCE</u>

FIGURE II-2-5

CONFIDENTIAL

(1) Secure and jam-resistant transfer of messages in the near FEBA through air-ground and ground-ground links with improved message transfer reliability.

(2) Improved jam resistance and lower probability of intercept.

Further, those elements equipped with PLRS or JTIDS terminals are provided with:

(3) Centralized real-time, automatically reported and displayed location data on other tactical ground airborne elements.

(4) Real-time position and navigation data to platoon-level ground elements and individual aircraft for FEBA operations.

(C) The scenario at this point assumes that PLRS is deployed on the ground, and that the OAS aircraft (say the A-10), the FAC-A, FAC, FIST Chief, and the FO are all equipped with compatible terminals.

(C) The OAS aircraft navigates part I of the mission from the airstrip to the general area which is controlled by a PLRS master unit. Once entering the range of the PLRS net, the pilot has accurate positioning and navigational information to proceed to the contact point. Even before reaching the contact point, with the assurance that he will accurately arrive at the pre-designated position, the pilot can be in contact with the FAC-A through PLRS to assure the availability of updated target information on arrival. Upon arrival of the contact point or even well before, FAC-A defines the approach corridor to the IP and PUP and gives either absolute target coordinates or relative bearing and range with respect to the PUP as digital messages.

(C) There is no further communication needed as the aircraft approaches the FEBA. If equipped with PLRS terminal, he is cued to the approach corridor and target by coordinates within a CEP of 25 meters or so.

(U) With the target coordinates defined to which he can navigate, there are two options available:

(1) Coordinate cueing. In this mode, the pilot is led to the target by his HUD, visually acquires the target, and delivers ordnance such as Maverick by conventional techniques for pinpoint kill.

(2) Coordinate weapon release. In this case, a bearing with range limits may be defined for the pilot to fly and release ordnance, such as Rockeye for saturated area coverage.

(C) The advantages of this procedure are several. Since meaningful communications operations can begin once the pilot enters the PLRS net, precious time is gained. With the pilot's ability to navigate, his entire mission profile can be pre-determined accurately before he approaches the FEBA, thus removing the need for split-second ground-to-air coordination in the final leg of the mission. The target positioning can be delegated to lower organizational levels such as an FO who is equipped with a laser range finder and a PLRS terminal to communicate the coded message to the FAC-A; and finally, the ability to communicate and navigate accurately to target coordinates can replace conventional and vulnerable cueing measures such as smoke.

(C) This scenario can be carried over to helicopter maneuver missions as well. Target designation and coordinate entry into the PLRS by a scout can result in the dispatch of Cobras or AAHs through a pre-determined safe corridor to a PUP for target engagement.

(C) 3. Conclusions (U)

(C) It is very likely that PLRS or a system of similar potential will be deployed with Army forward elements in the early 1980s. JTIDS will be deployed later for use with Air Force elements. OAS aircraft FACs and FAC-As should be equipped to operate compatibly with whatever system is deployed to Army ground elements and helicopters, and use whichever system is fielded first. Specifically (assuming early Army deployment of PLRS) it is concluded that OAS would be significantly improved by:

(1) The equipping of A-10 and other OAS aircraft with PLRS or compatible terminals.

(2) The equipping of the FAC-A, FAC, FIST, and FO with PLRS.

(C) 4. Recommendations (U)

(C) Expedite the creation and fielding of an integrated joint digital communications and common-grid positioning system based upon use of PLRS for the Army and JTIDS for the Air Force. If one of these is delayed or not implemented, the other should be used by both Services for OAS.

(C) Develop a common digital target language for joint Army/Air Force use.

(C) NATO standardization is not difficult to implement technically and should not be used as a reason for delay.

(C) D. JOINT TRAINING AND TESTING (U)

(U) 1. The Problem

(U) Joint training and testing of OAS components and systems is required in an operational environment.

(U) 2. Discussion

(U) During the course of the study, several deficiencies in current OAS capability have been identified. The Task Group has recommended candidate components and systems to redress these deficiencies and thus improve the effectiveness of OAS. An essential concomitant is to develop a program to exercise these various components and systems in an operational feedback to the systems and component developers and to allow early procedures and tactics development. But this is not enough; to be effective, these exercises must be joint. With a few notable exceptions, joint operational exercises in the tactical arena have addressed fairly narrow operational test and evaluation (OT&E) issues. Recent examples include GUNVAL, EWCAS, AIMVAL/ACEVAL, etc. Of the attempts to establish broader and more permanent joint test agencies, JTF-2 was short-lived and ineffectual; and the USDR&E(OT&E) Directorate fell far short of its aim to integrate the various Service OT&E activities into the Continental Range concept.

(U) Most of the joint (multi-Service) character of these exercises has been imposed upon the Services from the OSD/USDR&E levels, which have not been notably successful in eliciting unreserved Service participation and support. One evident reason for this restrained enthusiasm has been the Service perception that any deficiencies revealed by such joint exercises would be glaringly exposed not only to its sister Services but also to the highest DOD/OSD levels, and that corrective measures would not be left to Service prerogative. In such an atmosphere the Services see themselves in a no-win situation.

(U) In addition to these limitations, most joint operations--even extensive field exercises--have largely ignored the need for <u>training</u> in the joint arena. This need is nowhere more evident than in joint Army/Air Force OAS operations.

(U) From this history two clear lessons emerge:

° If the Services do not voluntarily undertake joint exercises to resolve joint interoperability problems of equipment, tactics, and doctrine, they will be forced to do so by higher authority and under less than optimal conditions.

° Field exercises must pay increasing attention to training in conjunction with joint operations.

(U) Fortunately both of these critical factors were perceived and agreed upon by the recent commanding general of TRADOC and the TAC, who established several joint groups to study such common problems as the Suppression of Enemy Air Defenses (SEAD).

(C) <u>3. Proposed Solution</u> (U)

(U) Currently, the Air Force has two operational training programs which lend themselves, in terms of facilities and expertise, to expansion into the joint Army/Air Force tactical arena: RED FLAG, conducted in the Nellis Air Force Base/Fort Irwin complex, offers an operational feedback opportunity; BLUE FLAG, conducted in the Eglin Air Force Base complex, offers the opportunity for OT&E of Command, Control, Communications and Intelligence improvements with operational battle management feedback. Although both of these "Flag" programs were conceived as unilateral TAC vehicles for operational training, joint participation of the Army has begun and is growing.

(C) For example, a joint exercise could be run in the fairly near future to explore the coordinate-based cueing scheme discussed elsewhere in this report. Such an exercise could make use of elements already in existence or underway including the Army SOTAS, the Air Force JTIDS in a pod, operational A-10s with heads-up display, ground observers, PLRS terminals, etc. manned by operational personnel. The exercise should close the weapons loop and actually attack targets under realistic conditions.

(U) Now is the time for TAC and TRADOC to combine forces to develop a joint OAS training and testing program using either or both of these facilities. A spirit of free-play, unencumbered by higher authority (above TAC/TRADOC), is required to encourage innovation.

(U) 4. Recommendation

It is recommended that TAC and TRADOC develop a joint OAS training and testing program, incorporating early use of new hardware (including prototype equipment when applicable), to provide operational feedback to equipment developers and to begin early definition of operational procedures and tactics.

(C) E. TOWARD IMPROVED OAS HAND-OFF (U)

(C) 1. The Problem (U)

(C) In a high-threat battlefield environment, a fundamental problem in conducting OAS is to reduce to an acceptable level the attrition rate of all elements--

the ground FO, GLLD, FAC, FAC-A, FIST party, designator aircraft (if any), and strike aircraft. The GLLD and the strike aircraft are particularly vulnerable in their normal mode of operation. A key element in reducing their vulnerability is the accomplishment of target hand-off (and/or target designation for terminal guidance) in minimum time with sufficient accuracy and facility to permit first-pass munitions delivery with very brief aircraft exposure.

(C) Based on exercise experience with laser designators, the critical time period for vulnerability to enemy weapons appears to be about 10 seconds. If the laser operates for more than this time, it appears that it can be found and fired on. For shorter periods of operation, it should be safe from immediate fire, though it will probably be necessary for the laser unit to displace regularly. How frequently it has to displace will probably depend on how long the laser has operated since its last displacement.

(C) For the attack aircraft or the attack helicopter, it appears that if they remain exposed to detection within enemy gunfire range on the order of 20 or more seconds, they will probably be taken under fire. The key to survivability is to remain unmasked for less than 20 seconds--if possible for as little as 10 seconds. As a corrollary to this, for attack aircraft near the FEBA, it is necessary that the flight path be as close to the ground as possible.

(C) In general OAS requires target detection and acquisition, a task whose difficulty stems from the need to minimize exposure. The problems of target detection and acquisition from the air are greatly compounded in conditions of low visibility. Without the ability to see the target through smoke, for example, the attack aircraft is not able to accept target hand-off, despite the fact that the ground observer is providing it with a fairly accurate indication of the target's location.

(C) <u>2. Discussion (U)</u>

(U) It is convenient to separate our discussion of target hand-off into two parts. First, some of the more pertinent features of our present capabilities are reviewed. Then, new technical means of enhancing our target hand-off capabilities, relative to the preceding problem statement, are discussed.

(C) Present Target Hand-off Capabilities. Present capabilities fall into four categories. These are: (1) use of prominent ground features and/or smoke marking, (2) Creek Braille, (3) radar beacon bombing, and (4) laser cueing and laser target designation. These are discussed in the following sections.

(1) Prominent Ground Features and/or Smoke. This is the most basic method of target hand-off. Its nature is sufficiently well known. Here we shall comment on its limitations. To acquire the target in this way, the aircraft cannot, in general, fly very close to the ground all the way. The aircraft must pop-up in the last 20-plus seconds of the attack, at which time it is dangerously exposed. Moreover, it is difficult with this method to clearly indicate target areas for weapons such as Rockeye when the targets are masked. This system is highly dependent on air-ground voice communication, which near the FEBA, is susceptible to jamming.

(2) Creek Braille. Creek Braille is a concept initiated within United States Air Forces Europe for conducting offensive air support against predetermined target areas and involves minimum communication/coordination with controlling agencies. The concept is based on peacetime planning for navigation and weapons delivery in target areas where our ground forces are given target coordinates and TOT prior to takeoff, and can conduct the mission without any airborne communications. The concept as initially set forth has a lot of merit. It has been enthusiastically embraced in some areas, to the extent that target areas numbering in the thousands have been identified, thus making realistic pre-planning most difficult. A concept is currently being worked in USAFE and AAFCE to provide for common pre-determined contact points and IPs throughout the central region, from which aircraft can be "fanned" to attack time-sensitive or predetermined "kill zone"-type targets. "Kill zone" target areas would be located by the pilot with the assistance of a 5 kilometers by 5 kilometers template which

will overlay his cockpit chart. Coordinates of the centroid of the template would be specified.

Creek Braille could deteriorate rapidly in a dynamic battle scenario due to a lack of depth, but in the important early hours of an attack it should be quite effective. It could assist in CAS but would require additional communications to more fully define the target location. In this case, depending on how close to the FEBA this communication takes place, it might be subject to jamming. Creek Braille is clearly not the whole answer.

(3) Radar Beacon Bombing--Present Capabilities. Ground-based radar beacons provide a limited current capability to direct strikes at night and in bad weather. Target offset information (bearing and range from the beacon) is passed verbally to the strike aircraft by the FAC and the pilot is thus cued to the target. Using a radar offset bombing mode, the pilot may then fly to a computed weapons release point without actual target acquisition.

(C) There are several deployable radar beacons currently operational. The primary one is the PPN-18A, a J-band beacon which is used with the F-111, A-6, and A-7. Other beacons, in the I-band, are in limited use with the F-4 and F-16. The disadvantages of having different beacons for the different types of aircraft are obvious. A new, dual-band (I and J band) beacon, the TPN-28, has been developed. This beacon can be used with the F-4, A-6, A-7, F-16, and F-111 aircraft. Obviously, none of the beacons can be used with the A-10, since it has no radar.

(C) When a beacon is used the FAC must communicate to the strike aircraft the beacon type, code and coordinates (within 2 miles); together with the range and bearing from the beacon to the target, and the target elevation. This information is transmitted by voice. The offset information is entered manually into the aircraft bombing computer.

(C) If the terrain is flat, the run-in altitude of the attack aircraft need not be significantly higher than for other types of attack. If, however, the terrain is hilly, the attack aircraft may be forced to a significantly higher run-in altitude in order to acquire the beacon, thus increasing its vulnerability to enemy weapons. Also, because of its detectability, the beacon itself may be subject to enemy artillery fire.

(C) The accuracy of beacon offset bombing is largely dependent on the accuracy of the computation of the range and bearing of the target from the beacon. In most cases, the error in this estimate is much larger than the delivery error of the equipment. (An exception is the F-4 which, due to a limitation in updating the computer for 30 seconds prior to weapon release, has much poorer delivery accuracy with offset beacon bombing than do the other types of aircraft.) With current equipment, overall bombing accuracy might be on the order of 300-500 feet CEP for the F-111 and A-7 and 1500-2000 feet CEP for the F-4. These accuracies obviously do not give a reasonable probability of kill against individual point targets, but do permit attacks on area targets. The accuracies (with the possible exception of the F-4) may permit cueing of other acquisition systems such as visual, laser, Infrared imagery, and even radar detection of the target itself in some cases.

(C) To sum up, the deficiencies of beacon bombing with present equipment are: lack of accuracy, beacon detectability by the enemy, excessive aircraft exposure in hilly terrain, accuracy limitations, and inability to be used with the A-10.

(4) <u>Laser Cueing and Laser Target Designation</u>. Present equipment in the form of GLLD and the LTD allow target cueing for the A-10, F-16, AAH and AH-1S. These laser designators can indicate target position through indication on a HUD or other display unit on the aircraft. As soon as an unobstructed line-of-sight exists between the aircraft or helicopter and the target, the display will indicate the target location to within a few meters. This will permit an aircraft like the A-10 to approach low, and when within line-of-sight, detect the target and deliver gunfire. Similarly, it allows an attack helicopter to unmask, rapidly detect the target, and deliver fire.

(C) The basic problems with this form of target cueing have to do with reduced visibility, in which the aircraft cannot see the target even though the cueing is perfectly accurate, and controlling the laser to turn on and turn off for minimum on-time presents a coordination and communication problem.

(C) Laser target designation (as distinct from laser cueing) can be performed with the ground-based laser unit, to allow the attacking aircraft (firing Laser Maverick) or the attacking helicopter (firing Laser Hellfire) to break-off and remask without waiting to guide the missile to impact. Here the basic problem is with the communications link needed to obtain laser turn-on with minimum total on-time. The link's susceptibility to jamming is an obvious problem.

(C) One particularly interesting use of the laser designator sidesteps most of the problems of target cueing and entirely eliminates aircraft exposure. The AAH has the ability to fire Laser Hellfire in an indirect fire mode; for example, from behind a hill. The missile will first climb and then fly straight and level, toward the target. (Given the proper target coordinates, the AAH on-board navigation and fire control computer has the ability to determine the correct launch heading.) The laser designator operator, informed of missile launch, must turn the designator on so that the Laser Hellfire missile will receive a minimum of about five seconds of terminal guidance to the target. With good synchronization, not only will the helicopter avoid exposure, but the laser designator's exposure will be considerably reduced. The need for good communications is again emphasized.

(C) <u>Technical Means of Enhancing Target Hand-Off Capability</u>. We have identified four areas in which new technology can be applied to enhance our hand-off capability. These are: (1) Coordinate-Based Cueing; (2) Improved use of Ground Beacons; (3) Burst Digital Communications; and (4) Reduced Visibility Sensors. The technical aspects of these are discussed below:

(C) Coordinate Based Cueing: Looking ahead to the advent of better target designation, INS in the strike aircraft, a common position location system such as PLRS or JTIDS, and an on-board computing capability, we can synthesize a cueing system for strike aircraft which is not dependent on voice communications (thus being able to work in multilingual environment) and which can take advantage of remotely located target sensors.

(C) In the scheme proposed here, coordinates of the moving or fixed target would be passed digitally to the strike aircraft, where they could be combined with the coordinates of the strike aircraft and the strike aircraft attitude to drive HUD on which location of the target is indicated. Even under poor visibility conditions, such a display would allow the pilot to approach the target with complete flexibility in flight path, perhaps glimpsing the target near the HUD symbol if visibility permitted. Range and range rate or other necessary inputs could be provided to the fire control computer and would permit area-ordnance delivery under adverse conditions without direct acquisition of the target by the pilot. The proposed system minimizes the need for self-contained target sensors and could be of considerable help to aircraft such as the A-10 in the OAS role.

(C) Improved Ground Beacon. Several improvements would increase the effectiveness of deployable beacons for cueing or bombing. Among these are:

a. Improving the accuracy with which the FAC can locate the target relative to the beacon. A laser range finder would improve significantly the estimation when the FAC can see the target. The Analytical Photogrammetric Positioning System (APPS) should improve accuracy when the beacon and target can be located accurately on a map. It is understood that both systems are being tested currently.

b. A directional antenna, instead of the omnidirectional antennas on the beacons now available, would reduce significantly the vulnerability to enemy detection and location, and would increase the beacon signal strength in the sector toward which it is directed.

c. A data link for the beacon to transmit target location would reduce the requirement for voice communications.

d. The possibility of mounting the beacon on a helicopter in which the ground FAC could operate should be examined. This would improve the flexibility of the system and in many cases, permit lower run-in altitudes for the attack aircraft.

(C) Burst Digital Communications. There is really only a very small amount of information involved in defining a CAS strike. The time-bandwidth product consumed in conventional voice communications between the ground observer and the strike aircraft or attack helicopters is vastly in excess of what is required. If strike coordination information is reduced to its most compact form in accordance with a preformatted message, this message could be transmitted in digital form over the same (voice) link with relatively high anti-jam capability. To accomplish this, three things are needed: (1) a message format flexible enough to be information efficient and simple to use, (2) a message entry device which can interface to a radio in place of a microphone, and (3) a message display unit that can interface to a radio in place of a speaker. The entry/display unit would be designed to "expand"/encode the strike information to make full use of the available time-bandwidth product on the voice link, in a way that would provide jam resistance. The technology for these improvements is straightforward. Experience with existing equipment (i.e., the Litton IDT) indicates that the human factors aspects are acceptable.

(C) In addition to the ability of this type of communications to work in a jamming environment where voice communications would fail, using the <u>same</u> voice communication link equipment, it is significant to note that with a well-designed message format the target message will be independent of national language. The implications of this for NATO operations are significant.

(C) <u>Reduced-Visibility Sensors</u>. Problems associated with night operations, operations in reduced visibility, and operations in smoke will interfere with target acquisition, with target hand-off, and with terminal guidance. There are a number of new technical developments which can be applied to these problems such as thermal infrared and millimeter wavelength sensors. Some of this technology is well developed and can be applied in the near future. Other parts of the technology are still developmental; all that we can do at present is push the basic research and development needed to support the potential future applications. In the following paragraphs, we discuss some of these.

(C) Target acquisition and tracking at night, in moderately limited visibility, and in a moderate smoke environment can be accomplished by use of a ten-micron FLIR. In these conditions, laser cueing and laser terminal guidance with the conventional 1.06 micron laser designators can be done. What is needed is to have a FLIR capability on the designator unit, and also on the weapons platform for cueing. For the GLLD, the addition of the AN/TAS-4 FLIR, developed for the TOW missile launcher, would provide the appropriate capability. (We understand that this is presently planned.) Similarly, for the LTD addition of the AN/TAS-5 FLIR, developed for the DRAGON missile launcher, would provide the appropriate capability. (In each case, i.e., GLLD/TOW and LTD/DRAGON, there is a good match of operating range and target types.) Aircraft that have been cued to the target with a laser device, some self-contained seeker is required to provide an autonomous attack capability. Such a FLIR is planned for the AAH, but is significantly absent from the A-10, which would require it for use with the GAU-8 gun in limited visibility conditions.

(C) For conditions of even poorer visibility or heavier smoke, it may still be possible to detect targets with a thermal infrared FLIR, while the 1.06 micron laser beam would not be able to penetrate effectively. Under these conditions the laser beam from a 10.6 micron laser would be able to penetrate. (For most obscurants, the attenuation coefficient is only about one-tenth as much at 10.6 micron as it is at 1.06 micron.) This suggests the desirability of performing laser cueing and laser designation at 10.6 micron. The technology for CO_2-lasers for the designator is well in hand, and because of the greater power/efficiency such a unit may be smaller/lighter than the present 1.06 micron laser designators. Any design problems for a 10.6 micron laser designator should be straightforward. The technology problems that force us to view the use of 10.6 micron laser designation as a research and development matter pertain to the seeker head and its detector. We have to cool the detectors, probably to about liquid nitrogen temperature, but we know how to do this. More seriously, however, there is a basic incompatibility between detector sensitivity and detector size/field-of-view. It will probably be necessary to make use of current development on two-dimensional infrared detector arrays to resolve this incompatibility. The detector arrays will probably require on-chip high-frequency pulse-detection circuits. Technical developments in this area are moving fast enough that it is reasonable to expect eventual development of such a capability. With reasonable emphasis, technical feasibility could probably be established in about five years.

(C) For particularly severe conditions of low visibility or very dense smoke, ten-micron operation will not be possible, either for target acquisition or missile guidance. In this case it becomes interesting to consider the potential of millimeter wavelengths such as the 3 millimeter, 94 GHz atmospheric "window." For moderate ranges (i.e., several kilometers) penetration will be reasonable, but because of diffraction/resolution effects detection ranges may be as little as one kilometer. With special techniques three kilometers range may be possible. With a 3 millimeter radar it may be possible to pick out targets such as a moving tank by its doppler signature at 3 kilometers range. Other promising techniques include active imaging (principally at 1 centimeter and 3 millimeters), fire control pointing and tracking (principally at 3 millimeters), beam riding missile guidance (principally at 3 millimeters) and passive short range detection and homing (principally at 1 centimeter). Some of these cases are being explored. The pay-offs are uncertain in the sense that we are not sure how much the clutter, low resolution, ground-plane reflections, etc., will limit performance. But concern for our military position if some of these techniques are possible and we do not develop the ability to exploit them while others do, argues strongly for a fairly broadly based exploratory effort in this area.

(C) 3. <u>Recommendations</u> (U)

(C) In order to enhance probability of engagement and reduce exposure of strike aircraft, attack helicopters and man on the ground:

Develop a coordinate-based cueing system which will:

a. Generate target coordinates (periodically).

b. Enter target classification.

c. Transmit (route) data to weapons platform.

d. Display target location on a HUD, based on target coordinates.

To improve operations with ground beacons:

a. Improve accuracy by providing accurate (~100 ft CEP) range and bearing from beacon to target.

b. Reduce probability of detection by screening the beacon from the enemy.

Develop burst digital transmission, to reduce vulnerability to jamming and enhance reliability of communications. We should plan to provide, "tomorrow", ancillary device for digital burst entry into existing tactical radios. (This should be an IDT-like system.)

In order to enhance acquisition of targets (by pilots and ground observers) at night and reduced visibility, we should:

a. Accelerate provision of FLIR for GLLD and LTD and other equipment.

b. Expedite development of long wavelength IR lasers and seekers for designation and weapon guidance.

c. Accelerate exploration of millimeter wavelength technology.

(C) F. CROSS-SERVICE UTILIZATION OF TARGETING INFORMATION (U)

(C) 1. The Problem (U)

(C) It must be anticipated that many targets located by the sensors of one service would be appropriately struck by weapons of another service. For example, enemy AD units found by the Air Force's PLSS to be located within reach of Army artillery might well be priority artillery targets. Conversely, those located by the Army's AGTELIS or the FIREFINDER AN/TPQ-37 backtracking radar--especially those targets beyond artillery range--might well be struck by the Air Force.

(C) The problem is to assure that time-urgent and perishable targeting information immediately reach the appropriate strike forces independent of Service origin.

(C) 2. Discussion (U)

(C) The PLSS system utilizes three high-altitude airborne platforms (probably U-2 aircraft) deep in friendly territory which are accurately located in "electronic coordinates" tied (through distance measuring equipment) to a network of fixed ground stations. These aircraft overlook the whole battlefront, and receive and relay signals from enemy emitters to a ground master station/computer. For pulsed emitters, the TOA at the aircraft receivers uniquely determine the emitter location; for CW emitters, a correlation of the relayed signals at the master station determines the TOA data and again provides a unique solution for the emitter location.

(C) Once the emitter location is determined in the PLSS electronic grid, this information can be used to direct/guide a strike weapon--such as Wild Weasel aircraft, GBU-15 guided glide bomb, artillery, etc.--to the target location. Rapid strike response is clearly necessary for time-urgent targets such as mobile enemy air defenses.

(C) The Army's AGTELIS system also uses TDOA location of enemy emitters but, being ground-based, surveils a much smaller area (e.g., a Division front 40 kilometers wide and 30 kilometers deep) and thus needs only a smaller data-handling capability. The location information provided by AGTELIS can be used by PLSS to guide strike weapons, but AGTELIS itself has no self-contained weapons-guidance capability.

(C) The Army's AN/TPQ-37 FIREFINDER radar designed for backtracking artillery projectiles, will also see AAA shells and SAMs. Location information on these AD weapons is, of course, of great interest to the Air Force. Moreover, SAM-launcher/AA-gun location information augments and complements that on the associated AD radars provided by PLSS and AGTELIS. However, to backtrack accurately nonballistic projectiles, such as SAMs or rocket-assisted projectile (RAP) artillery rounds, requires a special nonballistic backtracking algorithm. Development of such an algorithm is now being considered by TAC.

(C) 3. Proposed Solution (U)

(C) The solution proposed for expediting the inter-Service flow of targeting information is illustrated in Figure II-2-6. Here the solid lines indicate the data links presently planned. The dashed lines represent the proposed additional direct inter-Service cross-links, which would tie AGTELIS to PLSS and PLSS to TACFIRE without any intervening nodes.

(C) At present there is no plan to establish commonality of the coordinate grids used respectively by the Air Force (PLSS) and Army (AGTELIS FIREFINDER) systems. With reference to its fixed ground stations, PLSS establishes an "electronic coordinate system." By contrast the coordinate system for AGTELIS and FIRE-FINDER are planned to be based on fiduciary points whose locations are determined using conventional artillery survey means and maps. At the very least, these two coordinate systems must be tied together. This problem will, of course, be solved once PLRS and JTIDS are made interoperable and deployed. However, in the near term a simple and inexpensive expedient would be to use jeep-deployable tethered balloons containing corner reflectors (metallized-films) that could be located by the TPQ-37 radar. Such balloons have already been developed under the Navy Science Assistance Program (NSAP). Equipping the jeep with a PLSS transponder would then allow tying together both the PLSS electronic grid and the FIREFINDER grid in the simplest and most direct fashion.

(C) Previously in this report, the recommendation was made to preallocate sorties to Army Corps commanders for upcoming time blocks and for subsequent suballocation of these sorties down to Division and perhaps down to Brigade. But there still remains the problem--at these levels--of assigning these sorties to specific targets in a timely manner and of engaging these targets with the strike aircraft. This is particularly relevant in the case of mobile targets beyond line of sight of forward observers and are in reduced visibility.

(C) One approach to enhance the assignment of sorties to targets (and the engagement of these targets) under the conditions described above is to use the data from SOTAS. The use of SOTAS in the execution phase of

(C) FLOW OF TARGETING INFORMATION (U)

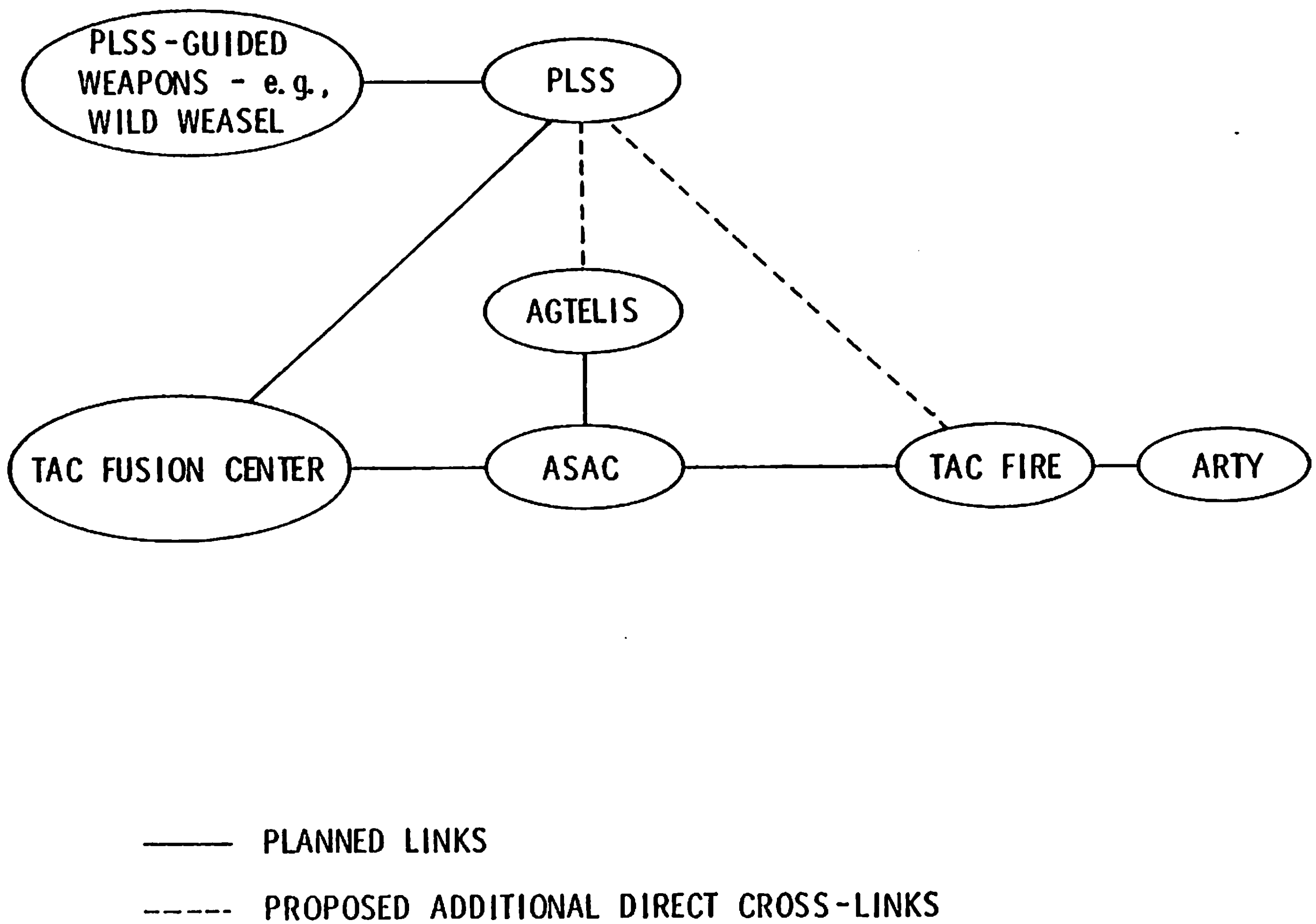

Figure II-2-6

strike aircraft was tested in Reforger '77. SOTAS derived data was provided to the crew of an F-111A via the Air Liaison Officer who was in the SOTAS ground station.

(C) The use of SOTAS should be emphasized as a means of providing sensor data directly to those who need it most in the execution phase--both to the ground commander in assigning aircraft to specific targets and to crews in strike aircraft to assist in the engagement of targets.

(C) 4. <u>Recommendation</u> (U)

(C) In order for each Service to be able to apply its unique strike assets to high-priority targets located by the other Services, it is recommended that:

direct two-way data links be provided for transmitting PLSS-target locations to TACFIRE for possible strike by artillery; and for transmitting target locations determined by AGTELIS and FIREFINDER (TPQ-37) to PLSS for possible guidance of aerial ordnance;

pending deployment of a common inter-Service coordinate grid system, the Army/Air Force utilize "survey jeeps" equipped with PLSS transponders and deployable tethered corner-reflector balloons whose positions (at artillery batteries, AGTELIS fiduciary points, etc.) can be readily determined by the FIREFINDER TPQ-37 radar.

provide data from SOTAS directly to ground commanders (down to Brigade) to assist in the assignment of allocated sorties to specific targets.

provide data from SOTAS to strike aircraft to assist in the engagement of these aircraft against targets to which they have been assigned.

(C) G. <u>TOWARD AN IMPROVED A-10 AIRCRAFT</u> (U)

C) For OAS over the central European battlefield the U.S. Air Force is counting heavily on the Fairchild A-10, with a planned buy of over 700. This aircraft is especially designed for the CAS role, with heavy armor, high maneuverability at low altitudes and extended range/loiter time. The principal armament of the A-10 includes the very competent 30mm GAU-8/A gun and up to six AGM-65C Electro-Optic (EO) MAVERICK air-to-surface missiles.

(C) Recognizing that the high density of Soviet battlefield AD systems expected in the ETO would preclude air operations of the A-10 at all but very low altitudes, the TAC is conducting the development of low-level tactics and training with the A-10 at attitudes of 60 m under the Red Flag exercises at Nellis Air Force Base. Although this commendable program has proved quite successful and has won the enthusiasm of the A-10 pilots, it is evident that these demanding low-level tactics leave little pilot attention to spare for the main mission and are anyway limited to VFR conditions--i.e., clear visibility and daylight. Moreover, the imposition of low-level flight precludes use of bomblets in dispensers. For example, the ROCKEYE II submunition and even several of the candidate Wide Area Antiarmor (WAAM) submunitions being developed by ADTC may require deployment altitudes of several hundred feet to achieve proper submunition impact orientation. This demands either a pop-up maneuver which increases the exposure of the A-10 or the development of a loftable or powered submunition dispenser that can climb to the requisite altitude.

(C) The above considerations constitute serious limitations for VFR operations. A more serious limitation is the lack of capability at night and under IFR due to adverse weather. Under IFR, the A-10 has limited navigation capability and also is deficient in its ability to search, acquire and engage a ground target.

(C) One further observation may help clarify the night/all-weather problem: namely, that linking the much easier nighttime-capability problem to the much more difficult all-weather problem discourages taking those relatively simple and inexpensive steps that could result in a fairly competent night capability. This appears very much worthwhile for the A-10 even if an all-weather capability is infeasible (or unaffordable). For example, the possibility (mentioned in Section II-F) of utilizing the SOTAS capability to bring an aircraft track into coincidence with a ground target might make a significant improvement in the nighttime capability of the A-10.

(C) To enhance the survivability of the A-10 and to provide a modest capability to operate at night, the following ideas -- some of which are already underway -- seem worthy of support:

1. Adapt the HUD/MAVERICK cockpit display to a FLIR/IR MAVERICK system to provide a clear-nighttime capability;

2. Provide an inertial navigation system;

3. Provide a radar altimeter/warning system;

4. Adapt a PLRS/JTIDS location and communication system to the A-10 platform;

5. Provide chaff/flare dispensers;

6. Consider modifying the A-10 to a 2-seat version to reduce pilot workload;

7. Alternatively, provide an autopilot;

8. Accelerate procurement of the I^2R MAVERICK system;

9. Modify the HUD to include a projected map display;

10. Provide (in pods) additional mission and survival aids (e.g., ECM gear); and

11. Provide a simple powered free flight dispenser weapon for delivery of bomblets like ROCKEYE.

(C) Since the time available did not permit a properly informed consideration of such possibilities, the Task Group strongly urges that a special group of knowledgeable individuals--consisting of avionics specialists, A-10 engineers, A-10 pilots and appropriate SAB members--be convened to consider these and other possible A-10 improvements.

(C) On the premise that virtually any measures would be welcome that can help the A-10 fulfill and survive its difficult assignment, several members of the Task Group discussed the possibility of an expedient modification that might make the use of CBU ordnance feasible in the near term. The concept involves adapting an existing rocket motor, such as the 5" ZUNI, to propel a ROCKEYE II canister ahead and above the A-10 vector so as to disperse the CBUs over the target area. The reasoning underlying this proposal is that:

(1) Although ROCKEYE II may be only marginally effective against tanks, it has the highest effectiveness of any weapon currently in the tactical stockpile; it is quite effective against lightly armored vehicles--e.g., APCs and trucks; and, moreover, has an antipersonnel mode.

(2) A drawback in using ROCKEYE II at the very low AGLs (e.g., 60 m) now being practiced by the TAC and USMC A-10 pilots is that the bomblets must be released from the canister above ~300 m AGL to allow sufficient time and fall to achieve proper (i.e., near-vertical) bomblet orientation.

(3) This requires a lofting or pop-up maneuver which increases A/C exposure by overflying the target and is limited to strictly VFR conditions.

(4) By contrast, a canister having its own propulsion could be fired with a kilometer or two stand off and without any special aircraft maneuver other than navigation to the proper range and heading to the target.

(5) If the A-10 had a radar altimeter, a navigation system (either inertial or externally vectored) and a FLIR it might be possible to deliver such ordnance over a designated target point even under conditions of low visibility.

(6) The canister could be opened in the standard way using a fuze triggered either on a fixed time setting or on motor burnout.

(C) Although the mating of mismatched components not designed to interface seldom yields a satisfactory solution, we are driven to consider such a kluge here simply because of the desperate lack of any suitable A-10 CBU ordnance, especially for the immediate future.

(C) Two further recommendations, relating to A-10 operations rather than modifications, are to:

Examine the possibility of utilizing SOTAS location information to bring the A-10 ground track into coincidence with a SOTAS target and thus facilitate A-10 target acquisition--or even conduct the target engagement (e.g., for blind delivery of an area-type cluster bomb unit weapon).

Evaluate by an actual field exercise, joint with Army RED teams, the degree of threat posed by an internetted system of GRAIL missileers to aircraft like the A-10 (or COBRA-TOW) operating at low altitudes over the battlefield, as described above.

(U) H. NATO IMPLICATIONS

(U) The fusing of multi-nation army and air components under command of a given nation has indeed a number of recognized problems - namely doctrinal differences, cultural and training, as well as an array of time-tested national procedures unique to a given Service component. In NATO, the problem is compounded by currently incompatible communication systems and language differences.

(U) While NATO does sponsor a number of operational exercises to help train and fuse components into an effective force, the process is a two-way affair; that is, the U.S. should participate in NATO exercises as well as vice-versa. There should be a mutual effort among the allies to develop scenarios for exercises that iteratively test and evaluate new techniques, tactics and procedures oriented to achieve interoperability.

APPENDIX A

DEFINITIONS

1. ALLOCATION - The distribution of offensive air support (OAS) sorties among the Army units. (A portion of the total OAS sorties are retained by the Air Force component commander for battlefield air interdiction.) The allocation process starts at the Corps and may extend down to Brigade through suballocations. The allocation process is dynamic and will be adjusted as battlefield requirements dictate, up to an established time window when the allocation is considered to be firm and the sorties are on-call to the Army unit.

2. APPORTIONMENT - The division of air assets according to mission, i.e., counter-air interdiction and offensive air support. The apportionment is done by the Joint Force Commander.

3. ASSIGNMENT - The identification of a specific attack asset to fire on a special target. The responsibility for assignment resides with the unit to which the attack asset is allocated.

4. BAI - Battlefield air interdiction. Operations against targets beyond the fire support coordination line but which are of imminent concern to the ground forces. These operations require coordination with ground forces, normally of Corps level.

5. CAS - Close air support. Operations against targets located between the furthest line of friendly troops and the fire support coordination line. These operations require close coordination and integration with the fire and maneuver of the ground forces.

6. OAS - Offensive air support. Operations involving attacks against targets which, due to their nature and location, require some degree of coordination with ground forces. The operations are subdivided, according to target locations, into close air support and battlefield air interdiction.

UNCLASSIFIED

REPORT OF TASK GROUP III

(S) INTERDICTION ENEMY

COMMAND AND CONTROL (U)

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(S) ABSTRACT (U)

(C) This section treats the topic of the utility of and capability for NATO detection, identification, location, and neutralization of WP C^3 assets in a European War environment. The current principal deficiencies in capability are identified and proposed solutions for both near-term (pre-1983) and longer-term (post-1983) are presented. The needs are also considered in light of two time "zones":

- pre-war (collection, confusion and deception)

- post-attack (identification, localization, neutralization).

(S) The principal deficiency identified is an almost total absence of current emphasis on the C-C^3 mission and a corresponding lack of organizational tasking. There is a major failure to extract and utilize existing data collected by both national and theater assets.

(S) Proposed approaches and recommendations for solution include:

(C) (a) Provision of an essential organizational and doctrinal focus for C-C^3.

(C) (b) Development of a joint Air Force/Army activity to screen existing data for C-C^3 uses.

(S) (c) Development of C-C^3 as a major functional element of BETA and its descendants.

(S) (d) Implementation of "fingerprinting" techniques to enhance location.

(S) (e) Emphasis on countering Soviet C-C^3 by deception of REC pre-attack and by destruction after a war starts.

(S) (f) Incorporation of EW capability into PLSS.

(S) (g) Concentration on ARM C-C^3 weapon development, particularly for use against the SVOD system.

(U) In addition to the recommendations in this section, some are available in a specially classified appendix.

Contents, Report of Task Group III

(S) I. SUMMARY (U)

(S) A. TOPIC (U)

(S) This study assessed the capability of US forces to detect, identify, locate, and neutralize key WP tactical C^3 elements in engaged and reserve forces, with particular emphasis on mobile command posts. Initial attention was focused on evaluation of capabilities possible through the use of existing or programmed US assets; then projections of technical and other improvements were considered. A principal point of departure was the 1977 Defense Science Board study of this topic.

(S) B. KEY OPERATIONAL NEEDS (U)

(S) In a comparison of NATO and WP capabilities in C^3 assets, the present balance is strongly in favor of the WP. In addition to substantial numerical superiority in number of types and fielded equipments, WP doctrine integrates C-C^3 into their overall offensive warfare doctrine. Both physical attack and electronic countermeasures are not only called for in doctrine, but are also supported by REC, a dedicated organization trained in these disciplines. This potent advantage over NATO is further enhanced by the WP having the attack initiative in any first battle, with the obvious advantage of being able to fight from "fixed" plans for some period. On the other hand, both historical trends and observations of current training WP exercises indicate a substantial disinclination toward initiative actions without higher chain of command authorization; which implies a potentially substantial benefit to be obtained from disruption of this chain.

(S) NATO operational needs for C-C^3 must be categorized by war phase, i.e.:

(S) Active pre-war confusion and deception. C-C^3 activities may be very profitable if they are able to cast doubt on the validity of WP pre-plans and/or to indicate NATO ability to frustrate these plans. Useful results might include uncertainty, hasty re-planning, delay or cancellation of the attack. Such a capability is, however, rather fragile in the sense that it requires some warning time and any repeated use would probably sharply reduce its effectiveness. Passive pre-war C-C^3 actions would largely be confined to building data bases to support not only indications and warning and electronic order-of-battle (EOC); but also to maintain updated wartime C-C^3 plans and possibly, "pre-loaded" capability.

(S) Initial attack and "steady state" phase activities may differ somewhat in target prioritization and time-line requirements but are functionally essentially the same, with focus on disrupting WP ability to coordinate key forces for either offensive or defensive actions by cutting the chain of command. It is important in this connection to recognize that most C^3 assets, probably more so than other weapon systems, can be disrupted as effectively by temporary neutralization as by outright destruction. In general, such harassment also requires at least an order of magnitude less expenditure of assets - accuracy of location, number and size of delivered weapons, etc. - than destruction.

(C) Because of the WP doctrine and practiced capability for skipping one inactivated level of command, it is necessary to make coordinated attacks on at least two adjacent levels - with Army Main and Division Main the most likely targets.

(S) Two other potential C-C^3 target types must also be considered as primary, high yield modes. These are the particular C^3 assets associated with the offensive REC (jamming, destruction, etc.) units, and the Soviet SVOD Navigation System. The first of these is important because of the necessity for protecting our own C^3 ability, which the WP plans to neutralize to about 30% of nominal. "Jam-proofing" if technically feasible and physical protection of these assets will cost several $100M and require 5-10 years to complete; while counter-force to REC may be obtainable much more readily and cheaply. The SVOD is an extremely attractive target because it is not only the basic centralized guidance system for WP airborne platforms, but also is interlinked into many target designation and fire-control systems.

(U) A major requirement for C-C^3 capabilities is that they not require diversion of a major percentage of assets - from development investments through delivered weapons - available to NATO. The investments for C-C^3 must also be justified on the basis of pay-off compared to the attack of other targets. Furthermore, the C-C^3 measures should not significantly degrade NATO C^3.

(U) Table III-1 summarizes the candidate US/Allied actions as a function of the war phase.

(S) C. CRITICAL DEFICIENCIES (U)

(C) The major current deficiency in NATO C-C^3 is the lack of awareness of its importance and its potential payoff. There has been little effort to implement C-C^3 planning by the JCS (although this is now underway), the Services and the using commands. No definitive doctrine which considers C-C^3 as a "system" exists, and no one commander or organization has the assigned responsibility for it.

(U) From a system and technology standpoint the following are the most important current deficiencies:

(S) 1. There is a failure to extract and process C-C^3 intelligence data which is already regularly collected in the National Intelligence Centers, and to a lesser degree in theater Interdiction and Warning (I&W) intelligence.

(S) 2. Both current and developmental collection systems tend to emphasize radar rather than communication frequencies.

(C) 3. As a result of 2 above, NATO C-C^3 location accuracy is low.

(S) 4. Dedicated C^2 for C-C^3 is non-existent.

(S) 5. There is very little focus on development of systems or equipments to destroy or harass C^3.

TABLE III-1-1

(S) CANDIDATE U.S. ALLIED ACTIONS (U)

TIME PERIOD

SOVIET FUNCTION	PRE H	POST H	STEADY STATE
RECONN	C&D ACTIONS	DESTROY REC C^3	DESTROY REC C^3
ARTILLERY	H-12 TO H MASK REAL LOCATIONS CREATE MANY FALSE TARGETS	DESTROY ARMY & DIV MAIN - IF POSSIBLE HARASS AND FORCE MOVEMENT - IF NOT FORCE LOAD ON FORWARD CPS DESTROY FWD CPS H TO H + 12	H-12 TO H + 12
AIR	H-1 TO H + 1 DECEIVE REC SVOD	H + T FOR ECHELONS DESTROY SVOD	H-1 TO H + 1 H + T FOR ECHELONS
MANEUVER	H-4 TO H + 1 MASK REAL LOCATIONS CREATE MANY FALSE POSITIONS	DESTROY RGT MAIN - IF POSSIBLE HARASS AND FORCE MOVEMENT - IF NOT FORCE LOAD ON FWD CPS H TO H + 12	H-r TO H + 12

(S) 6. There is an almost total lack of a US cover and deception activity.

(S) 7. The existing assets and C^3 structure for detecting, locating, identifying, deciding on C-C^3 actions, and implementing these actions are neither survivable, nor do they produce data which is timely for C-C^3 use.

(S) D. PROPOSED APPROACHES FOR IMPROVED CAPABILITY (U)

(U) This section contains a summary of all Task Group outputs. Additional recommendations are contained in a specially classified appendix.

(C) Near Term (78-83). The first need is to provide the essential focus, organizational responsibility, and planning for C-C^3 within the US and in NATO. Detailed recommendations for achieving this is beyond the scope and capability of this Task Group, but deserves the highest priority in the US command structure.

(U) The following approaches merit consideration for joint action by the Air Force and the Army.

(S) 1. A joint C-C^3 intelligence screening activity. Since much useful data is already being collected regularly, a small staff (possibly augmented by contracted services) could develop a C-C^3 target identification service for European Command without need for major additional resources in sensors, etc.

(C) 2. A C-C^3 tailored C^2 system could provide a nearer term capability than will be demonstrated in BETA and operational systems that follow-on after BETA. When these follow-on systems are operationally available, the C-C^3 command system could provide a redundant back-up.

(C) 3. Evaluation should be made of RPV/ Drone use to provide low cost (compared to aircraft) platforms for locating C^3 systems, for providing target marking for attack by assets and for either harassment or destruction.

(S) 4. Influence the requirements specified for planned developments such as PLSS, BETA, Tactical Fusion Center (TFC), TIPI-II to provide important C-C^3 features.

(C) 5. Upgrade existing and programmed collection systems, e.g., National assets and other location systems, to provide better means to detect, identify and accurately locate enemy C^3.

(S) 6. A confusion and deception (C&D) capability (as practiced by the British in World War II) should be developed by establishing a covert group for this purpose.

(S) 7. A specialized anti-REC capability is needed, but this Task Group lacks adequate information to specify the best form of their action. It must however, be clearly established as an element of the combined arms team.

(S) 8. Categorize and evaluate munitions and devices to counteract enemy C^3 either harassment or destruction. FAE, for example, could be used to destroy enemy C^3 hidden in forests when the location of individual elements in the C^3 are not known. Expendable jammers, mines, and Have Name weapons may so disrupt the C^3 that it would be forced to move prematurely.

(S) 9. Initiate development of specific C-C^3 weapons of the ARM type.

(C) Longer-Term (Post-1983).

(S) 1. Implement EW "fingerprinting" techniques to enhance C^3 location and identification.

(S) 2. Incorporate EW location capability into PLSS.

(C) 3. Field expendable jammers and decoy transmitters for aircraft and artillery emplacement.

(S) 4. Field RPV/Drone carried sensors for close targeting/localization of C^3 assets.

(C) 5. Characterize and allocate wide-area munitions types for C-C^3 useage.

(S) 6. Field specific C-C^3 ARM weapons, with first priority on the SVOD.

(S) E. RECOMMENDED ACTIONS (U)

(U) Near-Term (78-83).

(C) 1. Establish C-C^3 responsibilities at appropriate Service and user organizations and develop the systems architecture and doctrine for a survivable C-C^3 implementation.

(C) 2. Develop C-C^3 plans at all appropriate organizations -- coordinate between Air Force and Army.

(C) 3. Task National assets and other activities to produce C^3 target parameters.

(C) 4. Field a C-C^3 command system in Europe to provide EUCOM, USAREUR and USAFE C-C^3 target data, to prove feasibility, and to support development.

(S) 5. Develop an initial C&D capability aimed at REC and Soviet Intelligence Collection Assets.

(C) 6. Test the capability of C-C^3 applications of RPV/Drones.

(S) 7. Initiate a counter-SVOD ARM development.

(C) 8. Develop special C-C^3 disruption devices such as FAE, mines, and expendable jammers.

(U) Long-Term (Post-1983).

(C) 1. Develop new systems to identify functional elements, e.g., artillery CP, within a concealed and dispersed Army or Division main command center.

(C) 2. Develop a family of low cost (under $100K including payload) RPV/Drones for selected C-C^3 activities - detect, identify, locate and destroy.

(S) 3. Develop "Expels" and other systems with enhanced C-C^3 target parameter capability especially for communications emitters.

(S) 4. Develop other special C-C^3 devices and technology.

a. Disposable jammers with friendly frequencies to confuse enemy REC.

b. Automated fingerprinting, templating techniques.

c. Improved ARMS and other stand-off munitions for use against communication emitters and other C^3 assets.

(S) II. DISCUSSION (U)

(S) A. ANALYSES OF OPERATIONAL AND FUNCTIONAL NEEDS (U)

(C) 1. BACKGROUND (U)

(U) The WP buildup of their forces in Central Europe, particularly over the last 15 years, has put them into a position of overwhelming numerical superiority in most categories of weapons. Qualitatively they have also greatly improved their position relative to NATO, and although NATO is still qualitatively ahead in some categories, it is behind in others. Qualitative factors are by no means significant in affecting the Pact numerical advantage.

(U) WP doctrine calls for carrying on combined tactical nuclear and conventional operations if and as necessary, and their planning is based on the assumption that their forces may be attacked by nuclear weapons at any time. Therefore, there is emphasis on avoiding dense concentrations of forces which would constitute lucrative targets for tactical nuclear weapons except for as short a time as necessary to achieve a breakthrough. Thus, their plan for offensive operations is to be carried out on a relatively tight time schedule for the convergence and effective integration of combined arms forces along axes of attempted breakthrough whether the operation employs conventional weapons only or both conventional and nuclear weapons.

(U) The WP emphasis on the offensive and the breakthrough of armor at high rates of advance has lead them to develop high mobility in equipment and concepts for all force elements including infantry, artillery, armor, air defense and the associated command and control. A collateral benefit of the mobility of these elements is that their movement reduces their vulnerability by reducing the time available for the identification, location and attack sequence. In addition, there is emphasis on vulnerability reduction through sufficient redundancy of critical force elements and supporting systems, including C^3.

(C) The WP concept for sustaining a major offensive is based on the use of echelons at each force level which follow the first echelon forces at the appropriate time to bolster flagging efforts and/or exploit openings which have been developed. In the initial phases of the attack, the time phasing of lower-level force echelons (second echelon Battalions of the first echelon Divisions) is more or less preplanned. However, the employment of higher-level echelons (second echelon Divisions) depends on the relative rates of progress along various axes of attack. There is considerable dependence on C^3 in the event of significant deviation from the initial plan or in any case when the time for commitment of second echelon Divisions. Moreover, the Soviet doctrine of centralized high-level control of military forces places substantial demands on C^3 in assuring success of major attacks.

(C) The NATO military plan for Europe is primarily defensive in nature. The primary threat is a WP surprise attack since NATO in its peace-time posture is not properly armed and deployed to meet a major Soviet thrust. It depends on a postulated minimum of 48-hours warning to posture itself against an aggressive threat. Moreover, because of its numerical disadvantage, NATO forces are heavily dependent on the entry of additional assets such as some Canadian troops and US aircraft and supporting resources from their home bases. Because surprise attack is such a formidable threat, NATO places emphasis on intelligence to provide the earliest possible I&W of increased Soviet mobilization. This reliance tends to drive all near real-time sensors and intelligence collection efforts to support this objective to the possible detriment of others.

(C) NATO, because of its numerical inferiority in weapons across the board, must place great reliance on C^3 as a "force multiplier" so that its more limited fire power resources may be applied at the right place at the right time. By the same token, NATO effectiveness, particularly the disposition of reinforcement to reach anticipated strike points, is extremely vulnerable to degradation of its C^3 which, in comparison with Soviet C^3 is lacking in redundancy and mobility.

(C) As a matter of doctrine, which is probably reinforced by the perception of the extreme vulnerability of NATO to deterioration of its C^3, the WP is thoroughly committed to an extensive plan for aggressive suppression of NATO C^3. This plan is roughly characterized by the objective of destroying about 30% interference with NATO C^3 by jamming and 30% by destruction. This total of 60% interference with NATO C^3 is deemed by the WP, to be adequate to render it almost totally ineffective. The responsibility for Soviet C-C^3 operations rests with dedicated REC forces. REC units are attached and controlled at front and Army levels and assigned to other locations and forces and levels at times required by the attack plan.

(C) On the NATO side, given limited resources and the difficulties of assessing and predicting C-C^3 value and effectiveness, there is no plan or major organizational responsibility for integrated C-C^3. Except for certain communications jamming activities, there are few, if any, discrete plans or capabilities for countering specific elements of Soviet C^3 affecting selected force elements (e.g., artillery). In the contest for scarce NATO resources, C-C^3 has thus far proved to be noncompetitive, not only in acquisition of specialized capabilities, but also in planned priorities for allocations of firepower by operational commanders.

(U) Of late, the growing awareness of the degree of Soviet emphasis and commitment to C-C^3 has forced NATO to reconsider existing attitudes and positions on the value of C-C^3. The present study departs from the 1977 Defense Science Board study and identifies and examines in greater detail a number of areas of C-C^3 which are of high potential value in ground-air operations in countering a WP thrust in Central Europe.

(C) 2. CRITERIA FOR ESTABLISHING C-C^3 PRIORITIES (U)

(U) Although convincing quantitative measures for the effectiveness of various C-C^3 actions are very difficult to come by in most cases, there are a number of factors which can be used to assess how such actions might be prioritized and to indicate that they may represent reasonable levels of effort relative to the results which may be anticipated. The major factors are:

(U) a. Effectiveness in stopping or slowing the Pact Offensive Threat. Here the time criticality of the operation controlled in relation to the time-line of the attack is a major consideration. Also the size and function of the forces being controlled and their essentiality at a given phase of the attack (artillery and aviation in the early phases of attack).

(C) b. Feasibility of locating the target within its time cycle of movement. Most US sensor systems have only periodic access to targets (an airborne SLAR sweeps out its swath over the period of its flight mission time and then lands). Even if the sensor is directly data linked to a processing and interpretation center, these operations take additional time. Equally critical is the time required for an operations staff to evaluate data and to recommend the most lucrative targets for the commander to attack. Further, if positive target identification or refinement of location requires correlation of several sensor outputs, then several may require transmission to analysis center for further processing and decision making. The time cycles for these activities at present may be as long or longer than the times between movements of WP C^3 elements, especially at lower levels. More advanced sensor systems and information processing systems for analysis and distribution in the future should improve the time cycles. For some classes of targets, and some phases of the attack, <u>the time cycle will always be a critical limiting factor</u>.

(U) c. Response time for C-C^3. After a C-C^3 target has been detected, identified, located and evaluated, there remains the question of whether it can be attacked in the time remaining within the target movement cycle. This factor will often be a deciding one in selection of specific weapons for specific targets. The other controlling variables, being the availability, range and accuracy of the selected weapon and its delivery systems.

(C) d. Firepower resources required in relation to the total available. If C-C^3 operations are to prove practical during peak surge periods in requirements for firepower support (artillery and tactical air) such as would occur, for example, during the initial phases of attempted Soviet armored force breakthrough, the firepower for effective C-C^3 action will be necessarily limited to a small fraction of the total available. This factor will often lead to a decision to harass (with mines and expendable jammers) rather than to destroy enemy C^3 targets.

(C) e. Capability of assessing effects of counteraction and restoration of C^3 targets. In order to sustain suppression of C^3 targets, particularly when the counteraction is less than total destruction, some means of periodically assessing the operating status of progress toward restoration of the target is highly desirable (periodic readthrough of communications links being forwarded to determine if alternate frequencies are being used or relocation of CP forced to move by harassment). C^3 targets for which such assessments cannot readily be made, could lead to excessive expenditures of resources for suppression.

(U) f. Synergism with other friendly force actions in defense and counterattack. This factor is a counterpart of the concept of selection of specific targets on the basis of their roles in the time planning of the attack. For example, suppression of Soviet AD C^3 becomes especially valuable in NATO CAS or interdiction operations.

(U) 3. <u>THE VALUE OF C-C^3 ACTIONS</u>

(U) One might characterize the value of C-C^3 actions by considering the following:

(U) a. Soviet functional vulnerabilities and their exploitation.

(U) b. The impact of such actions on degrading Soviet force effectiveness.

(U) c. The impact on the degradation of Soviet REC capabilities.

(U) d. The size of required and available US and Allied resource allocation to effect C-C^3 actions.

(U) e. An examination of the situation through those measures of effectiveness which the US normally uses in justifying its own C^3 systems.

(U) Clearly the value of C-C^3 is dependent upon the time during an operation when it is put into effect. To this end it is worthwhile examining that particular issue in a broader context.

(U) The circumstances under which C-C^3 could be valuable includes both the arena of deterrence and that of defense should deterrence fail. It is clearly in our best interests to determine what C-C^3 actions will enhance deterrence. These, whatever they may be, would either render more uncertain the Soviet assessment of the outcome of a particular military action, or in a better case, present them with problems such that they would be sure that the outcome was unfavorable before such actions were ever taken.

(U) Should deterrence fail and defense be required, there are three sets of general circumstances. The first occurs in the period of time prior to the initiation of hostilities after it is clear they will be initiated. This is the so-called pre-H hour time frame, and might extend for twelve to twenty-four hours prior to the commencement of hostilities.

(U) The second time period is the post-H hour time period when preplanning on the Soviet side may be substantially fulfilled in terms of actions which they expect to take. This period of time extends from H-hour until any pre-set plans must be substantially modified to compensate for deviations arising during the attack.

(U) The third general condition applies in the so-called steady state after the initiation of hostilities. Here it is expected that NATO will carry on both defensive and offensive actions and will counter attack to regain lost territory in a manner consistent with the charter and policy of the alliance.

(U) All of the circumstances must be considered in examining the value of C-C^3. They will be addressed as they are appropriate in the examination of the five general topics which were previously stated.

(C) 4. WP FUNCTIONAL VULNERABILITIES (U)

(U) Functional vulnerabilities derive from the nature of operations, the organization which the Soviets employ for their execution, the tasking given each organization, and the training which underwrites all of the above. A detailed examination of these interdependent issues has been carried out. It is reported in a specially classified appendix to this report.

(C) This analysis uses as its focus seven basic Soviet combat operations:

a. The operational breakthrough controlled by Army and involving several divisions along with Army and Front assets.

b. The Division level attack against a defending enemy.

c. The meeting engagement.

d. Pursuit operations.

e. River crossing operations.

f. Tactical and approach marching which are key features of all operations.

g. Defensive operations.

(C) The analysis concludes that there is substantial potential to disrupt various portions of these on-going operations by degrading the effectiveness of command and control and taking advantage of the inflexibility associated with Soviet preplanning. This analysis also points out that two levels in the zone of the main attack must be countered. This does not mean all CPs or all command functions must be engaged with $C-C^3$ action. It is rather focused on a relatively small subset of the total. In general, though, two levels of command must be negated - either Army and Division and Regiment or the other.

(U) The details of the vulnerabilities and the impact of $C-C^3$ actions are outlined in the special appendix.

(C) 5. <u>$C-C^3$ IMPACT ON WP FORCE EFFECTIVENESS</u> (U)

(U) The effectiveness on WP forces in operations is dictated by the manner in which echeloning and combined arms operations are carried out. To a large extent, echeloning can be preplanned but its effectiveness will ultimately be dictated by the "fine tuning" exercised by command at the time of commitment of successive echelons. Therefore, command impact is crucial for the success of echeloning operations.

(U) This is also true in conjunction with combined arms operations. WP doctrine calls for concerted action on the part of suppression assets (artillery, multiple rocket launchers, surface to surface missiles, and fixed and rotary aircraft) which will deliver fire in support of attacking troops; maneuver forces whose coordination with fire through co-location of commanders and through the implementation of Battalion operations which form the cutting edge of the combat unit; and AD which provides the major protection required to prevent NATO air forces from successfully attacking and destroying Soviet units as they prepare for and execute operations.

(U) C-C^3 actions may cause echeloning to be poorly executed in time and space, and, under best of circumstances, may essentially lead WP echelon forces into traps where their destruction can be effected. The combined arms operations which are necessary on the modern battlefield require that the various means of suppression operate in concert with maneuver and defensive forces in order to provide the maximum synergism between these elements against the defenses which are to be penetrated.

(C) Loss of artillery, for example, or the miss-timing of air attacks which would cause both conflicts with artillery and with AD units, thereby breaking the stride and momentum of the attack. Artillery setup times are substantial. The employment of air is carried out through the employment of critical time windows. Maneuver forces depend upon fire suppression of active defenses for the successful completion of their mission. Modern day anti-tank defenses and main guns on tanks can effect such attrition against attacking forces that these must be suppressed by artillery to a substantial degree before assault conditions are favorable. Soviet battalion operations in assault are commanded through very few nets at battalion level. The Soviets place great emphasis on electronic means of communications between elements. These can be disrupted and, in addition, false information can be fed into the system.

(C) Finally, the Soviet AD, which are thick and numerous, can be denetted through proper action against the command and control elements. This would cause semi-autonomous or fully-autonomous operations. Under these conditions each unit may have to use its own organic acquisition equipment and be acceptable to ARM attack; lacking that, have substantially reduced fire-power capability. A key factor in causing Soviet air defenses to become degraded would be to destroy the SVOD navigation, and control system to disrupt the safe corridor recovery of AD and tactical aircraft through their own defense systems.

(S) 6. THE IMPACT OF SOVIET REC ON NATO C^3 (U)

(S) It is clear from the evidence at hand that successful Soviet REC operations through deception jamming and electronic warfare and through the control of firepower based upon direction finding will cause serious degradation in US and Allied C^2. It may, in fact, achieve well above its advertised target 30% neutralization of NATO C^3, particularly near the FEBA zones. Any degradation which can be effected by NATO C-C^3 action against REC units and assets will have a double effect. Soviet capability will be lessened and US and Allied C^3 will be less degraded.

(S) 7. THE IMPACT OF C-C^3 ON NATO RESOURCES (U)

(C) C-C^3 actions can only represent attractive alternatives if their impact on NATO resource allocation is modest and the return is substantial. To provide a simple assessment of some possibilities, a zero order analysis was conducted. It addressed the composition and disposition of the CPs, how often they move, how long they are fixed, what capabilities are required to destroy or harass them, what are reconstitution procedures should certain CPs be degraded, what is the impact of harassment on CP operations, some sizing calculations to quantify the various processes and finally, a potential concept of operations and its related impact on resources.

(S) Table III-2-1 displays the relevant parameters for the deployment distances of various CPs, and their size (in km^2, personnel, and vehicles). It is seen that there are really three classes or kinds of CPs. They are

TABLE III-2-1

(S) CHARACTERISTICS OF WP C^3 ELEMENTS (U)

ECHELON & TYPE	LOCATION FROM FEBA (KM)	DEPLOYED AREA (KM^2)	VEHICLES	PERSONNEL
BATTALION	3	SGV*	4	10
REGIMENT				
Main	5	0.4	20	40
Rear	10	*SGV	8	20
DIVISION				
Main	15	3	80	175
Forward	5	SGV	8	15
Alternate	15	0.3	8	25
Rear	20	0.4	20	130
ARMY				
Main	50	15	250	750
Forward	20	SGV	12	25
Alternate	50	0.5	20	50
Rear	75	10	120	550
AIRBORNE DIVISION CP	FEBA to 20	NA	1 (Helicopter)	4 (Estimated)
FORWARD OBSERVER	FEBA	NA	1	4 (Estimated)
REC CP	50-100	0.2	**20	**6-100
AIRCRAFT CONTROL	30	SGV*	3	15

*SGV - Small group of vehicles
**These are estimates and these resources could be integrated into the Army and Front and CPS.

either large, such as the main or rear CP; they are small in size ($2km^2$), such as forward or alternate CPs; or they are represented by a small group of specialized communications vehicles occupying an extremely small area (~1 hectare).

(S) Table III-2-2 characterizes the movement and residence time of these units as derived from an examination of Soviet operational time lines. It is seen that the largest of the Army CPs might be in place for 36 or more hours; Division Main CP, 10 or more hours; regimental main CP, 4 or more hours. This gives one rough measures to estimate the $C\text{-}C^3$ system parameters needed against each type.

(S) Figure III-2-1 displays the availability of the larger headquarters if they are forced to move. It is seen that the availability of the larger headquarters is approximately 0.7 under normal conditions. As they are forced to move, the Army, Division, and Regimental headquarters degrade in availability by a factor of 2 to 3 with several moves, because the setup and tear-down time is so substantial. Should these headquarters be forced to move because of either harassment by munitions or jamming which prevent their successful use, then either movement must be effected or operations must be shut down until interdiction can be overcome.

(S) Table III-2-3 presents sizing calculations for the destruction of CPs. This table and the accompanying Figure III-2-2 display the depth of various kinds of CPs and the tonnages (and related sorties or artillery rounds) required to produce a 60% level of damage. Sixty percent was chosen since this is the Soviet norm for damage levels requiring replacements of units. It is seen that very large asset allocations are required to destroy Army and Division and Regimental main headquarters while only very modest allocations of resources are needed to destroy the forward or alternate CPs. In addition, the tonnages and related delivery requirements for either mining or jamming with expendable jammers near CPs are very modest, and can be carried out with a few tons of munitions which are variants of those in development today.

TABLE III-2-2

(S) SOVIET COMMAND POST OPERATIONAL FACTORS (U)

COMMAND POST TYPE	MOVEG PER UNIT TIME	TEAR DOWN TIME HR	MOVEMENT DIST/TIME KM / HR	SET UP TIME HR	ACTION TIME HR/DAY	FRACTION OF TIME FIXED	FRACTION OF TIME MOVING	OPN AVAIL
ARMY MAIN	1/48 HR	3	30/2	8				
DIV MAIN	2/24 HR	1	10/1	2	16/24	22/24	2/24	0.6T
RGT MAIN	4/24 Hr	0.5	5/0.5	1	16/24	22/24	2/24	0.6T
DIV FWD	6/24 HR	0.1	1-2/0.1	0.1	22.2/24	23.4/24	0.6/24	0.91

FIGURE III-2-1

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IMPACT ON EFFECTIVE "HARASSMENT" ON CP AVAILABILITY (U)

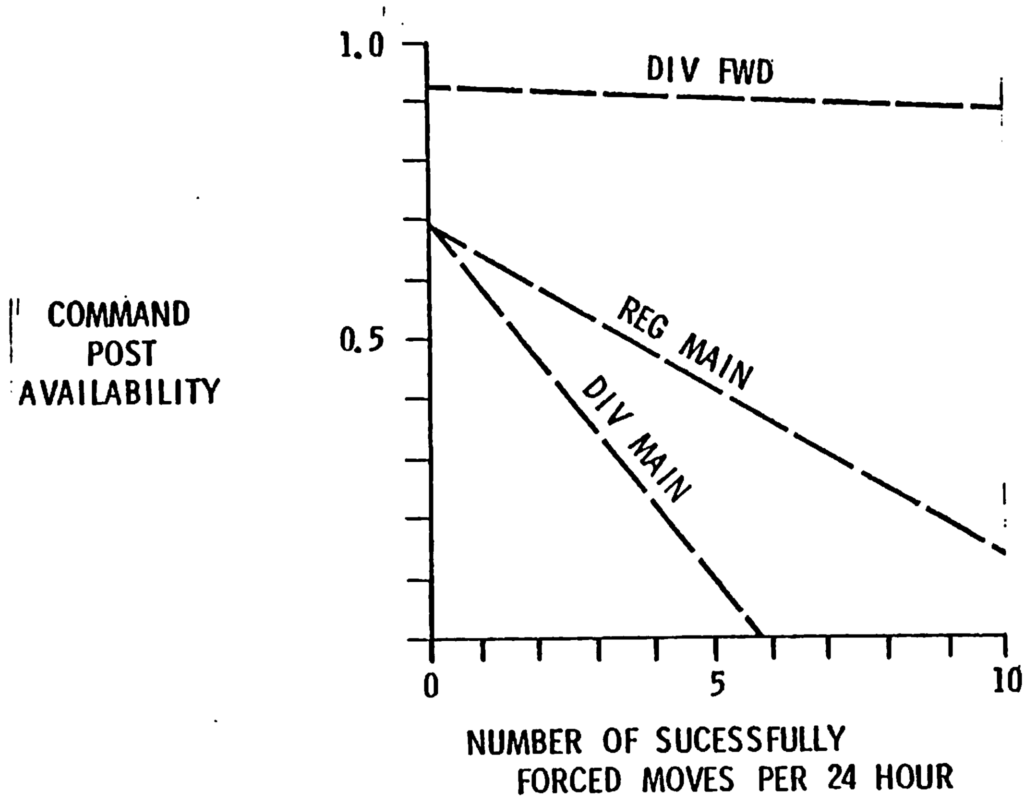

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TABLE III-2-3

(S) MUNITIONS SIZING FOR COMMAND POST TARGETS (U)

- suppress 2HA
- suppress 0.25 km^2
- suppress 1.0 km^2
- suppress 5x1.0 km^2

} Achieve Damage Probabilities of 50% to 60%

° soft targets - trucks, vans, people
° stored energy - fuel, munitions

		Army Fwd Div Fwd Reg Rear Btn 2 HA TGT	Army Alt Div Rear Reg Main 0.25 km^2 TGT	Div Main 1.0 km^2 TGT	Army Main Army Rear 5x1.0 km^2 TGTS
CBU-58	air delivered	2 tons	25 tons	100 tons	500 tons
ROCKEYE	air delivered	2.5 tons	32 tons	130 tons	650 tons
MK-82	air delivered	2.5 tons	32 tons	130 tons	650 tons
M-483	artillery	4.5 tons	54 tons	216 tons	1080 tons
M-549	artillery	5.4 tons	65 tons	260 tons	1300 tons
FAE (1000 lb)	air delivered	2 FAE	25 FAE	100 FAE	500 FAE

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FIGURE III-2-2

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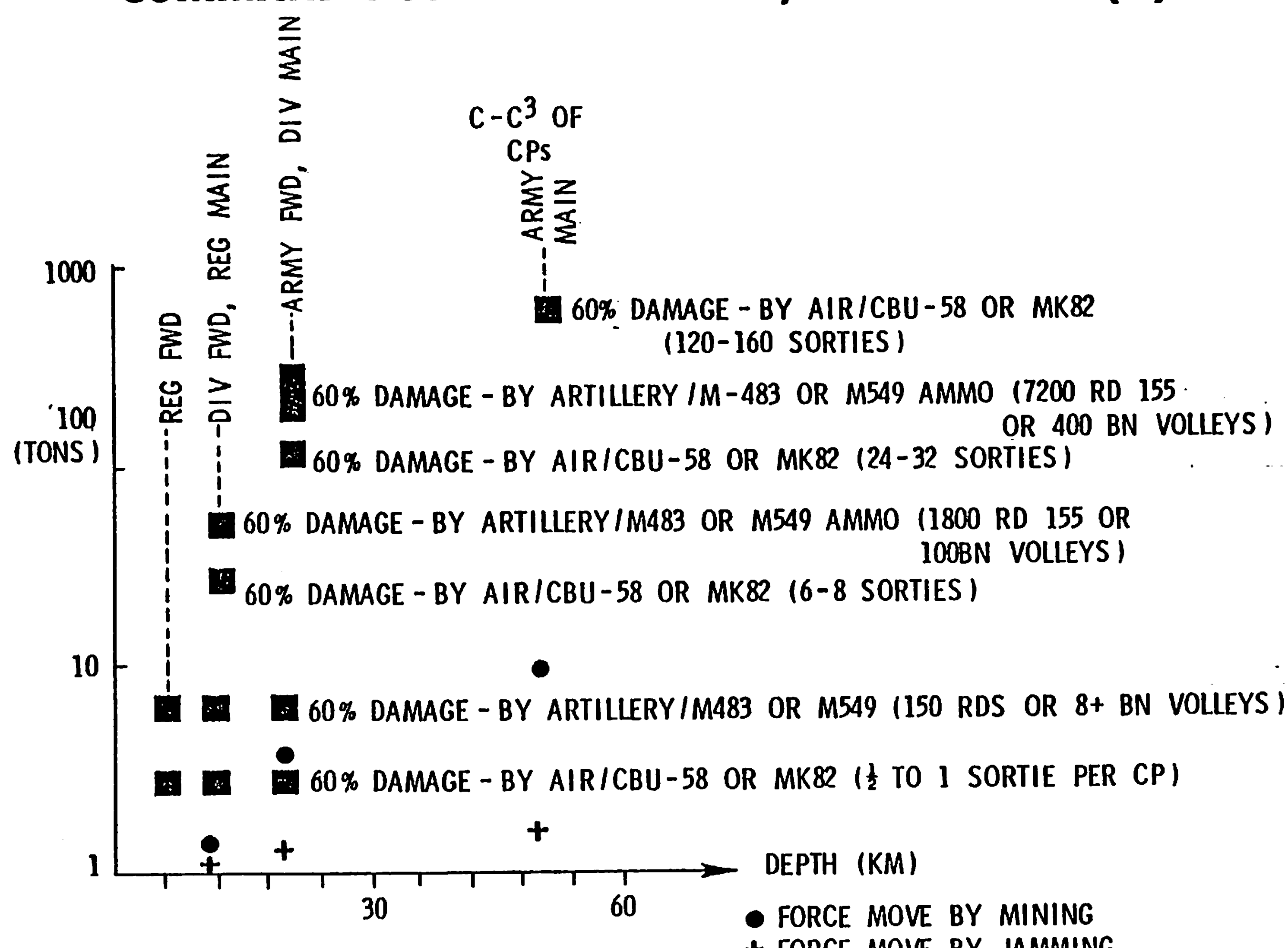
COMMAND POST INTERFERENCE/DESTRUCTION (U)



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(S) A potential concept of operations should involve selecting the key CPs controlling a given main attack or successfully mounted secondary attack. This will be generally one Army main, one Division main, and one or two Regimental main CPs. These could be "mined" with the Artillery Delivered Anti-Personnel Mine (ADAM) mine, the ROOK, and possibly small FAE, although they are not currently optimized for this task. The success of such mining operations would require that the Soviets move the CP or face the destruction of personnel and equipment when these mines are detonated. Optimized munitions would create fires in fuel tanks and surrounding forests.

(C) Movement of these CPs would cause general nonavailability and force the load from main CP to alternates and forward. The communications capability of main CPs are substantial, but forward and alternate CPs have much less capacity. In general, communication levels at these smaller CPs would rise substantially; so it should be possible to locate them with greater accuracy for attack, reduce their effectiveness because of overload.

(S) It may be seen from the preceding tables and figures that the munitions requirement necessary for destroying these small CPs are very modest. It is therefore concluded that a modest allocation of resources (some approximately 3-10% of one day's expected firepower expenditures) would substantially negate selected C^3 assets with a combination of harassment and destruction of the target CPs.

(S) 8. MEASURING C-C^3 EFFECTIVENESS (U)

(C) The effectiveness of C^3 is generally evaluated through wargaming techniques and measures of effectiveness which involve the timeliness and quality of information and its impact on combat situations measured through FEBA movement and rate of attrition; but it is not clear that a two-sided analysis can be done to include effects of degrading C-C^3 WP capability with presently available or projected modeling and gaming techniques. While it is to be expected that such efforts would generally show the effects which have been topically outlined in the previous sections, it would be worthwhile to carry out such assessments to search for results substantially different from those stated here and to quantify sensitivities associated with actions stated previously. Such assessments would be supported and illuminating, if achievable.

(S) Pending the development of suitable techniques it is recessing to consider more heuristic or intuitive assessments of the probable impact of effective C-C^3. The following are some observations made by the Task Group in this connection:

(C) The true test of overall C-C^3 effectiveness is only possible in actual combat.

(S) C&D can be practiced in peacetime. Its success can possibly be ascertained through intelligence sources.

(S) Experiments can and should be conducted with existing and improved collection assets to measure their ability to identify and locate WP C^3 elements during training maneuvers or force rotations.

(S) Measuring can and should be conducted with existing and improved condition assets to measure their ability to identify and locate WP C^3 elements during training maneuvers or force rotations.

(S) Measuring the effectiveness of C-C^3 harassment or destruction techniques remains the most significant problem. Field exercises can provide only very crude measures. U.S. experiences where EW so disrupted field exercises that the jamming was discontinued to permit any productive training, bolsters confidence that C-C^3 is indeed very important (and also that U.S. is highly vulnerable); but does not yield quantitative values of results versus assets invested.

(C) Rough quantitative "force-divider" ratios are, however, available such as:

- one artillery CP controls 18 tubes
- one armor CP controls 43 tanks
- one SVOD controls 100's of aircraft

(S) In addition, one can compare the cost to provide AJ to our ground radars and our communications versus the cost of disabling REC.

(S) Finally, the essential value of our own C^3 survival can be balanced against the cost in weapon assets to disable WP C-C^3. A desired end result of such an analysis would be to provide a sharper focus on the C^3 elements to be given greatest attention in C-C^3.

(S) B. <u>CURRENT AND PROJECTED CAPABILITIES</u> (U)

(U) 1. <u>OVERVIEW</u>

(U) The input briefings and data provided this Task Group supported by the wealth of information contained in the Defense Science Board report and the recently completed "in-house" Air Force study made it abundantly clear that considerable C-C^3 capability exists today. The need is to "get our act together." This situation is summarized in Table III-2-4. The many assets involved were, of course, developed for other objectives. The fact is that C^3 centers are, indeed, softer and fewer in number than the targets, e.g., tanks, SAM systems and artillery, against which most NATO weapons have been dedicated.

(U) Certainly improvements are desirable and will be addressed in subsequent sections of this study.

(S) 2. <u>ASSESSMENT OF ARMY CAPABILITIES TO DESTROY OR HARASS WP C^3 ELEMENTS</u> (U)

(S) C^3 associated with any combat force is a key element to the success of the battle; however, because of the priority to destroy hard targets (maneuver forces) in the first and second echelon forces, this segment of the WP force structure has not been specifically targeted. The US has clearly defined, as high priority, the investment of major resources to insure that our C^3 is secure and functional throughout the battle. This is imperative if we are to fight out-numbered and win the first battle. Common logic would indicate that if the US has placed key emphasis on their own C^3 elements, then WP forces would require these same ingredients to win the first battle and make the significant gains that their doctrine dictates.

TABLE III-2-4

(S) SCORE BOARD (U)

ITEM	PRESENT STATUS	DEFICIENCIES
Location & Identification	Considerable data for C^3 Location adequate for harassment	Not utilized for C-C^3 Few tailored for C-C^3 Accuracy deficient for destruction
Analysis & Correlation	Several centers in operation	Data collection not coordinated Lack timeliness for most C-C^3
Delivery Systems	Many assets: Aircraft, artillery, Missiles	Aircraft survivability Quantity limitations Range limitations except aircraft
Payloads	Many effective payloads	No disposable jammers Cluster/wide area munitions not optimized

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(C) Locating and identifying WP C^3 elements at all echelons from regiment through Army is a major task when considering the large numbers that are deployed at each echelon. At first glance it would appear that to be successful in degrading the WP forces C^3 elements, a high percentage should be destroyed. Destruction would require the WP to reconstitute the element with both equipment and personnel with the major penalty being the loss of valuable time during critical phases of the battle. Even though destruction appears to be the best and most permanent approach, it is costly in terms of resources required and time to execute. It also requires very accurate data concerning the location of major components of the C^3 element.

(C) In view of the high cost to locate key components of WP C^3 elements and the large tonnages of munitions required to effect destruction, other alternatives were examined. NATO currently has capability to locate C^3 elements only to a degree that our jamming capability may intermittently disrupt the WP C^3 capability. In addition, NATO has the capability to harass WP C^3 elements with firepower with minimun impact on the available firepower.

(C) The current US Army capabilities to harass and destroy WP C^3 elements are depicted on Table III-2-5. These capabilities are adequate to maximize the impact on all C^3 elements from the FEBA up through the Division echelon. The available firepower is timely and accurate enough to put maximum pressure on the C^3 elements and cause the WP commander to take alternate courses of action to sustain the momentum of the battle. Each change that must be made by the WP commander could delay the battle and in some cases could overload some C^3 elements to a point that would render them ineffective. If this happens, we have accomplished the mission without the high cost of critical resources. See Table III-2-6 for an overview of the US capabilities and the C^3 systems that can be impacted.

(C) Even though it appears that we have the present capability to put substantial pressure on the WP C^3 elements, we have deficiencies in our total C^3 effort. Aside from the lack of C-C^3 doctrine or organization, the Army's principal deficiency is that our current systems cannot put adequate firepower on C^3 elements beyond 40 kilometers. The C^3 elements beyond current

TABLE III-2-5

(S) ARMY WEAPON SYSTEMS AND CAPABILITIES (CURRENT & NEAR TERM) (U)

SYSTEM	RANGE (KM)	*EFFECTIVE RANGE (KM)
105MM		
- M101A1(T)		
Conventional	11	7.5
Range Augmented Projectal (RAP)	14.5	9.7
- M102		
Conventional	11.5	7.7
RAP	15.1	9.8
155MM		
- M114AI(T)	14.6	9.8
- M109A (SP)		
Conventional	14.6	13
RAP	19.4	13
- M109A (SP)	18.1	12
- M198 (T)		
Conventional	22-24	15
RAP	30	20

TABLE III-2-5 (Continued)

SYSTEM	RANGE (KM)	*EFFECTIVE RANGE (KM)
8 Inch		
- M110	16.8	11.2
- M110A1	20.6	14.1
- M110A2		
Conventional	29.3	19.6
RAP	TBD	
175MM		
- M107	32.8	21.9
2.75 Rocket	4	4
4.2 Mortar	6	6

*Effective range is based on a planning factor of the weapon system being positioned about 1/3 of the maximum range of the weapon for the FEBA.

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TABLE III-2-6

(S) ARMY REPRESENTATIVE CAPABILITIES TO DESTROY OR HARASS WP C^3 (U)

	CURRENT							FUTURE				
C^3 ELEMENTS	105	155	8"	175	2.75 ROK	4.2 MOR	AIR DEF	GSRS	LANCE	RPV	SCAT MINE	U/E JAM
REGIMENT												
MAIN	x	x	x	x	x	x		x	0	x	x	x
REAR	x	x	x	x				x	0	x	x	x
DIVISION												
MAIN-ALT		x	x	x				x	0	x	x	x
FWD	x	x	x	x	x	x		x	0	x	x	x
REAR		x	x	x				x	0	x	x	x
DIV ABN CP							#					
REC CP												
AIRCRAFT CONTROL										x		
FO VEHICLE	x	x	x	x	x	x		x	0	x	x	x
ARMY												
FWD		x	x	x				x	0	x	x	x
MAIN-ALT												
REAR									x			

NOTE: # If high enough to observe and within range of AD weapons.

X Weapons which impact on C^3 elements.

0 Has capability but cost and accuracy may be limiting factors.

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range limitations include some of the aircraft control and REC elements and the Army echelon (with the exception of the Army forward). In addition to the distance factor, another key deficiency is the amount and type of munitions that are available to support the C-C^3 mission. Some programmed capabilities include:

(C) LANCE Missile (Conventional). The LANCE was introduced into the Army inventory with only a nuclear capability. A decision has been made to develop a nonnuclear round for the LANCE which will provide a range of 70 kilometer, about a 50 percent increase in range for conventional weapons. Even though the additional range is a plus, the missiles are relatively high cost, and the accuracy does not lend itself to be effective against small targets such as groups of CP vehicles in a C^3 complex. Even with these limitations, however, the LANCE will be an effective harassment weapon system for delivery scatterable munitions and jammers.

(C) General Support Rocket System (GSRS). The GSRS is currently in the development stage and when fielded will provide a major increase in high volume of fire in a short period of time. This system appears to have high potential for harassing or destroying C^3 elements from the FEBA through the Division main C^3 elements. It is also programmed to have a capability to deliver scatterable mines which appear to have high potential for harassing C^3 elements.

(C) RPVs. Conceptual testing of Aquilla Mini-RPV was completed in 1978. There is a critical need for an unmanned vehicle of this type that can observe the enemy during day, night, and in all types of weather. The RPV will provide us with a significant improvement in our capability to locate and identify C^3 elements. The size of some C^3 elements makes it very difficult to identify specific key elements within the C^3 complex. The first generation Mini RPV will have a real-time, day-only TV capability with a built-in laser designator for directing cannon-launched guided projectiles. It will have a range of 20 kilometers beyond the FEBA which will limit our capability to observe the Army C^3 echelon. While the first generation Mini RPV has limitations as it is related to the total battlefield, it will provide the commander with the first organic capability to observe the battlefield in real-time. This will also be a major factor in assisting the commander in moving his forces to maximize his assets to blunt an attack, put firepower on the right target at the right time, locate WP C^3 elements with precision. The advanced Mini RPV will be a follow-on effort with new sensors that will provide significant increases in capabilities. It will have a day/night and all-weather capability and about a 50 kilometers range. The concept of putting expendable jammers on the Mini RPV is currently being investigated. Other developmental sensor packages include FLIR, Radio Relay, and decoys.

(S) Unattended Expendable (U/E) Jammers. Conceptual test and evaluation of U/E barrage jammers will be completed in 1978. Initial testing has indicated that this type jammer, which is small and light weight, has a high payoff at a relatively low cost. Hand emplaced, air delivered, and artillery versions were evaluated. Their low power, short effective range, and our ability to deliver them among the WP forces will insure that they do not interfere with our own C^3 elements. The U/E barrage jammer will be packaged for remote deployment by artillery or other delivery means such as rotary/fixed-wing/RPV air drop, or hand emplacement. The U/E barrage jammers will be packaged for deployment by 155mm weapons systems to make maximum use of the high number of present and projected 155mm pieces in the field. Future efforts could easily adapt the payloads to the M509 carrier round for deployment by 8-inch weapons, or, for lower development costs, the item could easily be sleeved for suboptimum use of the approximately 2:1 volume increase available in the M483 family of base-ejected ammunition. No modifications to the existing base-ejected cargo round hardware are envisioned, resulting in low development and ballistic similitude.

(S) Capable of being packed nine per MM483 rounds the U/E barrage jammer payloads are essentially short cyclinders of 5-inch diameter and 2-3/8 inch height. The jammer becomes armed after sensing the setback and spin of launch. A borerider senses when the unit is free of the carrier. At this point, a timer is activated allowing sufficient time for the unit to fly, impact, and come to rest. After this elapsed time, the antenna ground radials are deployed (to stabilize tipping of the vertical element) a small clearing charge unobstructs the antenna port (should the device spin into soft earth or land in weeds or snow), the vertical antenna element pops up, and the electronics are activated to begin the jamming mission. The jammer will remain active for approximately 60 minutes (minimum of 30 minutes under arctic conditions) before either a timer or battery sensor initiates an internal pyrotechnic network to destroy critical components rendering the item useless as a jammer. As a possible antidisturbance mechanism, a small percentage (say 5%) of dummy units could be deployed with explosive charges which would detonate upon any motion after the item comes to rest.

(S) The U/E barrage jammer will omit continuous noise across the 1.5 to 12 and 20 to 51.5 MHz bands. The transmitter is frequency modulated at rates to appear as FM ambient noise to the victim radio operator. Since the transmitter need not be periodically deactivated to determine if the victim signal is still on the air (lookthrough), the victim has no audio indication he is being jammed. Enemy use of alternate frequencies will prove fruitless, since the jamming covers the entire tuning range of his equipment. The logical assumption made by the victim is that either the other end of his link is inoperative or his equipment is malfunctioning. The U/E jammer has no effect on friendly communications or intercept receivers because normal deployment of the U/E jammers places it in close proximity to the threat receivers.

(S) ADAM - The Army has a major combat development program for a family of scatterable mines that will be effective against armored vehicles and personnel. The ADAM will be well suited for the C-C^3 mission. In order to increase its effectiveness it should be employed with a mix of HE and/or smoke. The ADAM is programmed to be configured in the 155mm round and will include 36 individual mines with trip wires. When it is activated it pops-up about shoulder height and has the capability of killing or injuring several people. Since scatterable minefields are not marked with any degree of accuracy they all have a self-destruct capability. This will make it possible for friendly forces to conduct offensive operations in areas previously mined without clearing the minefield.

(C) In addition to the future development of major systems there are programs to improve the munitions of selected weapon systems:

a. The current 2.75 inch rocket has a short range and is primarily effective against area targets. Improvements include extended range, better fire control and a more effective warhead against hard targets. Currently it is fired from helicopters which operate near the FEBA.

b. Extended range projectiles are being developed for the 155mm and the 8 inch weapon systems. These will provide more complete coverage of C^3 elements in the Division echelon.

c. Currently a vigorous smoke program is being pursued. At first glance one may wonder what effect smoke could have on C^3 elements. If used alone, it would have a very minor effect; however, if you combine this capability with HE and scatterable mines, it could impact heavily on the ability of the WP C^3 elements to operate effectively and/or remain in position. Our current artillery delivered smoke capability is limited because of the large number of rounds required to produce an effective smoke deterrent for any length of time. Ongoing developments in the WICK concept for smoke rounds will provide a significant improvement in our artillery and mortar smoke capability.

(S) 3. PRESENT AIR FORCE CAPABILITIES AND DEFICIENCIES (U)

(U) Air Force C-C^3 capabilities, such as they are, fall into two broad types of activities which can be best referred to as "lethal" and "non-lethal." Each of these categories will be examined in the background discussion which follows.

(S) US/NATO military reliance on electronic control is considered a major weakness by the Soviets. They have made disruption of this control a prime objective. As early as 1974, Air Force Special Comm Center Study "ECM vs 407L/412L...Analyses of Soviet Warfighting Posture" documented that the WP had gathered sufficient intelligence on US/NATO electronic equipment to support all of their major contingency plans. The emerging WP objective is disrupting NATO electronic control systems centers on introducing further time delays in the control process so that if and when the information is finally surfaced it is obsolete. The generally established target priorities are as follows (descending order of importance):

1. Artillery, rocket and Air Force units that possess nuclear weapons, C^3.

2. CPs, Observations Posts, radio centers and radar stations.

3. Field artillery, TAF and AD units.

4. Reserve forces and logistic centers.

5. Point targets jeopardizing advancing Soviet forces.

Additionally, the Soviets focus much of their collection efforts on determining and updating the electronic order of battle. They have further prioritized jamming of US Division communications by establishing four levels of interest:

1. The common nets.

2. Artillery fire C^3.

3. Operational guidance and request nets for TACAIR support.

4. Reconnaissance and radar warning nets.

(S) Although present Soviet EW equipment technologically lags US systems development, they have effectively countered by developing doctrine which (1) exploits NATO capabilities; (2) establishes a massive yet effective organizational structure; and (3) fielded large numbers of adequate equipment.

(S) On the other side of the coin, current US/NATO non-lethal $C\text{-}C^3$ assets are extremely limited and are further degraded by the employment standoff distances required. The large number of WP back-up communication modes available and the lack of NATO abilities for accurate and timely identification of critical links degrades the existing capability to a point approaching zero. Any WP growth in this area will result in future NATO C-C^3 capabilities being "even worse." At present only Coronet Solo poses an airborne communications jamming capability. Although this system's primary use is to counter hostile government TV and radio broadcasts, an incidental communications jamming function against ground links was discovered during exercises. The system is presently installed on a Pennsylvania Air National Guard EC-121 and has transmit and receive capabilities covering the 35-45MHz frequency range.

(S) Future applications of communications jamming (C-C^3 capability) operations are proposed in only two areas:

1. Retrofit EC-121 Coronet Solo equipment in C-130s. Enhanced systems to counter WP combined arms Army ground to ground and GCI links may also be included.

2. Continued design and development efforts for an AD communications jammer by Sylvania may produce capabilities in the areas of Red C^3 functions.

(C) Turning to the lethal aspects of Air Force C-C^3 efforts, tactical aircraft (F-4, A-7, A-10, etc.) are currently able to apply a variety of destructive weapons in C-C^3 roles against mobile and moderately fortified WP C^3 elements. The Table III-2-7 depicts the characteristics of representative destructive munitions needed for C-C^3 operations.

(C) The accuracy of Air Force tactical fighter weapons delivery systems against point targets ranges from CEPs of from 50 feet with visual systems to 400 feet for poor weather delivery.

(S) Present and future C-C^3 deficiencies in non-lethal and lethal air assets are readily apparent. The non-lethal capability is presently extremely thin. Even with the planned enhancements, Coronet Solo employment will undoubtedly continue to be through the use of standoff techniques to preserve the airborne platforms. The net result of this approach is less disruptive power reaching enemy C^3 elements. Constraints resulting from the small number of sorties available from the Coronet Solo force coupled with slow geographic movement times

TABLE III-2-7

(S) REPRESENTATIVE MUNITIONS (U)

Desired Characteristics	TACAIR Munitions	Principal C^3 Targets
	PRESENT	
High accuracy for use against point targets; Wide range of explosive/ destruction power.	M61 20mm Gun GAU-8 30mm Gun LGB's	Electronic/Comm Van, Generators, Support Vehicles
Area Destruction/Denial	GP Bombs (MK 82,84), with contact and time delay fusing; Air delivered mines Cluster Munitions Pyrotechnic Munitions	Revetted and lightly fortified command bunkers, personnel concentrations, support vehicle & truck parks
	FUTURE	
Comm and Data Link homing capability; Localized destruction	Unknown	Command radio transmission links, antenna sites

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and resulting in low time on station, points to the need to develop power jamming devices which can be implemented near or on the target C^3 sites. The result of this technique is higher disruptive power levels of jamming reaching the target elements even though the jammers are of lower power.

(C) The success of lethal attacks on C^3 elements is critically dependent on the ability to locate the specific targets so that they may be visually or electronically detected and attacked by the weapon delivery system. As was previously noted delivery accuracies are obtainable. What is missing is the wide area destructive/harassing munition which can economically reduce Soviet C^3 effectiveness.

(C) The bottom line is that, like the WP, NATO too can realize the maximum potential effect on the air-land battle only when a coordinated lethal/non-lethal doctrine, employment concept and support equipment development effort are combined in a coordinated effort.

(S) C. PROPOSED CONCEPTS (U)

(C) 1. CONCEPTUAL C-C^3 SYSTEM (U)

C-C^3 is truly a systems problem in which enemy C^3 assets must be located and identified, decisions must be made on the optimum actions to be taken, the actions must be instigated and the results must be evaluated. The flow of actions are shown schematically in Figure III-2-3.

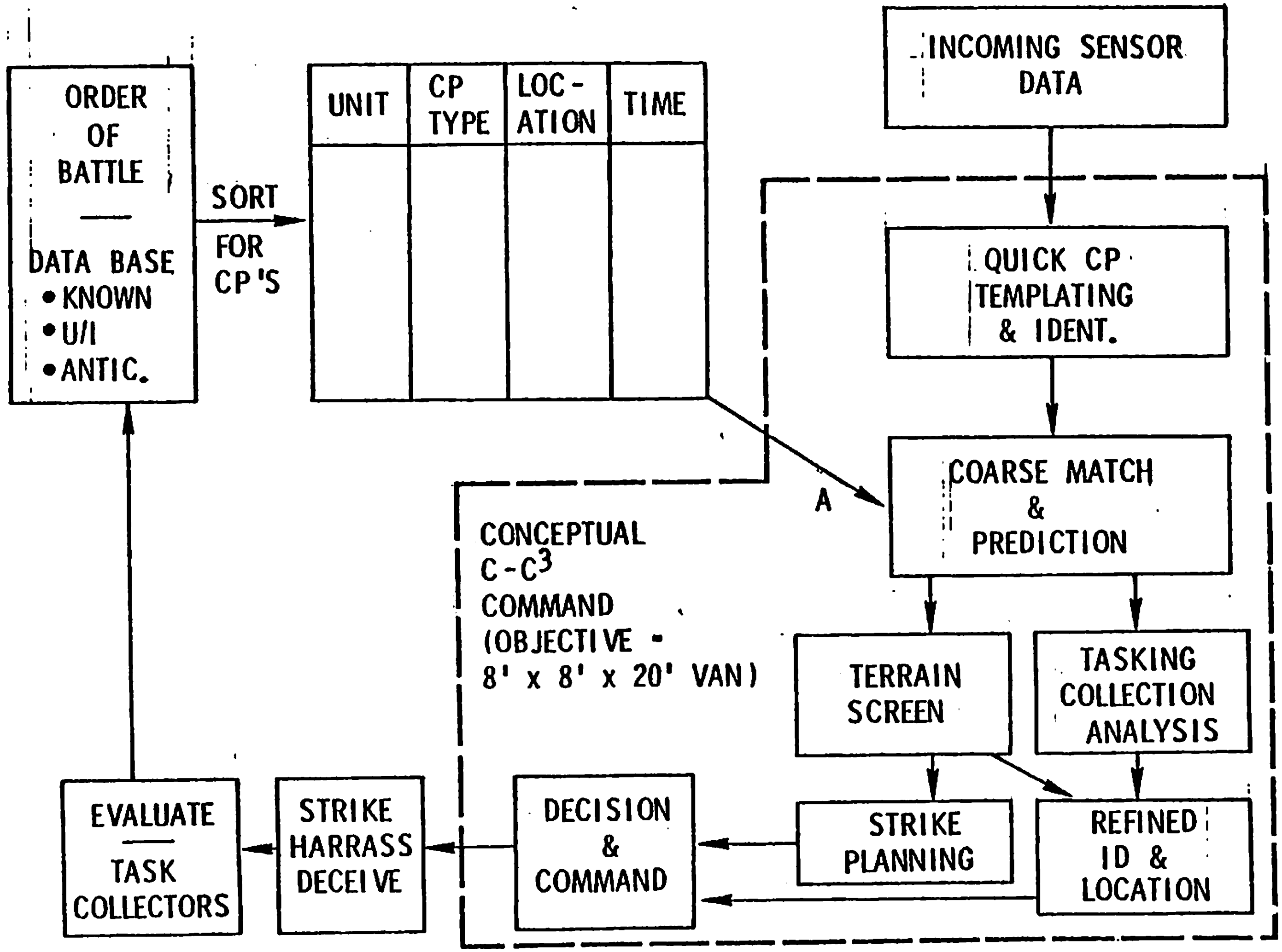
(S) It will be noted that the actions contained within the dotted lines essentially constitute a command and control system for C-C^3. As such the emphasis is placed on aids to identification, correlation with existing data, and timely decision making. We believe such a command and control system is of great value to C-C^3, can be fielded more quickly than an operational version of BETA and represents a smaller investment.

(S) 2. DETECTION-IDENTIFICATION-LOCATION (U)

(S) The targets of interest are the various CPs of Soviet military forces, Army Main, Division Main, Regimental Main or Alternate Forward. These posts are

FIGURE III-2-3

CONCEPTUAL C-C^3 SYSTEM FLOW (U)



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at depths of a few to 50 kilometers behind the FEBA and move on schedules of an hour or so to 36 hours. The larger posts -- such as Army Main or Division Main -- are characterized by a large area, remotely located antennas and many vehicles, a smaller area, vehicle-mounted antennas and only a few vehicles.

(S) C-C^3 location accuracy must be appropriate to the counteraction intended; for example, the location would have to be determined to 50-100 feet for precision or selective destruction. On the other hand, harassment (such as artillery fire, mining localized jamming accuracy to a fraction of a kilometer) is sufficient. However, there is also an important timeliness constraint. Detection/identification/location must be done on a time line that is consistent not only with the ability of US forces to respond and take the desired counteraction, but also with the typical move schedule of the appropriate CP target. For a small one that remains in place for an hour or less, the response time from initial location to completion of the counteraction must be a fraction of an hour; for larger ones, the corresponding figure is 10-15 hours.

(S) For such targets there are many signatures that can be exploited to locate and identify them; for example, there is the overall visual appearance, number of vehicles, gross area, type of vehicles, or special configurations of other equipment that may be present. Another signature is the pattern of radio emissions -- HF, UHF, multi-channel -- the pattern of radio traffic, details of the radio signals - voice radioprinter and fingerprints of either the radio signals or any nearby pulse emitters such as local defenses. For the large post, internal movement of vehicles or transient helicopter traffic is also a possible signature.

(C) The problem is in four parts:

- Detect and identify the presence of CPs in the pre-attack period.

- Know their customary pre-attack positions plus such characteristic parameters as set-up tear-down time, typical rate of movement, field emplacements and other signatures.

- Track the movement of a CP from position to position during exercises or in the post-attack period.

- Importantly, do the last two tasks with sufficient accuracy and timeliness for desired counter-actions.

(S) There exists today a variety of data sources that can be used to detect/identify CPs and to locate them by sensing typical signature parameters. Among them are:

- SLAR imagery such as UPD-4.

- Tactical SIGINT field assets such as Guardrail, RF-4C, TEREC.

- National technical means.

- QSR-infrared imagery.

- Rivet Joint collection

- SR-71 reconnaissance.

- MTI radar such as the Mohawk OV-1.

(S) The data collected by any one of these is by itself inadequate to establish location sufficient for an accurate destructive strike action, especially by artillery. However, location accuracy is adequate for such harassment actions as artillery-delivered mines, localized jammers or for cueing a tactical photo-reconnaissance mission.

(S) It is obviously possible in principle to combine data from several sensor-collection sources to improve accuracy. There are available today for this purpose:

- Tactical field intelligence staffs.

- The Boerfink bunker.

- The COIC.

- Tactical photo reconnaissance centers.

- National SIGINT centers.

- Centers for National Technical means.

(S) However, since enemy CPs do not now have a particularly high priority of concern, the timeliness with which such analysis and correlation activities can respond is generally inadequate for most C-C^3 purposes.

The conclusion is that there are in place today many assets that collect information pertinent to locating and identifying CPs, but such information is not routinely processed in a timely and appropriate manner for the purpose of planning against enemy C^2. Furthermore, in some instances the data is spread across different military Services or across systems subordinate to various agencies. Sharing of it is inhibited by traditional jurisdictional barriers.

(S) There are presently planned systems expected to be available by 1983 that can provide additional data for more accurate identification and location. Representative ones are:

- ASR SLAR.

- RPV/Drone sensors.

- PLSS.

- Improved tactical SIGINT support from National means.

- Improved MTI radar (SOTAS).

- CEFLY LANCER airborne emitter location system.

(S) There are also presently planned future analysis and correlation assets anticipated to be operational by the 1983 time period. Among them are:

- The Air Force TFC

- The Army ASAC.

In the interim, the BETA test bed and experiments will have provided valuable guidance and experience for combining data from different sources by new and innovative techniques; e.g., templating of targets.

(S) The concept of templating to locate CPs is particularly intriguing. The Army is presently studying this concept at Ft. Huachuca, where they are combining state-of-the-art sensor inputs and using regression analysis techniques to obtain location/configuration of CPs. This promising concept should be emphasized.

(S) Today, CP data are contained in the EOB that is maintained regularly by tactical intelligence staffs, but not in a uniquely identifiable form. Depending upon which sensors/collection systems happen to be operational, the rapidity with which an EOB can be updated will vary from a fraction of an hour to many hours. As noted previously, location accuracy is generally too poor for destructive counteractions (though, perhaps, adequate for harassment). With presently planned future sensor/collection systems and correlation/analysis centers, the accuracy with which CPs can be located will be adequate for all counteractions, and the response time can be made sufficiently fast. On the last point, there will be no technical limitations but organizational and jurisdictional interfaces (The "Green Door Problem") will have to be streamlined, including those with national centers. However, unless such information -- normally considered to be intelligence -- is made available to the operations and targeting staffs in a timely manner, it will still be impossible to adequately accomplish the C-C^3 mission. To encompass the full breadth of destructive and/or harassment counteractions against Soviet CPs at all levels, there must be full cooperation between Air Force and Army organizational elements, joint tasking of collection assets, and sharing of data by organizational elements for planning and allocation of resources. There must also be adequate transfer of relevant data from the intelligence staffs to the operational and planning staffs.

(S) 3. C-C^3 HARASSMENT AND DESTRUCTION (U)

(C) The US Army is currently undertaking an advanced development program for U/E jammers targeted at WP communications over the frequencies 2-12 MHz and 20-51.5 MHz. These take the forms of artillery-delivered, hand-delivered, and drone/RPV borne jammers operating in the barrage mode to effectively deny use of the HF and VHF portions of the WP communications spectrum within a very specific geographic area. In addition to continuing the current U/E jammer development program, it is proposed that two extensions to this program be initiated.

(C) The first extension is to adapt the U/E jammer technology to operate over the complete range of MHF, UHF, the frequencies used for the multichannel, wide area (TROPO), and the air-to-ground VHF single channel systems at Division and Army CP levels. Deployment of U/E jammers operating at all WP communications frequencies would effectively deny WP Division and Army level CPs communications long enough to either interrupt the WP C^2 and/or force a move. If used in conjunction with the scatterable mines, attempts to locate and remove U/E jammers would result in the detonation of the mines. Overall, their use alone or with mines would create the desired harassment and relocation of the CPs.

(C) Second, it is proposed that the expendable jammer technology currently under development be adapted to operate over the frequency range of friendly communications. These U/E jammers should be designed to be deployed (artillery or drone/RPV) against specific WP ground-based REC systems after they have been located by friendly intelligence and targeting assets.

(C) WP doctrine provides for the integration of EW and destruction of NATO C^3 as an effective method of battle action. The REC units tasked with the responsibility for these actions are intended to increase numerical superiority of WP forces and introduce delays in the ability of US forces to respond. REC units, especially associated CPs, have been identified as very high priority C-C^3 include: intercept, direction finding, and jamming. The majority of REC equipment is ground-based with a limited airborne complement.

(C) Critical to a REC unit's effectiveness is its ability to collect signals and information in the portions of the communications spectrum used by US/friendly forces. By deploying U/E jammers, operating at friendly frequencies, these devices would effectively prevent (or cover) enemy interception of friendly communications by transmitting noise modulation to degrade the effective sensitivity of the WP-REC collection systems while providing no recognizable signature or indication of jamming. Very importantly, the power levels can (and should) be sufficiently low to preclude interference with friendly communications.

(C) The Army Signals Warfare Laboratory estimates this program would require $6.5 million over five years.

(C) Various weapon mixes may be employed to achieve damage or imminent threat to the relatively soft targets presented by most tactical C^3 nodes. Such effects may include:

- death or injury of exposed personnel,

- penetration and damage of equipment or trucks,

- penetration and firing of vehicles and generator fuel tanks,

- starting of fires in forests and brush areas providing enconcealment,

- felling of small trees, etc., near vehicles/and personnel.

(S) The above requirements should be expanded to consider tradeoffs with scatterable jammers which may be almost as effective in forcing shutdown of communications, and the synergism of combinations of scatterable jammers and munitions.

(S) Two key actions to implement this proposal in the near term are a review of the Army ICM and Air Force WAAM programs to assess their $C\text{-}C^3$ weapon potential; and subsequent identification of changes appropriate to enhance C^3 capability. In the longer term, there should be joint funding of research and development efforts to provide tailored/optimized munitions for $C\text{-}C^3$.

(S) An example of a tailored, optimized weapon for C-C^3 could evolve from the Air Force Have Name program. Such technology has great promise for the C-C^3 mission. It would be particularly effective when employed from a cluster weapon containing a combination of mines, fabrication and pyrotechnic bomblets in the same canister.

(S) Another extremely attractive C-C^3 candidate would be development of a seeker for existing anti-radiation missiles (AGM-45, AGM-78, HARM) that would allow them to detect and home on signals from the Soviet SVOD navigation and control system. SVOD is an excellent example of the emphasis placed by the Soviets upon C^3. Its destruction, exploitation, or degradation would have a grave impact on their ability to control and employ their TAFs. It would appear that a relatively small technological and financial investment in countering SVOD would result in a great payoff for friendly forces, in particular NATO C^3.

(S) 4. <u>RPV/DRONE TECHNOLOGY</u> (U)

(U) Enemy C^3 targets have a wide range of replacement value and defenses. Not all are worth the risk of expensive aircraft. Vehicles with enough sophistication to perform significant parts of the C-C^3 mission at costs between 1/30 to 1/300 of the cost of a manned airplane are possible. RPVs operate with a two-way link with man in the loop for data evaluation and/or mission decisions whereas a drone is self-contained and may adjust its mission profile based on preprogrammed criteria.

(S) The United States and its allies are developing a number of fixed and rotary wing aircraft for use as RPVs. Gross weights of between 30 and 300 kilograms and of maximum dimension from 1.5 to 10 meters. Most have been developed for military missions but the technology developed, for example by NASA for remotely piloted research vehicles (RPRV), is also available. Each of the US Services has worked with one or more of these small airframes, the Army's Aquilla being the most tested with 190 flights, of which 150 were operated by Army crews. It is a reusable, relatively low cost airframe capable of carrying a variety of electro optical and radio frequency payloads.

Standing off 2 kilometers and beyond, it is capable of detecting (through signal analysis) and identifying C-C^3 targets. The target position can be measured electro-optically with respect to the RPV to typically 100 meters depending on range and possibly 10 meters at 1 kilometer. Ten meter accuracy of the RPV in the UTM reference system may be possible, whereas current bearing and range systems, should provide 100 meter accuracy at all useful ranges. Alternatively the target can be designated electro-optically by the RPV.

(C) In addition to an RPV for collecting information on emeny C^3, the same airframe is used with different payloads: for offensive C-C^3 ECM for example for jamming and for spoofing, or for carrying modest warheads to attack soft C^3 emitters.

(C) A variety of sensors, navigation aids, data links and payload systems are available, but not in production, with size, weight, power and cost goals set for RPVs. A variety of RPV RF, laser, EO payloads and warheads are under parallel development.

(C) A drone operates without a man in contact to make decisions. They can perform a number of missions including ECM or carrying a warhead to an emitter. The self-contained logic potential increases every year for a fixed outlay because of the rapid changes in electronic technology. Pulsed emitters can be distinguished more readily than CW. An interferometric technique under development by Lincoln Laboratories provides a CW target selection and homing with a miniaturized antenna installation compatible with an expendable drone and with capability below 100 MHz.

(C) We recommend that a set of RPV/Drones be developed with a mix of sensor/munitions specifically designed and optimized for C-C^3. Low cost, approximately \$10 to \$100k per vehicle, must be maintained for the RPV/Drone role to be justified. Initial procurements in lots of 50 units for technology and operational verification appear to be justified on the basis of studies and experience to date. This could be quickly followed by procurement and field deployment to provide the C-C^3 capability now sorely lacking in the European theater.

(S) 5. WIDE AREA ANTI-ELECTRONICS WEAPON (U)

(U) A wide variety of weapons has been proposed and/or developed by the US which exploit the electromagnetic radiation emitted or sensed by much of the C^3 electronic equipments. Such equipments, of course, are necessary components of modern CPs of every level. There are not, however, any weapons which are "anti-electronic" per se, i.e., weapons which are directed at exploiting intrinsic properties of all electronic equipment to obtain their destruction.

(S) It is proposed that a joint Army/Air Force investigation program be initiated to systematically analyze electronic components and equipment for intrinsic properties which could be exploited to develop an "anti-electronics" weapon. Since WP electronics appear destined to be built of semi-conductor devices, the search should probably concentrate on semi-conductor device properties. The property selected should be such as to permit the development of a low tonnage (under 100 lb.), wide area (1-10 Km^2) weapon.

(S) Two candidates for investigation are suggested. The first is the vulnerability of semi-conductor electronics to high electric fields such as those associated with the EMP of a nuclear explosion. Non-nuclear means of generating on EMP are known and may be adaptable to an anti-electronics weapon. The second is the set of phenomena associated earlier with the Have Name program. Other candidates might be obtained from semi-conductor device manufacturers by soliciting from them accounts of what have been problems to them and causes of numerous semi-conductor device failures.

(S) The weapon proposed is the "anti-electronic" analogy of chemical biological "anti-personnel" weapons. While we recognize the high risk associated with such a speculative proposal, we believe the unique worth of such a weapon for C-C^3 warrants the investigatory effort.

(C) 6. COVER AND DECEPTION (U)

(C) Soviet doctrinal statements, although they indicate serious intent to accomplish certain objectives, do not necessarily equate to a practical capability to do so - particularly under combat conditions. Thus C&D to protect real NATO targets from attack and to create at least some covering signatures and evidence of targets which are actually false serves to dilute and frustrate WP reconnaissance, target location activities and the weapon systems themselves.

(C) High on the target priority list are "enemy means of nuclear delivery." Thus emplacing decoys and creating false SIGINT and other signatures of nuclear capable artillery batteries, LANCE units and Air Force nuclear delivery units may be highly effective.

(C) C&D with regard to NATO C^3 by simulating, for example, false CP emissions from locations remote from actual high value targets will serve to blunt the Soviet objective of destroying 30 percent of NATO C^3. Similarly, multitudinous transmissions of dummy (taped) communications on actually unused channels will serve to dilute Soviet jamming capabilities and the SIGINT systems which, among other functions, serve to provide control information for the REC effort.

(C) C&D actions are particularly important during the hours preceding H-hour since they are "passive" in nature and hence acceptable as non-preemptive. They are, in fact, the only pre H-hour actions the NATO forces can undertake to blunt the WP attack.

(C) The Defense Science Board (DSB) 1977 Summer Study on Counter C^3 has an excellent discussion of C&D. The 1978 DSB study also makes several recommendations for C&D which we strongly endorse. In addition to these recommendations, we recommend that the NATO Allies be strongly encouraged to take responsibility for developing specific action plans for C&D. In particular, in view of the strong British history of successful C&D actions, we recommend they be encouraged to take the lead in this NATO effort.

(S) D. RECOMMENDED PROGRAM AND TECHNOLOGY INIATIVES (U)

(S) 1. DETECTION, IDENTIFICATION AND LOCATION (U)

(C) In the near term the principal technology limitation will be in regard to the accuracy with which a CP can be located. There is also a timeliness limitation, but it is largely one of organizational barriers and jurisdictional prerogatives. However, there are actions that can be taken by the Army and the Air Force, individually and jointly, to improve the viability of counteractions against the Soviet command/control structure.

(C) a. Create a counter-command/control targeting cell in both Army and Air Force tactical and operational staffs to exploit traffic coming from CPs, to locate them with direction finding and other presently available techniques, and to prepare appropriate pre-planned attacks against them on a continuing basis. In effect, CPs should be included in the target list with sufficient priority to assure that they will be attacked at the onset of hostilities.

(C) b. Dramatically improve the data base of knowledge on Soviet CPs of all kinds, for example, teardown time, setup time, rate of movement, site configuration, vehicle population, detectable signatures.

(C) c. Institute a field experiment to evaluate how Soviet C^3 can be continuously detected, identified, located and attacked or placed on target lists. This should be done on a time line basis for Pre-H, H-hour, Post H, and steady state situations.

(S) d. The non-pulse fingerprinting work presently funded by DARPA should be emphasized in scope and funding level, but directed toward signals of interest for $C\text{-}C^3$ mission. At the present, the work is concerned largely with the R-123 Soviet radio set whereas the equipments of interest for $C\text{-}C^2$ are the various transmitters and signals associated with each of the various CPs of interest, and with data links supporting weapon systems control.

(C) e. There is presently under consideration an action to add non-pulse capability in the Air Force PLSS system to be known as the ELS. However, the frequency range of this new feature has not yet been decided nor have appropriate programmatic and funding decisions been made. It is virtually necessary to expedite the needed funding and programmatic decisions to assure that a significant non-pulse capability for locating emitters will be added to PLSS in time for its operational testing and deployment.

(S) f. A technology program at Lincoln Laboratory is examining new signal processing techniques for improved ARM seekers. The same technique may have applicability to ground-based or airborne location systems for non-pulse emitters. This work should be vigorously continued, with the application of such techniques to ground-or air-based location systems also evaluated.

(C) g. A newly-funded study is examining artillery delivered expendable devices as part of a single-station emitter-location system, which may be a valuable capability to attach at various levels of the Army structure. Evaluate expansion of this program to a variety of artillery-delivered, single-based systems for detection and location of emitters.

(S) h. Establish a research effort to investigate the applicability of Bayesian statistical techniques to assist in tracking the movement of CPs from location to location. Such techniques have been successfully used in a simulation environment by the Air Force project CONSTANT LINK for similar purposes.

(C) i. Task the national and tactical intelligence resources to improve the understanding of Soviet CPs and their relevant behavior parameters, e.g., signatures, response time, movement rates.

(S) j. Assure that the experience and accomplishments of the two Air Force projects ATLAS and CONSTANT LINK are made fully available to the BETA test bed and experiments. Each of these has examined in a research simulation environment some aspects of data fusion that are relevant and pertinent to capabilities that BETA must have.

(S) 2. HARASSMENT AND DESTRUCTION (U)

(S) a. The Army expendable jammer program should be adopted to operate over friendly communication frequencies. This will deny WP REC units SIGINT vital to their effectiveness without interferring with friendly C^3.

(S) b. The Army expendable jammer program should be adopted to operate over all WP CP communication frequencies, including multichannel, UHF single channel and wide area tropo. These devices will deny critical division Army level C^3 and force CP relocation - the objective of harassment.

(S) c. The current Army ICM and Air Force WAAM programs should be jointly reviewed for potential technology initiatives and program modifications specific to C-C^3 munitions.

(S) d. Joint Army/Air Force research and development programs should be funded to identify and develop new wide area weapons such as Have Name, which are uniquely "anti-electronic" and low tonnage.

(S) e. The NATO Allies, led by the British, should be encouraged to take responsibility for developing detailed tactical plans for European C&D actions.

(S) f. The development of the US Army Mini-RPV program (Aquilla) should be continued, and the mix of payloads optimized for C-C^3 (Pre 1983).

(S) g. Develop a set of RPV/Drones and C-C^3 payloads maintaining low cost ($10K to $100K per vehicle). Continue development of Air Force harassment drone and the miniature interfermetric CW homing technique of Lincoln Laboratories (Post 1983 deployment).

(C) 3. NATO IMPLICATIONS (U)

(C) The importance of C^3 centers as targets increases significantly as the WP forces tend toward greater centralization of their C^3 functions. Within NATO (and the US as well) however, there is wide disparity among operators regarding the allocation of scarce resources to destroying or degrading the WP C^3

capability. The US appears directed toward a course of action which now recognizes the potential benefit derived from countering enemy C^3 but until NATO-made acceptance of this philosophy is brought about, it will be difficult to implement meaningful solutions to the C-C^3 problems. The difficulties associated with releasibility of sensitive information will likely compound the problem and considerable effort seems warranted to build the case.

(C) A key element in the effective interdiction of C^3 is the capability to work within the time-decision framework of the enemy. This requires NATO-wide rapid collection, evaluation, and dissemination of intelligence from all sources coupled with the means to quickly determine whether to exploit or disrupt particular enemy activities, and employ the appropriate systems on a new real-time basis.

(C) It is recognized that a US only C-C^3 capability would be of limited value in Europe. The capability must exist throughout a major portion of the NATO forces to have a large impact. Thus, it is of major importance that development of C-C^3 capability be done in active cooperation with our NATO allies.

(U) Implicit in this intent is the need to engage in briefings and dialogue with appropriate nations: for example, with SHAPE and NATO to solicit their reactions and support at the earliest possible time, to insure that their views are reflected in the end product of the study.

(C) Experiences in the past suggest that NATO is not willing to accept "fait accompli" studies on hardware by US. It is cautiously suspicious, and is reluctant to accept proposals pending their own analysis that weighs the proposal in terms of their perceptions of need, commitments and impact on their budgets, manpower/economic national impact, productivity by their nation, effective use of their limited technology and know-how. As a result, U.S. initiatives may be immersed under a cloud of rejection unless:

a. Early national involvement at the birth of the idea is actively achieved either by bilaterals or by NATO/PANEL/COMMITTEE agreement.

b. Proposal provides for a basis of national sharing of both manpower, industrial capacity, and technology with reasonable trade-offs.

(C) Fundamental to NATO are national prerogatives, hence, requirements must be based on scenarios that are nationally acceptable. Hence, proceeding into development prior to an established "need base line" is like a time-bomb if it is deferred. The U.S. tends to state solutions to requirements which may not be based on nationally or NATO approved scenarios. Yet, national requirements do exist based on discrete perceptions of the threat under a nationally conceived scenario. Inhibited by security aspects, portions of the threat within the terms of reference of this study may not be available to certain nations. This could result in lack of national interest and commitment, due to inability to properly assess the threat. Hence, a limited number of the big nations may recognize the threat. Their response, in an active and mutually supported effort is needed to develop a NATO-supported statement of operational need. This is an essential pre-cursor to achieving agreement on development effort. Experience in the past has shown that attempts to by-pass this step resulted in the "time bomb" delay. In the case of AWACS, after it was flying and demonstrated, it took three years to generate a set of requirements.

(U) Accordingly, if time is of essence, the threat must be recognized, and a set of scenarios developed that will permit national evaluation and pave the way to generate a NATO statement of requirements.

(U) Action can be enhanced by bi-laterals of US with UK and FRG. Earliest possible involvement is essential to preclude national rejection and deferment of actions.

(C) The U.S. objective within NATO should be:

a. Promote U.S. objectives in NATO rationalization, standardization and interoperability.

b. To enhance credibility of both National and NATO needs.

c. Encourage early multi-national participation.

d. Precipitate action by NATO.

U.S. strategy should include:

a. Avoiding the impression that a study is complete.

b. Providing opportunity and time to get national reactions and recommendations.

c. Soliciting joint national execution and implementation.

d. U.S. contacting NATO SHAPE leaders to develop guidance and strategy.

(C) Possible courses of action include:

Alt 1. U.S. brief nations, NATO, SHAPE on study to include threat.

Alt 2. U.S. brief selected nations (UK, FRG) and consider bilaterals with each to be followed by briefs to NATO/SHAPE.

Alt 3. Arrange special session of Big 3 (US, US, FRG) to brief and develop strategy to implement U.S. proposal as pre-cursor to other two alternatives. It is assumed that France will not be included in this cooperative effort because of the security issue.

(S) 4. <u>NEEDED IMPROVEMENTS IN NATO C^3</u> (U)

a. Each of the joint study task groups noted the importance of upgrading NATO and U.S. C^3 in all areas, the most important of which was survivability. In light of the great emphasis placed by the Soviets on using their REC units to destroy or neutralize NATO C^3, and in recognition of the reliance we place on our C^3, the recommendation is made that NATO concentrate upon C^3 survivability. The effort should focus on mobility for those elements which must remain above ground, or operate in the immediate operational areas. The purpose of this should be to insure that frequency of movement, if only for short distances, will prohibit the Soviet REC effort from pinpointing and targeting unhardened C^3 elements.

b. It is also necessary that NATO C^3 demonstrate timely responsiveness to changing situations or conditions. The principle of flexibility must be continuously emphasized and exercised throughout NATO's spectrum of operations and planning. Although this Group stressed the need for timely responsiveness in the $C-C^3$ cycle of detection, identification, location, harassment, and destruction, it applies to all areas of C^3.

c. Stress must be put on continuing toward a goal of improving communications, particularly in the following areas.

(1) Reduction in bandwidth through the use of increased radio discipline, increased pre-planning such as the Creek Braille project, and the use of DMED techniques.

(2) Introduction of AJ/LPI on all important communications links.

(3) Development of fail-soft multi-path nets.

(4) Acceleration of the development of DSCS III.

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REPORT OF TASK GROUP IV

(S) TEMPLATING AND COUNTERING SOVIET AIR DEFENSE ON THE BATTLEFIELD (U)

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(S) ABSTRACT (U)

(U) This section treats the subject of NATO's ability to detect, to locate, to template (classify) and to counter, by direct and electromagnetic means, WP AD systems in a European war scenario. The principal current deficiencies in capability are assessed and summarized, and proposed solutions are presented for near (pre-1983) and longer-term (post-1983) operational introduction. The report separately discusses the two major topical areas (templating and countering) and in addition, presents the possible capability and advantages of determining the affiliation of individual radars to specific army units.

(S) The primary conclusions in this section are that the U.S. and NATO presently have an unacceptable capability to template and counter WP AD. This situation will dramatically improve in the longer term with the addition of systems specifically designed for the task (PLSS, AGTELIS, EF-111, etc.). It is concluded that, with the exception of PLSS, countering AD is not done on a systems basis, despite the fact that WP AD is highly netted, and organized for maximum effectiveness. Most recommendations attempt to attack the AD system from a top down basis, denying or degrading internetting to a maximum extent possible. Specific recommendations include inputs on the EF-111, APR-38, PLSS, AGTELIS, GUARDRAIL and other systems now in use or in development.

(U) Specially classified appendices contain material, including recommendations, not suitable for inclusion in this SECRET report.

Contents, Report of Task Group IV

(S) I. SUMMARY (U)

(S) A. TOPIC (U)

(S) Critical tasks at the outbreak of hostilities will be the detection, location, and classification (by weapon type) of enemy AD. These are required (1) to assist in the planning of air operations both near to and well behind the FEBA, and (2) to pinpoint and to help prioritize strikes against the AD units themselves. A significant number of these are highly mobile, thus making timely detection, location, and classification a necessity. This overall process may be called templating the AD battlefield.

(S) There is strong evidence to suggest that WP forces will mount a sophisticated EW campaign to frustrate NATO attempts in this area; including the use of (1) alternate wartime frequencies and operating modes, (2) previously unobserved netting of AD elements to minimize the detection of particular radars until later in the engagement (EMCON), and (3) dedicated C&D.

(S) The U.S. EW arsenal designed to counter the Soviet AD network consists of collection systems, warning receivers, jammers, and special purpose equipment to facilitate destruction of Soviet AD units. The Task Group reviewed the capabilities of selected U.S. systems against the SA-4, SA-6, SA-8 and ZSU-23-4 systems in their latest modes of operation. This task is discussed in the section entitled "Countering the Air Defenses on the Battlefield."

(C) The operational task faced by the U.S. EW arsenal is to attrite and/or to degrade the Soviet AD system such that Army and Air Force helicopters and aircraft do not sustain unacceptably high attrition rates.

(U) The Task Group reviewed U.S. capability to achieve both the templating and countering tasks now and in the future, assuming a massive WP offensive against NATO. Both programmed systems and applicable research and development elements were included.

(S) A major effort was undertaken to understand how the Soviet electromagnetic environment would change in wartime, including the impact such changes would have on present and programmed U.S. ELINT, ECM, Radar Warning, and anti-radiation strike assets such as WILD WEASEL.

(S) Because of time limitations, only U.S. (and not the rest of NATO) capabilities were considered. Further, the study concentrated on radar directed systems only. As a result, a large number of other important air defenses, such as the SA-9, ZSU-23-4, SA-6, and SA-8 (in their autonomous optical modes) were not considered. Although this is an important limitation, forcing the enemy to rely on the optical tracking mode, as opposed to the highly netted radar mode, will significantly reduce his effectiveness.

(S) B. KEY OPERATIONAL NEEDS (U)

(S) To template the battlefield, the key needs were defined to be:

(a) Determination of the number of AD weapons within the primary zone to within 20% of actual number.

(b) Location of AD weapons to within a few kilometers for the battlefield management purposes (AD, avoidance, self-protection requirements, assessment of battlefield situation).

(c) Location within a few minutes of AD systems to within 50 meters for strike purposes.

(d) Correct classification of weapon system type (SA-6, SA-4, etc.) 90% of the time.

(e) Determination of the presence of previously uncommitted fighting units (and associated AD) in a timely manner to ascertain major lines of advance, reinforcements, or cross echeloning.

(f) Determination of the affiliation of WP AD assets to Army echelons to assist in providing senior U.S. and NATO commanders with indications of the trend of the battle.

(g) Determination of post-strike effectiveness against AD assets.

(S) To counter Soviet AD, the key needs are:

(a) Physical and electronic attack of the AD system elements which allow it to operate as an effective network; i.e., LONG TRACK and FLAT FACE radars and selected communications.

(b) Assurance of proper functioning of warning receivers to allow pilots to take evasive maneuvers when under the threat of imminent attack.

(c) Employment of self-protection jamming devices to foil SAM/AAA/AAM attack.

(d) Location of enemy radars to facilitate the above actions.

(S) C. CRITICAL CAPABILITIES AND DEFICIENCIES (U)

(S) Table IV-1-1 summarizes our present capability to meet the operational needs for "templating" the AD battlefield. Although marginally effective in exploiting major WP activity during exercises, our capability appears significantly deficient in all categories when matched against the wartime threat. This is due primarily to our inability to determine which AD assets, observed at different times, are actually units which have moved (multiple bookkeeping); an inability to obtain sufficiently unique signatures or data sets to identify weapon types; and a general problem of saturation of the limited assets presently available to handle the target-rich wartime environment.

(S) Table IV-1-2 summarizes our present capability to meet the operational needs for countering the Soviet AD system. Some of our deficiencies are directly related to the fact that many of our EW assets are dedicated exclusively to self protection of individual aircraft when threatened by the entire Soviet AD system. We have not dedicated enough assets to previously degrade the system integrating components (early warning, target acquisition radars and important communication links) of the enemy AD system. Further, many of our EW systems are updated versions of equipments used in the Vietnam War

TABLE IV-1-1

(S) TEMPLATING SOVIET AIR DEFENSE BATTLEFIELD (U)

REQUIREMENT	PRESENT U.S. CAPABILITY TO FILL REQUIREMENT
Determine the number of air defense radars arrayed to an accuracy of 20%	Inadequate; 50% to + 100%
Locate air defense radars to an accuracy compatible with battle management needs (500M-5KM) and compatible with strike needs (50M)	Marginal for battle management; 4-20 KM Inadequate for targeting; 4-20 KM
Determine the association between radar and weapon correctly 90% of the time	Inadequate in wartime; 50-60%
Determine the trends in the enemy air defense plan	Poor (assumes loss of Berlin and Augsburg stations)

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TABLE IV-1-2

(S) COUNTERING SOVIET AIR DEFENSES (U)

REQUIREMENT	PRESENT U.S. CAPABILITY TO FILL REQUIREMENT
Deny the enemy his Early Warning, Target Assignment and Height Finder Radar Capability	Jamming - virtually none Attack - limited, with WILD WEASEL
Deny the enemy his data link communications among SAM elements	None
Assure proper functioning of warning receivers	Acceptable in medium density; unsophisticated environment; capability falls off rapidly in sophisticated, dense environment
Employ self-protection jamming devices to foil SAM/AAA/AAM	U.S. Army - none U.S. Air Force - marginally adequate, but with external pods
Locate enemy radars to facilitate above needs	Not accurate enough to target

against a relatively unsophisticated, immobile threat characterized by SA-2 and SA-3 type equipments.

(S) D. PROPOSED APPROACHES (U)

(U) The Task Group has developed several detailed recommendations which are contained in the discussion section and summarized in Section III for reference. In this section are highlighted certain selected recommendations or proposed approaches which the Task Group felt were the most important and had the greatest impact and/or interactions with other systems.

(U) The proposed approaches are divided into two time phases:

Near Term - operational introduction in or before calendar year 1983;

Longer Term - operational introduction in or after calendar year 1983.

(U) Each of the proposed approaches is briefly described and assessed for potential capability and payoff and associated impact; and ball park estimate of the costs and time required to accomplish a prototype advanced development program is made. These approaches are summarized in Tables IV-1-3 and IV-1-4 and in the specially classified appendices.

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TABLE IV-1-3

(S) PROPOSED APPROACHES (NEAR TERM) (U)

APPROACH	PAYOFF	DESCRIPTION	POTENTIAL CAPABILITY	ASSOCIATED IMPACT	DEVELOPMENT COST/TIME
Install Data Link recognition/ location capability on TEREC as an interim capability	H	Allows for immediate automatic recognition and location of crucial data link sources associated with SA-4, SA-6, SA-8; i.e., templating	Puts vital data link emitters at risk whenever they transmit; allows attack by destructive means	Minor	10M/24 months
Correlate MTI (e.g. SOTAS) data with ELINT (e.g. QUICK LOOK, TEREC, AGTELIS)	H	In fusion center match information on "movers" with information on emitters	Correlation of data facilitates "count" location and association on enemy air defense assets	Requires accurate common grid system. Should be tested in BETA program	Low
Install Data Link Jammers on EF-111	H	Jams crucial data links among key elements of SA-4, SA-6, SA-8 systems	Denies assignment strategy to SAM brigades and regiments. SAM batteries are relatively isolated from the rest of the battle. Denies EMCOM strategy	EF-111 tactics might be different with this payload than with radar jammer payload; adds programmatic impact to controversial program	20M/24 months

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TABLE IV-1-3 (Continued)

(S) PROPOSED APPROACHES (NEAR TERM) (U)

APPROACH	PAYOFF	DESCRIPTION	POTENTIAL CAPABILITY	ASSOCIATED IMPACT	DEVELOPMENT COST/TIME
Jamming of Early Warning, Target Assignment, Height Finder Radars	H	Select from 3 different options (ALQ-131, Hi Power EF-111 jammer, dedicated EF-111) to concentrate heavy jamming against LONG TRACK, FLAT FACE, THIN SKIN	Deny enemy his long range sensors so that he cannot easily assign SAMs to threats in an effective manner	Takes available jammers (ALQ-131, EF-111) away from certain threats and concentrates on selected targets	10M/12 months
Add Airborne Complement to AGTELIS and stop PIP on QUICK LOOK	M	Move quickly to the modern TOA system and away from the obsolete DOA system	Greatly improved location accuracy, reduced susceptibility to modern counter-countermeasures, less susceptibility to short on-time emitters	Improves system survivability and life cycle costs logistics, by trending to one fundamental type of system rather than two	20M/18 months
In-theater Rapid Reprogramming	H	Establish a limited European based capability to program EW assets quickly and responsively to PACT parameter changes	Minimizes impact of PACT "surprises" in terms of wartime frequencies and modes	Accelerates the trend toward field programmability of EW assets	4M/12 months

TABLE IV-1-3 (Continued)

(S) PROPOSED APPROACHES (NEAR TERM) (U)

APPROACH	PAYOFF	DESCRIPTION	POTENTIAL CAPABILITY	ASSOCIATED IMPACT	DEVELOPMENT COST/TIME
"Probing" of Air Defenses	M	Selectable jamming and stimulation of enemy air defense systems by low cost, expendable decoys	Takes enemy radars out of EMCON; forces enemy to reveal some portion of his planned counter-countermeasure strategy	Collectors must be on-station during probes, to collect "take". C^2 implication minimum	Decoys 5M/24 months
Improve navigation accuracy for special purpose SIGINT collectors: e.g., TEREC, GUARD RAIL, RIVET JOINT	M	Tie into early configurations of GPS	Improve location accuracy by factor of 2 to 3; can be quickly fielded; immune to TACAN/LORAN destruction	Minimal	Funded

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TABLE IV-1-4

(S) PROPOSED APPROACHES (LONGER TERM) (U)

APPROACH	PAYOFF	DESCRIPTION	POTENTIAL CAPABILITY	ASSOCIATED IMPACT	DEVELOPMENT COST/TIME
Install Data Link Recognition/Location Capability with PLSS/AGTELIS	H	Allows for immediate, automatic recognition and location of crucial data link sources associated with SA-4, SA-6, SA-8; i.e., templating	Puts vital data link emitters at risk whenever they transmit; allows attack by destructive means	Programmatic impact on two important, on-going programs, but greatly broadens their application	20M/24 months
Exploit "Fingerprinting" Technology on PLSS and AGTELIS	H	Exploit Frequency Modulation on Pulse (FMOP)	Unique affiliation of fundamental radar characteristics with serial number; allows accurate count of all air defense radars; their associated affiliations with maneuver elements, including track histories	Impacts two on-going programs if successfully developed. Requires active 6.3 programmatic support; has the potential to reduce analytic intelligence manpower	8M/24 months
Integrate WILD WEASEL and PLSS	H	Provides a ready strike asset (F-4G)	WILD WEASEL would then have self-contained (APR-38) as well as external guidance	Requires beacon on F4G	10M/12 months

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TABLE IV-1-4 (Continued)

(S) PROPOSED APPROACHES (LONGER TERM) (U)

APPROACH	PAYOFF	DESCRIPTION	POTENTIAL CAPABILITY	ASSOCIATED IMPACT	DEVELOPMENT COST/TIME
Close couple PLSS/AGTELIS	H	Integrate data streams and ground processing stations	Hybrid configurations of ground and air-borne elements permits maximum operational flexibility and contributes to survivability	Both programs are underway and would need modification. IOC's are different: AGTELIS IOC-1982 PLSS IOC-1985 makes C^3 easier	Unknown-may be large for AGTELIS-may delay development
Correlate SAR imagery with ELINT	M	In fusion center, match "Spotlight" imagery with ELINT	Provides ultimate in detailed association and count on enemy air defense assets	Dependent upon successful development of ASARS or UPD-X with one foot resolution and "zoom" capability; requires common grid; may be manpower intensive	Included in Development

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(S) II. DISCUSSION (U)

(U) As outlined in the summary, the Task Group considered two broad issues posed by the Soviet AD capability; how to detect effectively, locate and classify the major components and how to counter the formidable capability to assure that NATO air forces can continue to operate.

(U) We have labeled the former task as templating the AD battlefield. For all AD suppression objectives, it is adequate to know location (including any movement), type and wartime modes which can affect operation of EW assets. In reviewing this topic, however, the Task Group was intrigued by the broader importance of an even more detailed knowledge of an AD radar's genealogy, namely the ability to affiliate a particular radar with a specific army unit. Assuming technology will allow such a unique affiliation, and there is evidence that such is the case for a wide range of radars, then a radar signature would identify the specific Army unit location and act as a unique electromagnetic tag which is easily detected from even a short transmission. This intriguing possibility is discussed in more detail in Section IIB and Appendix C.

(U) Each discussion section is reasonably self-contained including a discussion of the operational and functional need, a capability and deficiencies assessment, proposed concepts, and recommendations.

(S) In the time available, the Task Group considered U.S. assets only, and hence did not consider ongoing or planned NATO developments which could be of interest. Further, the Task Group has not considered which specific assets would be held as unique National assets and which would be "chopped" directly to the NATO command. It appears clear, however, that the Mobile Air Defense Template, as it is known at the ASAC, would be immediately available to all NATO commanders for appropriate action. Therefore in essence, NATO will have the full capability of the system provided steps are taken to tie ASAC with appropriate NATO elements. Further, a detailed evaluation of supporting NATO collection systems should be undertaken to determine their utility in the ASAC.

(S) A. TEMPLATING WP AD ON THE BATTLEFIELD (U)

(S) 1. Introduction (U)

(U) The approach selected by this Task Group was first to assess information requirements on principal pact Soviet radar controlled AD systems in terms of numbers estimated in a given area, accuracy of location, and classification by type. This was done in order to establish a framework within which capabilities could be measured, deficiencies identified, remedies assessed, and specific prioritized action recommended.

(S) The primary threat systems considered for the near term are the SA-4, 6, 8 and ZSU-23-4. For the longer term the Task Group considered the SA-X-11 and expected improvements in counter countermeasures capabilities of present types of AD system radars.

(S) Existing and programmed U.S. collection systems considered including ELINT, COMINT, Radar Imagery of moving and stationary targets, and optical means. Infrared techniques were not included. We have included other u.S. developed assets owned or operated by other agencies than the theater forces (USAREUR and USAFE).

(C) The quantitative requirements used for reference are consistent with, but expand on the TAC/TRADOC user requirements definition. The Task Group has chosen to include requirements for mission planning as included in battle management in the regions close to the FEBA (less than 150 kilometers). In these regions of interest the location accuracy requirements for mission planning approximate those for battle management.

(U) The discussion below, supported by the appendices and references, assesses our capabilities, and potentials for improvement, in effecting timely (snapshot) assessments of the AD situation as required in a wartime environment in Central Europe.

(C) 2. Operational and Functional Needs

(U) The general requirement for order of battle information is summarized in Table IV-2-1. A commander must know accurately the number of AD systems opposing his forces if he is to assess enemy capability

(C) TABLE IV-2-1 (U)

MOBILE AIR DEFENSE SYSTEM ORDER OF BATTLE REQUIREMENTS[5] (U)

	ACTUAL # OF ENEMY AIR DEFENSE SYSTEMS PRESENT	LOCATION ACCURACY BATTLE MANAGEMENT	TARGETING	RADAR CLASS-IFICATION BY TYPE
Zone 1 FEBA-5KM	Within 20%	500M	50M	90%
Zone 2 5KM-50KM	Within 20%	3KM	50M	90%
Zone 3 50KM-150KM	Within 20%	5KM	50M	90%

(S) TABLE IV-2-2 TACTICAL COLLECTION SYSTEMS (U)

TYPE	SYSTEM	ORGANIC TO	IOC CY	PLATFORM	OPERATING ALTITUDE (KFT)	MAX RANGE (KM)	FEBA STANDOFF (KM)	FREQUENCY COVERAGE	SYSTEM SENSITIVITY	ACCURACY
COMINT	TACELIS	CORPS	OR	TRUCK	0.5	30	2 to 5	0.5 to 500 MHZ		2°LOB
	QUICK FIX	DIV	OR	EH-1	10	55	5 to 15	2 to 100 MHZ		2°LOB
	GUARDRAIL II	CORPS	74	RU-21	15	280	15	20 to 70 & 100-150MHZ		2°LOB
	RIVET JOINT II	THEATER	78	RC-135	35	430	60	20 to 500 MHZ		1.7°LOB
	ELS	?	82	U-2R TRIAD	70	600	175	0.02 to 10 GHZ		60 M CEP
ELINT	AGTELIS	CORPS	79	TRUCK	0.5	30	2 to 5	0.5 to 18 GHZ	-80 DBM	50 M CEP
	QUICK LOOK	CORPS	77	OV-1D	10	230	15	0.5 to 18 GHZ	-85 DBM	0.5°LOB
	TEREC	#AF	OR	RF-4C	20	320	25	2 to 12 GHZ	-65 DBM	0.5°LOB
	RIVET JOINT II	THEATER	78	RC-135	35	430	60	0.5 to 12 GHZ	-83 DBM	0.5°LOB
	PLSS	THEATER	85	U-2R TRIAD	70	600	175	0.05 to 19 GHZ	-92 DBM	16 M CEP
IMINT	UPD-4	#AF	OR	RF-4	20	70	25	-	-	10 FT IPR
	ASARS	THEATER	81	U-2R	70	100	50	-	-	10 FT/1FT
	SOTAS	DIV	81	EH-1	2.7-7.5	80	30	-	MTI	80 M at 30KM
	SLAR	CORPS	OR	OV-1	15	50	15	-	MTI	50 FT IPR
	KEY CHARACTERISTICS				SPATIAL COVERAGE			TARGET COVERAGE		ACCURACY

These systems are augmented by visual and IR systems capability will depend upon the development of fingerprinting techniques to identify specific radars by serial number. Thus, even though there is no direct operational requirement for serial number identification, fingerprinting could make a significant contribution across the board, from identifying individual unit movement to the assessment of the entire battlefield situation. The proposed concepts for application of fingerprinting to assist in establishing affiliation are described in Section IIB of this report.

(S) 3. Existing and Programmed Capabilities and Deficiencies (U)

(S) The primary near and longer term gross capabilities are summarized in Table IV-2-2 and the specially classified appendices. The present capabilities cannot be significantly changed before 1983 except through better utilization of systems already near or in production. PLSS and AGTELIS are assumed deployed in quantity in the post-1983 time period. Currently U.S. collection systems deployed and operated in quantities planned, will generally provide adequate frequency coverage and revisit rates in the prewar period. Near term estimates, however, are dependent on detailed assumptions with respect to Soviet designs and operating procedures. The baseline prewar estimates are also based on the knowledge that each AD radar is now operated for a brief time after each move for purposes of calibration, clutter adjustments, and confidence.

(S) Prewar capabilities for numbers estimates, i.e., in the time period up to rapid mobilization for war, probably cannot be improved significantly by purely technical means. Numbers estimates are closely tied to our level of knowledge of deployments of major Soviet tactical units as Tables of Organization and Equipment (TO&E) are well understood. These estimates are based on integrated data over a long period from many sources.

(S) In the prewar period the relatively crude locations information provided by DOA systems can be refined by photographic map correlations and is adequate for battle management. Also prewar classification capabilities are believed to average close to the 90%-correct requirement. In a transition period or under wartime conditions, we have major degrading influences as follows:

(S) (a) Expected Wartime Alteration of Threat Characteristics. Present collection systems, even in aggregate, require a significant time to obtain a data base and cannot maintain continuous frequency and area coverage. Thus, a change-over of all AD radars to new wartime frequencies would require hours to reestablish the EOB. This action, coupled with physical movement, could introduce a factor-of-two or greater uncertainty in numbers within a short time unless movements into an area can be monitored and identified by other means.

(S) (b) Changes in WP Doctrine. The intelligence based perception is clouded. On the one hand it is believed that the Soviets will be constrained to a relatively rigid scheme of frequency allocations for both radar and communication systems. Further, the deployed AD radars are believed to have little flexibility for changes except to switch to a preassigned set of battle frequencies (one of several choices). The density of emitters, the tactical doctrine of armies passing through other armies, and observed training as well as known hardware limitations, support these conclusions. Running counter to this trend we are seeing an increasing amount of PRF agility on all radars. RF agility is being observed on LONG TRACK and with the newer systems presently in development. Further, the WP can be expected to exert a strict level of emissions control in wartime unless the tempo of the action forces frequent alerts and target track by AD engagement radars.

(S) (c) Vulnerability of Key Collection Assets. Under peacetime conditions many relatively vulnerable aircraft and ground systems contribute to both technical and operational intelligence. Under wartime conditions, much of this supporting capability, e.g., Augsburg and Berlin either cannot be counted on to survive or will be required for other priority tasks. The surviving assets have neither the signal processing sophistication nor the skilled manpower available to handle the increased load, resulting from the loss or diversion of non-organic assets.

(S) The increasing vulnerability of reconnaissance aircraft used in penetrating missions is reflected in the trend to greater reliance on stand-off COMINT and ELINT platforms and greater reliance on national assets. National systems are employed in Air Force and joint exercises in either live or simulated modes.

the ground-based AGTELIS - hence the data processing and communications bandwidth requirements are each increased by at least an order of magnitude. AGTELIS collects signals from low power radars deployed near the FEBA (such as the PPS-4 and 5 equivalents of the TPS-33 equivalent). PLSS will not detect these signals from the side lobes at its stand-off ranges.

(S) Viability of both systems will be crucial in the 1983-on time period (particularly as the QUICK LOOK II and TEREC will lose effectiveness against more sophisticated radars). They are needed to provide the location accuracy required for strike, to provide the technical collection capability against more complex Soviet systems, and to provide the ability to reconstitute the data base rapidly under wartime conditions.

(S) PLSS plans to have four aircraft (out of 18 total) airborne continuously in order to assure triple intercepts. The system is vulnerable to loss or malfunction due to base attack, in flight attacks and/or equipment failures. In addition, the ground data processing modes are vulnerable to direct attack. The AGTELIS ground stations also are vulnerable; however, the greater redundancy reduces the impact of a loss.

(S) When JTIDS is available, the ASAC should be able to receive PLSS data directly, thus providing system level redundancy to AGTELIS. Prior to JTIDS, such data exchange can be by TADIL B from PLSS to the Corps and by common communications from Corps to Division. This, however, is not true interoperability of the assets of the two systems to provide mutual support in the event of equipment losses.

(S) If one assumes that enough PLSS and AGTELIS assets survive physically to obtain numbers and locations, under wartime conditions, the systems should not be degraded unless the Soviets adopt extreme counter-countermeasures.

(S) 4. Proposed Concepts for Capability Improvement (U)

(C) Near Term. In view of our assessment of the current situation, it is important to utilize all

Tasking and data handling procedures are being developed. The scoping of the overall situation will be materially assisted through such use of national assets. This subject is described in the specially classified appendices.

(S) It is the Task Group's assessment, however, that despite the assistance provided by national assets, the combined impact of these factors is to degrade seriously the estimated near term (pre-1983) capabilities to provide the AD situation assessment. It is the conclusion of the Task Group that both the knowledge of total numbers of AD units and the ability to type classify these will be degraded by at least a factor of two from prewar capability. Estimated capabilities are:

		Capability	
	Requirement	Prewar	Wartime
Number	± 20%	± 20%	- 50% to + 100%
Location			
Planning	3-5 km	3-5 km	3-5 km
Strike	50 m	-	-
Association	90% correct	70-90%	40-60%

(S) PLSS and AGTELIS are the two major new programmed ELINT systems. They will be supplemented by new COMINT systems, e.g., ELS. PLSS and AGTELIS are both planned to have capabilities for precision location of emitters through TOA techniques. The intercept and location aspects of the two systems are similar in function and they will have comparable capabilities to handle complex signals.

(S) The PLSS system will have an integral defense suppression capability - AGTELIS does not, although AGTELIS data will be fed to artillery units through TACFIRE.

(S) Both systems have broader missions than AD radar intercepts and location. The airborne PLSS system collects information from a much larger area than practical means to improve our capabilities for obtaining numbers, estimates, locations, and classifications or association of radar AD.

(C) Many concepts for improvements evolved from our discussions with Service, Industry, NSA and Intelligence community personnel. The recommended concepts (Table IV-2-3) for exploitation appear technically feasible, economically modest, and offer worthwhile improvement potential relative to their cost. Each concept is discussed in the following paragraphs.

(S) (a) <u>AD Templating</u>. AD weapons have distinctive electronic groupings on the battlefield. In many cases they can be precisely identified through a combination of ELINT (radars) and COMINT, which is a specialized form of templating. It is proposed that special purpose COMINT collection receivers be added to current and proposed ELINT collection assets to attempt to collect simultaneously and automatically associated COMINT during ELINT intercept. A more detailed description of this concept and the rationale is contained in the specially classified appendices. The payoff would be a capability to associate rapidly and correctly the radar with the weapon type. Technological feasibility of this concept has been demonstrated including the ability to collect and interpret the desired signals automatically. Development costs should run a few million dollars and initial operation at primary collection points should be possible within two years. Templating to a greater extent than weapon type, i.e., affiliation, is discussed in the specially classified appendices.

(S) <u>Recommended Program</u> (U)

(S) Develop special purpose collectors and processors which can automatically recognize AD associated COMINT, initially use with TEREC, later with PLSS/AGTELIS.

(S) (b) <u>Improved Platform Navigational Accuracy</u>. The emitter locating accuracies of existing airborne ELINT systems are determined by two principal factors: DF antenna beamwidth and aircraft navigation system accuracy. The design of the ELINT system antennas are limited by aircraft installation constraints and search rate requirements. The aircraft navigation system accuracies are limiting the emitter locating

TABLE IV-2-3

(S) NEAR TERM (U)

CONCEPTS	PAYOFF	TECHNOLOGICAL IMPLICATIONS AND FEASIBILITY	PROTOTYPE DEVELOPMENT COST/TIME	IMPLEMENTATION IMPACT
1. Air Defense Templating (Sec. II-A-2)	High	Requires development of special purpose VHF intercept module for ELINT PLATFORM. Technologically feasible -- has been developed in brassboard.	$20M/24 months	Allows association of Air Defense units to weapon type during EMCON situation.
2. Improved Platform Navigation Accuracy for SIGINT Collectors (Sec. II-A-3)	Med	None -- Uses Global Positioning System	Funded	Significantly improves airborne navigation accuracy thereby improving ELINT location data.
3. Movement Sensing and ELINT Correlation (Sec. II-A-4)	High	No technical feasibility issues - Application of SOTAS	--	Correlation of ELINT and MIT data will provide indication of Air Defense system movement.
4. Probing of Air Defense (Sec. II-A-5)	Med	May require use of penetrating decoys or extensive stand-off jamming (EF-111)	Decoys - $5M/24 months	Assist in locating and classifying Air Defense

accuracies of such systems as the TEREC equipped RF-4C and RIVET JOINT Automatic Electronic Emitter Locating System (AEELS). It could be improved by a factor of two if high accuracy navigation were possible.

(S) Replacement of the INS of these collection platforms by more accurate new navigation systems is straightforward, but would be expensive in each procurement and support costs and require significant time for aircraft modification and related training. The Air Force plans to have an operational Global Positioning System (GPS) in the early 1980s. This system is designed to support tactical as well as strategic systems. The addition, however, of a GPS receiver and integration of GPS data into existing INS systems could be achieved at relatively low cost and is recommended for platforms such as the RF-4C and RC-135V. An additional benefit would be to facilitate providing information in a common reference grid. As an alternate, PLSS might be employed as an inverse GPS. A possible limitation may be the potential vulnerability of either approach to jamming near the FEBA.

(S) Recommended Program (U)

(S) Utilize GPS or inverse PLSS to provide improved emitter location accuracy of airborne ELINT systems.

(C) (c) Tracking of AD Assets Using MTI Radar. (U)

(U) Movement Sensing Systems will be available in the near term. Those which can reach some distance behind enemy lines (approximately 30 kilometers) are the Army's OV-1D Mohawk SLAR and SOTAs. In the longer term, the ARPA/Air Force's ASSAULT BREAKER concept should have an equal or greater capability.

(U) Movement Sensing Systems (MSS) can be of value in resolving the enemy AD situation in two ways: first, by observing and reporting movement from known AD sites; and second, by observing and reporting rotating, rocking, or nodding radar antennas of AD systems.

(U) The Task Group intuitively believes that SOTAS is such a powerful tool that near continuous coverage should be planned -- and if so, this should be exploited for AD.

(C) In the second technique, the velocity gate of the moving target indicator (MTI) radar would be adjusted to detect and report moving objects (the radar antennas) which have motion but are not moving across terrain. A skilled radar technician or perhaps an automatic processor should be able to identify a radar antenna in motion from other moving objects. This technique would be particularly valuable for classification as well as adding much improved accuracy (100 meters). Prompt integration of this radar information with ELINT information in the ASAC for reporting and tasking is vital.

(C) Disadvantages are the limited depth of view beyond the FEBA and possible physical vulnerability of the SOTAS platform when near the FEBA and radiating.

(S) Recommended Program (U)

(C) Support to ELINT assets should be a priority task of SOTAS and appropriate communications should be provided. The techniques should be demonstrated both in REFORGER exercises and in the BETA experiment.

(S) (d) Probing of WP AD. Even in the near term, it can be assumed that the enemy will exercise strict emission control to minimize the opportunities for detection, location, and strike. Consequently, it may be necessary to find means other than real air strikes to force the radars and data links to emit. Such a capability would become even more important in the longer term when PLSS is operational and a comprehensive ELINT take obtained in a few minutes.

(S) Aside from the obvious tactic of carefully monitoring AD emissions during each NATO air strike, two other techniques appear to be useful: deception concerning NATO air strike missions, accompanied by massive stand-off jamming of the acquisition radars; and the use of low cost decoys (faithfully simulating threat aircraft), which penetrate the area of interest.

(S) It is assumed that Soviet SIGINT resources are used to alert the AD forces of pending strikes. Stand-off jamming of the acquisition radars, possibly accompanied by a C&D effort, may force a Soviet decision to operate the AD engagement radars autonomously looking for the threat.

(S) Decoys were successfully used by the Israelis during the 1973 war, and were developed further in the U.S.

(S) Recommended Program (U)

(S) The Air Force should immediately review the operational need for active probing to obtain AD situation intelligence during high intensity warfare. If active probing is found to be required, then both jammer and decoy approaches should be developed and evaluated.

(S) Longer Term Concepts (U)

(U) Concepts and programmatic aspects for longer term improvements in ability to assess the AD situation follows and are summarized in Table IV-2-4.

(S) (a) PLSS/AGTELIS Interoperability. The Task Group believes that a significant payoff in capabilities could be achieved by providing a functional capability to use elements of PLSS and AGTELIS in one or more of the following modes:

(S) (1) Processing of geographically selected PLSS emitter collection data in AGTELIS ground processing centers. This would require either that AGTELIS centers have dual capability to receive AGTELIS and PLSS sensor inputs or that the sensor data streams of PLSS and AGTELIS be in a common format. The strike calculations currently performed in PLSS need not be provided for in this AGTELIS mode.

(S) (2) Processing of AGTELIS sensor data in PLSS ground processing stations. This could be particularly valuable if the recommendation to consider an airborne extension of AGTELIS is implemented. Again this would require an AGTELIS data buffer at the PLSS ground station or a common sensor output format.

(S) (3) Combined use of sensor inputs in a flexible way. For example, an AGTELIS station (airborne or ground) output could be used in lieu of a third aircraft if only two PLSS aircraft were flying. By tying into multiple AGTELIS stations the whole front could, in principle, still be covered to a depth of 30 kilometers for ground based AGTELIS and much deeper for an airborne AGTELIS tie.

TABLE IV-2-4

(U) LONGER TERM

CONCEPTS	PAYOFF	TECHNOLOGICAL IMPLICATIONS AND FEASIBILITY	PROTOTYPE DEVELOPMENT COST/TIME	IMPLEMENTATION IMPACT
a. PLSS/AGTELIS Interoperability	High	May require common format for AGTELIS sensor data systems. Implies major change to AGTELIS ground stations. Judged feasible.	Major program change for AGTELIS. May delay development.	Provides redundancy for both PLSS and AGTELIS. Increases survivability, flexibility and availability.
b. ELINT/RADAR Imagery Synergism	Med-High	Dependent upon successful development of ASARS or UPD-X SAR system. Judged technically feasible.	--	Would provide information on location and actual numbers of deployed air defense systems.

(S) The programmatic implications may initially be severe but this is balanced by a potentially large increase in viability of both of these critical systems. The development time/cost implications will be relatively large for AGTELIS (as its overall program and unit costs are an order of magnitude lower than PLSS) but will not be large in terms of the aggregate cost of both systems. In fact use of some common components may contribute to cost reductions -- and development of a modular ground station capability appears very practical with modern data processing techniques.

(S) Recommended Program (U)

(U) The Task Group recommends formation of a joint Army/Air Force working group tasked to determine optimum integration solutions for PLSS and AGTELIS, not to debate the need.

(S) (b) Radar Imagery Correlation. Timely imagery, properly correlated with ELINT information, could provide a greatly increased capability to determine accurate locations and true numbers of moving enemy AD systems and possibly in classification by type. Photography and infrared imaging by airborne platforms is not considered herein because of the overflight problem. National imaging assets are of limited use for mobile AD EOB purposes because of relative priorities and timeliness. Synthetic Aperture Radar (SAR) imaging systems offer the potential advantages of night and all-weather operation, stand-off capability, and real-time down link of information.

(S) The current UPD-4 SAR is limited by range (30 nautical miles), resolution (10 feet), real-time down link (one data link system in Europe), relatively short on-station duration of the RF-4C, and possible ECM vulnerabilities. For these reasons imagery association is not considered a near-term capability.

(S) An Advanced Synthetic Aperture Radar System (ASARS) is now under development and designed to be carried by a U-2R aircraft. This U-2 system is planned to have a 100 nautical mile range and 10-foot area resolution with the capability to focus to a 1-2 foot resolution at a desired point. This resolution might even provide antenna size and shape information. The

Tactical Reconnaissance Data Link (TRDL) will provide real-time imagery and enhance command and control. If the currently planned ASARS development is successful, the U-2R or TR-1, with ASARS, would provide a long-duration, high-altitude platform contributing significantly to confirming continuing presence at a site, improving location accuracy, and providing an alternate type classification method.

(S) <u>Recommended Program</u> (U)

(S) Review planned ASARS program to assure incorporation of necessary interface capabilities.

(S) B. <u>THE UTILITY OF AFFILIATION OF AD ASSETS TO ARMY ECHELONS</u> (U)

(S) 1. <u>Operational and Functional Needs</u> (U)

(S) AD assets are uniquely tied to Soviet battle echelons by doctrine. If these assets can be related to Soviet Divisions, Armies or Fronts, a senior U.S. battle commander can deduce not only the trend of battle (or exercise), but also future intent from the structure and density of the units.

(C) Movement and deployment of AD units provide indicators of the battle plan of the enemy commander. Thickening of AD units in an area could indicate a planned massing of combat power in preparation for an attack or major breakthrough. Of particular interest is the deployment of the Frontal SA-4 Brigades. While SA-6 and SA-8 units are organic to the Divisions of that Army, more Army AD units may be supporting one Division than another in response to the current or planned situation.

(C) Continuity of knowledge of the movement and deployment of enemy AD units can provide the friendly ground commander with a good indication of the deployment and/or attrition of enemy divisions. Further, the movement of one battalion in a SA-4, 6 and 8 Regiment or Brigade, whether forward or to the rear, is a good indicator that major combat units will be, or are, moving in that direction.

(C) Considering the SA-4, 6, 8 and ZSU-23-4 threat (see Appendix IV-A) facing NATO in the Central Region (there are nine first echelon divisions along the approximately 180 kilometer line defended by the U.S. V and VII Corps), monitoring the order of battle is a monumental task, especially when considering the inherent ability of the enemy to move units quickly and often. Accuracy of approximately one kilometer will be required.* (Accuracy to 50 meters or less is desirable if the specific AD unit is to be struck by friendly resources.)

(S) A typical Soviet tank or combined arms Army, made up of four combat Divisions would have the following AD resources: 9 SA-4 Batteries each having 3 Transporter Erector Launchers (TEL); 10 SA-6 (4 TEL each); 10 SA-8 Batteries (4 TEL each); and 16 SA-9/ZSU-23-4 Batteries (4 TEL each). Figure IV-2-1 provides a typical deployment of the force.

(S) 2. <u>Assessment of Capabilities and Deficiencies</u> (U)

(S) <u>SIGINT</u>. The electronic signatures of the AD units described above, while sufficient to identify weapons type, are insufficient to identify affiliation and subordination. The specially classified appendices also discusses SIGINT techniques for determining affiliation.

(S) <u>ELINT</u>. The pre-hostilities ELINT capability will continue to be satisfactory. The addition of PLSS will greatly improve our wartime ELINT location capability and be more than satisfactory for affiliation, since the accuracy requirement for strike for which PLSS is designed is greater than for affiliation. Some attention to the survivability of PLSS airborne ground equipments is desirable. In addition, ground processors presently under development and demonstration/test in Air Force and joint exercises will provide the capability to handle downlinked data from national systems and thereby successfully implement the tactical/national interface.

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*to maintain resolution between units and continuity in tracking.

XX = DIVISION
XXXX = ARMY
4 - SA-4 BATTERY
6 = SA-6 BATTERY
8 = SA-8 BATTERY
9 = SA-9/ZSU-23-4 BATTERY

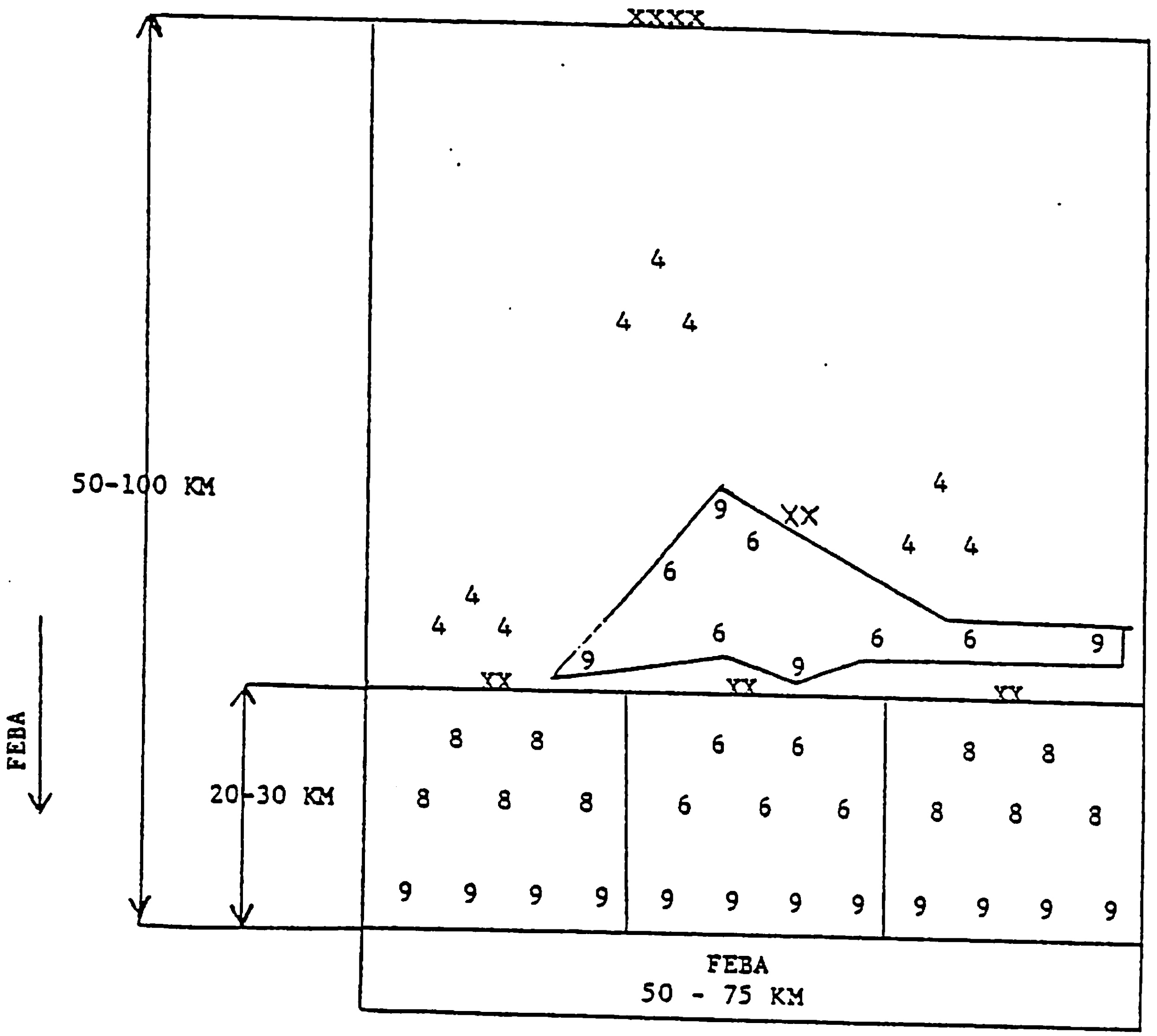

FIGURE IV-2-1

(S) Typical Air Defense Deployment in a Soviet Tank Army (U)

(S) Recommendation (U)

(S) Continue activities on both PLSS and national ground processors. See the specially classified appendices for detail.

(S) COMINT. The COMINT status is poor. ELS will provide the necessary location accuracy. However, it is unlikely that the required level of exploitation of AD-related communications can be accomplished with presently programmed capabilities. On the other hand, if tasking of COMPASS BRIGHT assets can be accomplished, some enhancement can be achieved.

(S) Recommendation (U)

(S) The ELS program should be continued, and a program for COMINT exploitation of AD-related communications must be vigorously pursued.

(SNF) Imagery. Another method for affiliating AD assets to Army units is the use of Imagery Intelligence (IMINT). The commonality and quantity of radars and associated vehicles of Brigade, Regimental, and Battalion headquarters can be used to identify specific headquarters affiliation. This affiliation is based on number and types of radars present and their distance from the FEBA (see Appendix B). Divisional associated AD Regimental headquarters (i.e., SA-6, SA-8 or S-60 Gun) can be expected to be about 20 kilometers from the FEBA in an offensive action and between 20-30 kilometers in a defensive action. Army and Front affiliated SA-4 Brigade headquarters will be located behind the Divisional units and about 40 kilometers in the offense and about 70 kilometers in the defense from the FEBA. The nearest SA-4 Battalion and its associated batteries will be from 25 to 50 kilometers from the FEBA.

(C) SAM and AA fire units will be more difficult to identify due to their mobility. However, each fire unit contains system peculiar equipment which will provide a positive identification for the SA-4 and SA-6 systems. The SA-8 associated vehicle provides a most unique signature for this system. The ZSU-23-4s will be difficult to identify; however, the GUN DISH radar, when erected, will help.

(U) The use of imagery as a stand-alone procedure for affiliation is not promising because it is largely inferential and manpower intensive. It will, however, provide collateral information when properly used by other systems.

(S) 3. A Proposed Concept for Rapid Affiliation (U)

(S) Fingerprinting. The communications exploitation procedures described above are extremely difficult to accomplish even though conceptually straightforward. If a simple, stable, unique signature could be found associated with a particular AD unit, it could be tracked wherever it went. If in addition, its affiliation with an echelon were determined, the trend of the battle would be more easily deduced. There are three fingerprinting techniques which are presently being pursued which merit increased attention: Frequency Modulation on PULSE (FMOP), Precision PRI (PPRI) and Channelization. A fourth, Radiation Intelligence (RADINT), is also discussed.

(S) (a) FMOP. Experiments have shown that radar pulses contain unintentional frequency modulation which is very stable. This phenomenon is most evident in magnetron transmitters but is also demonstrated by klystron transmitters. In fact, the modulation may remain phase coherent from pulse to pulse for klystron transmitters even when the radio frequency is slowly changed. The FMOP concept is important because it has been shown that Fourier coefficient association can be applied to identify and uniquely catalogue an intercepted pulse with high confidence (see Appendix C for a technical description of FMOP).

(S) One can envision two distinct modes of operation for FMOP. The first would add another dimension to the ambiguity space; RF, PRF, PW, scan type, scan rate, and (potentially) FMOP Fourier coefficients. It would find application in identifying particular radars that may have moved from previously determined locations. It could, therefore, insure that a single radar, by virtue of changing location, is not credited as two radars at two locations. This capability could also be used in the same mode to provide identification of established radars even after shifting to wartime parameters. Thus, the prior affiliation to numbered units will be retained.

(S) The second mode would be incorporated in equipment such as RWR and ALQ 119s. We estimate that the best method would be to load the data into the equipments from FMOP processing systems with their greater computational facilities.

(S) FMOP has been demonstrated in several brassboard configurations and has been shown to be effective against a class of U.S. and foreign radars.

(S) Recommendation (U)

(S) While there is much to be learned before operational equipment can be deployed, we recommend doubling the present FMOP 6.3 effort to the $2M level and begin development of brassboard equipment to assess performance against real AD radars. Development costs for a FMOP fingerprint system have been estimated at $10M nonrecurring, and $100K recurring (See Table IV-2-5(a).

(S) (b) PPRI. A simpler and more readily accessible signature is precision PRI. Experienced ELINT operators claim they can fingerprint radars by this method coupled with other data. Nevertheless the evidence is incomplete.

(S) Recommendation (U)

(S) Because of its potential, ease of access, and low cost we recommend careful collection, analysis, interpretation, and establishment of a PRI data base (See Table IV-2-5(b).

(S) (c) Channelization. See specially classified appendix for discussion.

(S) Recommendation (U)

(S) Research on Channelization deserves high attention (See SAB Appendix CD).

(S) Radiation Intelligence (RINT). RINT (sometimes called Unintentional Radiation Emission (URE)) is emitted from radars in synchronism with the main radar pulse, but at a much lower frequency (See specially classified appendix for a technical description of RINT). From radars operating at 3GHz the RINT emission is at

TABLE IV-2-5

(S) FINGERPRINTING SYSTEMS (U)

CONCEPTS	PAYOFF	TECHNOLOGICAL IMPLICATIONS AND FEASIBILITY	DEVELOPMENT COST/TIME	IMPLEMENTATION IMPACT
(a) NEAR TERM				
Precision PRI	High but Perishable	Feasibility based on emperical evidence. More information needed for higher confidence judgment	Low cost Done today	Provides finger-printing of some key AD radars. Requires data base
(b) LONGER TERM				
Exploitation of FMOP Technology	High	Sophisticated electronic equipment would be added to PLSS/AGTELIS.Valida-tion required.	1-2M/yr for 3 yrs should provide proof of principle	May provide a unique radar sig-nature for many Soviet air defense radars
ELS	High	Technically feasible	Funded/IOC-82	Provides real-time location on com-munications Emitters

frequencies from 0.1 to 0.5 GHz. Recent measurements show that some of these emissions can be ascribed to magnetron power oscillators, but modulators (both soft and hard tube) and high level timing circuits also produce these emissions, and they are difficult to shield.

(S) The importance of RINT is that these signals are present even when operational procedures severely restrict the emission of the main electromagnetic pulse energy. Thus there is the potential that the SA-4 PAT HAND, the SA-6 STRAIGHT FLUSH, and the SA-8 LAND ROLL target tracking radars can be identified and located even when not on the air.

(S) Recommendation (U)

(S) The technological implications of RINT are presently not understood sufficiently to make effective recommendations on program direction. Therefore, a modest 6.1, 6.2 effort should be continued.

(S) C. ASSESSING U.S. EW ASSETS vs WP AD (U)

(S) 1. Introduction (U)

(S) The U.S. EW arsenal consists of collection assets, radar warning receivers, jammers, and electronic equipments which facilitate destruction of enemy radars. Through close liaison with the intelligence community, the military tries to keep its EW equipments current with the changing nature of the enemy AD threat. This process, by its very nature, must lag Soviet developments, but need not lag Soviet deployments to the field. In spite of U.S. efforts to field countermeasures concurrently with Soviet deployments, we have not been able to react rapidly enough in spite of Quick Reaction Capability (QRC) programs in the past. Further, the QRC program has been relatively dormant in recent years.

(S) We have recently observed a series of counter-countermeasures on the part of the Soviet Union which may require a complete reevaluation and massive upgrading of our EW arsenal. These are:

(a) complex pulse trains

(b) increased frequency agility

(c) intrapulse modulations

(d) special antenna/processor configuration (e.g., scan with compensation)

(e) netted radars

(f) CW and pulse doppler radars

(S) Further, we fear that in the first few hours of hostilities we will be surprised by wartime tactics, procedures, and unforeseen modes on the part of WP forces. It is widely recognized that the current EW structure is not responsive to dynamic changes in the electromagnetic threat. The time lapse from detection/confirmation of a new operating mode of an enemy threat emitter to having a fix for Radar Warning Receiver (RWR) and/or ECM equipment in the field is unpredictable. The current system is plagued by a limited capability to collect radar parameter deviations, a loosely controlled system of reporting, a small cadre of personnel trained for analysis of data, a lack of adequate data automation to support software design and test, and a lack of dedicated secure communications to transmit changes to the theaters. It is necessary to configure our EW support system to accept in-theater reprogramming of equipments based on inputs from survivable collection systems which can rapidly observe the surprises which the WP has in store. To be effective, the collectors need to be active during the air strikes because many of the most effective WP radars will remain dormant (emission control) during intervals between strikes. Then, perhaps in a matter of a very few hours, the collector "take" must be converted to a format to allow for rapid insertion of new threat radar parameters into warning receivers, jammers, and other EW equipments before the next mission.

(S) In general, the U.S. EW arsenal has been designed primarily on a piecemeal basis; that is, the warning receivers, jammers, collection systems and radar-killing systems have not been integrated into an overall system for counter AD. On the other hand, the Soviet AD network (our target) is becoming increasingly formidable on a systematic, integrated and redundant basis. To counter this threat, we must look for and exploit synergisms in our EW arsenal. For instance, WILD WEASEL aircraft could be guided by PLSS while being protected by EF-111s; similarly SOTAS and AGTELIS are complementary in tracking AD radars as follows: AGTELIS locates them when they are stationary and transmitting; and SOTAS locates them when they are moving but silent; thirdly, killing and/or jamming of the LONG TRACK and FLAT FACE radars will force the PAT HAND and STRAIGHT FLUSH radars out of EMCON making them easier to locate and attack. Our recommendation then is that we consider systematic attrition and jamming of the enemy's AD system by the use of our EW arsenal as a system; this recommendation broadens the applicability of our area EW systems such as PLSS, AGTELIS and EF-111.

(S) 2. Capability Assessment and Deficiencies. An accurate assessment of the capabilities and deficiencies of the U.S. EW arsenal against the Soviet AD system is clearly a difficult undertaking. However, the Task Group felt it was necessary to make a beginning. Thus, in Table IV-2-6 we present comprehensive charts which depict the capabilities of specific EW equipments in four generic classes against the SA-4, SA-6, SA-8 and ZSU-23-4 AD systems. The four generic classes evaluated are:

warning receivers

jammers

tactical collection systems (radar bands)

specialized radar killing systems

Details used in this assessment are summarized in the specially classified appendices. Before addressing the specific deficiencies of present systems, we would like to note that not all data were available to us and that errors in judgment may have resulted. We feel, however, that the methodology is valuable and should be preserved.

(S) (a) Warning Receivers. The follow-systems are included in the category of " present capability": Army: ALR-39(V)1; ALR-39(V)2; ALR-46A Air Force: ALR-46A, ALR-56, ALR-62, ALR-69.

(S) Assessment (U)

(S) The trends are adverse. As the enemy AD arsenal becomes more sophisticated, our warning receivers are being stressed to their realistic limits. Broader

TABLE IV-2-6 (a)

(S) LETHAL DEFENSE SUPPRESSION (KILLERS) (U)

EQUIPMENT APR -38

PLATFORM F4G WILD WEASEL

MISSION DESTROY DEFENSES: DETECT, CLASSIFY, LOCATE, ASSOCIATE

IOC 1979

EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES	2, 4, 11 (RF AGILITY)	2, 4, 11
Flat Face (FF) Acquisition	YES	4	4
Thin Skin (TS) Heightfinder	YES	4	4
Pat Hand	YES		
Target Acquisition (TA)	YES	12 (EMCON)	12
Target Tracker (TT)	YES	12 (EMCON)	12
Missile Guidance (MG)	YES		
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	YES	2, 4, 11	2, 4, 11
Straight Flush	YES		
TA	YES		
TT	YES	5 (AGILITY)	5
Target Illuminator	YES		
Missile Receiver	N/A		
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	YES	2, 4, 11	2, 4, 11
Land Roll	YES		
TA	YES		
TT	YES		
MG	YES		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	3 (AGILITY)	3
General Net	NO		
Voice Radio	NO		

EQUIPMENT SHRIKE (AGM-45)

PLATFORM WILD WEASEL

MISSION DESTROY TARGET

IOC FIELDED

EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES	11, 2	11, 2
Flat Face (FF) Acquisition	YES	OUTSIDE FREQ RANGE	DO NOTHING EXTENSIVE; R&D ON 7 WAS FAILURE
Thin Skin (TS) Heightfinder	YES		
Pat Hand	YES		
Target Acquisition (TA)	YES	12 (EMCON)	12
Target Tracker (TT)	YES	12	12
Missile Guidance (MG)	YES	OUTSIDE FREQ RANGE	DO NOTHING
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	YES	2, 11; FF OUTSIDE RNG	2, 11; DO NOTHING
Straight Flush	YES		
TA	YES		
TT	YES	5 (AGILITY)	5
Target Illuminator	YES		
Missile Receiver	N/A		
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	YES	2, 11; FF OUTSIDE RNG	2, 11; DO NOTHING USE HARM
Land Roll	YES	OUTSIDE FREQ RNG	INCREASE FREQ RNG
TA	YES		
TT	YES		
MG	YES	OUTSIDE FREQ RNG	USE HARM
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	OUTSIDE FREQ RNG	INCREASE FREQ (HARM)
General Net	NO		
Voice Radio	NO		

EQUIPMENT	STANDARD ARM (AGM-78)		
PLATFORM	WILD WEASEL		
MISSION	DESTROY TARGET		
IOC	FIELDED		
EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES	11, 2	SMALL QTY IN INVENTORY PRECLUDES UPGRADE
Flat Face (FF) Acquisition	YES	OUTSIDE FREQ RNG	USE HARM
Thin Skin (TS) Heightfinder	YES		
Pat Hand	YES		
Target Acquisition (TA)	YES	12 (EMCON)	SMALL INVENTORY PRECLUDES UPGRADE
Target Tracker (TT)	YES	12	SMALL INVENTORY PRECLUDES UPGRADE
Missile Guidance (MG)	YES	OUTSIDE FREQ RNG	USE HARM
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	YES	2,11 FF OUTSIDE FREQ RNG	SML QTY IN INVENTORY PRECLUDES UPGRADE-USE HARM
Straight Flush	YES		
TA	YES		
TT	YES		
Target Illuminator	YES		
Missile Receiver	N/A		
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	YES	2,11 FF OUTSIDE FREQ RNG	SML QTY IN INVENTORY PRECLUDES UPGRADE-USE HARM
Land Roll	YES	OUTSIDE FREQ RNG	USE HARM
TA	YES		
TT	YES	OUTSIDE FREQ RNG	USE HARM
MG	NO		
Data Link	NO		
Voice Link	YES		
ZSU 23-4	YES		
Gundish	YES	OUTSIDE FREQ RNG	USE HARM
General Net	NO		
Voice Radio	NO		

EQUIPMENT	HARM (AGM-88)		
PLATFORM	WILD WEASEL		
MISSION	DESTROY TARGET		
IOC	1982-85		
EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES	2, 11	2, 11
Flat Face (FF) Acquisition	YES	4	4
Thin Skin (TS) Heightfinder	YES		
Pat Hand	YES		
Target Acquisition (TA)	YES	12 (EMCON)	12
Target Tracker (TT)	YES	12	12
Missile Guidance (MG)	YES		
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	YES	2, 11	2, 11
Straight Flush	YES		
TA	YES		
TT	YES	5 (AGILITY)	5
Target Illuminator	YES		
Missile Receiver	N/A		
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	YES	2, 11	2, 11
Land Roll	YES		
TA	YES		
TT	YES		
MG	YES		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	3 (AGILITY)	3
General Net	NO		
Voice Radio	NO		

TABLE IV-2-6 (b)

(S) RADAR WARNING RECEIVERS (RWR) (U)

SECRET

EQUIPMENT APR-39 (V) 1

PLATFORM UNIVERSAL ARMY HELICOPTER

MISSION WARN OF ATTACK, LOW SIGNAL DENSITY, LOW ALTITUDE

IOC FIELDED

EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	NO		
Long Track (LT) Acquisition			
Flat Face (FF) Acquisition			
Thin Skin (TS) Heightfinder			
Pat Hand			
Target Acquisition (TA)			
Target Tracker (TT)			
Missile Guidance (MG)			
Data Link			
Voice Link			
SA-6	YES		
LT/FF/TS	NO		
Straight Flush	YES		
TA	YES		
TT	YES		
Target Illuminator	YES	CAN'T WORK CW	ADD APR-44
Missile Receiver	NO		
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	NO		
Land Roll	YES		
TA	YES		
TT	YES		
MG	YES		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES		
General Net	NO		
Voice Radio	NO		

SECRET

EQUIPMENT	APR-39 (V) 2		
PLATFORM	SPECIAL ARMY ELECTRONIC MISSION AIRCRAFT: GUARD RAIL, MOHAWK, ETC.		
MISSION	WARN OF ATTACK MID-ALTITUDE/FRIENDLY AIRSPACE		
IOC	1981		
EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	NO		
Flat Face (FF) Acquisition	NO		
Thin Skin (TS) Heightfinder	NO		
Pat Hand	YES		
Target Acquisition (TA)	YES	1, 2	1, 2
Target Tracker (TT)	YES	1, 2	1, 2
Missile Guidance (MG)	YES		
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	NO		
Straight Flush	YES		
TA	YES	1, 2	1, 2
TT	YES	1, 2	1, 2
Target Illuminator	YES	CAN'T WORK CW	ADD APR-44 AS INTERIM
Missile Receiver	NO		
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	NO		
Land Roll	YES		
TA	YES	1, 2	1, 2
TT	YES	1, 2	1, 2
MG	YES		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	1, 2, 3	1, 2, 3
General Net	NO		
Voice Radio	NO		

EQUIPMENT ALR-56

PLATFORM F-15

MISSION WARN OF ATTACK

IOC FIELDED

EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	NO		
Flat Face (FF) Acquisition	NO		
Thin Skin (TS) Heightfinder	NO		
Pat Hand	YES		
Target Acquisition (TA)	YES	2, 4	2, 4
Target Tracker (TT)	YES	2, 4	2, 4
Missile Guidance (MG)	YES		
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	NO		
Straight Flush	YES		
TA	YES	2, 4	2, 4
TT	YES	2, 4	2, 4
Target Illuminator	YES	CAN'T WORK CW	INSTALL ECP (IN WORK) IOC 1980
Missile Receiver	NO		
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	NO		
Land Roll	YES		
TA	YES	2, 4	2, 4
TT	YES	2, 4	2, 4
MG	YES		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	4	4
General Net	NO		
Voice Radio	NO		

EQUIPMENT	ALR-69 AND ALR-62 **		
PLATFORM	F-16, A-10, F-4, F-111, EF-111A		
MISSION	WARN OF ATTACK		
IOC	FIELDED		
EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	NO		
Flat Face (FF) Acquisition	NO		
Thin Skin (TS) Heightfinder	NO		
Pat Hand	YES		
Target Acquisition (TA)	YES	2, 4	2, 4
Target Tracker (TT)	YES	2, 4	2, 4
Missile Guidance (MG)	YES		
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	NO		
Straight Flush	YES		
TA	YES	2, 4	2, 4
TT	YES	2, 4, 5	2, 4, 5
Target Illuminator	YES		
Missile Receiver	NO		
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	NO		
Land Roll	YES		
TA	YES	2, 4	2, 4
TT	YES	2, 4	2, 4
MG	YES		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	2, 4, 5	2, 4, 5
General Net	NO		
Voice Radio	NO		

TABLE IV-2-6 (c)

(S) ELECTRONIC COUNTERMEASURES (ECM);

SELF PROTECTION AND SUPPORT (U)

EQUIPMENT	ALQ-119		
PLATFORM	A-10, F-16, F-4, A-7, F-111		
MISSION	SELF PROTECTION JAMMING		
IOC	FIELDED		
EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	NO		
Flat Face (FF) Acquisition	NO		
Thin Skin (TS) Heightfinder	NO		
Pat Hand	YES		
Target Acquisition (TA)	NO		
Target Tracker (TT)	YES	CAN'T WORK SWC	7, DEV MONOPULSE TECHNIQUE
Missile Guidance (MG)	NO		
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	NO		
Straight Flush	YES		
TA	NO		
TT	YES	6	6
Target Illuminator	NO		
Missile Receiver	YES	THREAT SENSITIVE	6
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	NO		
Land Roll	YES		
TA	NO		7
TT	YES	CAN'T WORK SWC/MONOPULSE	7, DEVELOP TECHNIQUE
MG	NO		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	LACK OF POWER MGMT	DEVELOP POWER MGMT
General Net	NO		
Voice Radio	NO		

EQUIPMENT	ALQ-131
PLATFORM	A-10, F-16, F-4, A-7, F-111
MISSION	SELF PROTECTION JAMMING
IOC	1979

EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	PERHAPS		8, DETERMINE PAYOFF OF JAMMING
Flat Face (FF) Acquisition	PERHAPS		EW/ACQ/HF RADARS
Thin Skin (TS) Heightfinder	NO		
Pat Hand	YES		
Target Acquisition (TA)	NO		
Target Tracker (TT)	YES	CAN'T WORK SWC	7, DEVELOP TECHNIQUES
Missile Guidance (MG)	NO		
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	PERHAPS	8	8
Straight Flush	YES		
TA	NO		
TT	YES	6	6
Target Illuminator	NO		
Missile Receiver	YES	THREAT SENSITIVE	6
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	PERHAPS		8
Land Roll	YES		
TA	NO		7
TT	YES	CAN'T WORK SWC/MONOPULSE	7, DEVELOP TECHNIQUE
MG	NO		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	LACK OF POWER MGMT	DEVELOP POWER MGMT
General Net	NO		
Voice Radio	NO		

EQUIPMENT	ALQ-99		
PLATFORM	EF-111A		
MISSION	SUPPORT JAMMING FOR PENETRATING AND STAND OFF TAC AIRCRAFT		
IOC	1982		
EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES	MUST BARRAGE JAM TO COVER RF AGILITY	INVESTIGATE SPECIAL HIGH POWER JAMMER
Flat Face (FF) Acquisition	YES		
Thin Skin (TS) Heightfinder	YES		
Pat Hand	YES		
Target Acquisition (TA)	YES		
Target Tracker (TT)	PERHAPS		9
Missile Guidance (MG)	NO		
Data Link	YES	10	10
Voice Link	NO		
SA-6	YES		
LT/FF/TS	YES	MUST BARRAGE JAM TO COVER RF AGILITY	INVESTIGATE SPECIAL HIGH POWER JAMMER
Straight Flush	YES		
TA	YES		
TT	PERHAPS		9
Target Illuminator	NO		
Missile Receiver	NO		
Data Link	YES	10	10
Voice Link	NO		
SA-8	YES		
LT/FF/TS	YES	MUST BARRAGE JAM TO COVER RF AGILITY	INVESTIGATE SPECIAL HIGH POWER JAMMER
Land Roll	YES		
TA	YES		
TT	PERHAPS		9
MG	NO		
Data Link	YES	10	10
Voice Link	NO		
ZSU 23-4	NO		
Gundish	NO		
General Net	NO		
Voice Radio	NO		

SECRET

EQUIPMENT ALQ-136 (V) 1***

PLATFORM

MISSION

IOC

EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	NO		
Long Track (LT) Acquisition	NO		
Flat Face (FF) Acquisition	NO		
Thin Skin (TS) Heightfinder	NO		
Pat Hand	NO		
Target Acquisition (TA)	NO		
Target Tracker (TT)	NO		
Missile Guidance (MG)	NO		
Data Link	NO		
Voice Link	NO		
SA-6	YES		
LT/FF/TS	NO		
Straight Flush	YES		
TA	NO		
TT	NO		
Target Illuminator	NO		
Missile Receiver	YES	CAN'T WORK CW	FIELD ALQ-162
Data Link	NO		
Voice Link	NO		
SA-8	YES		
LT/FF/TS	NO		
Land Roll	YES		
TA	NO		
TT	YES	CAN'T WORK SWC	DEVELOP TECHNIQUE
MG	NO		
Data Link	NO		
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES	THREAT SENSITIVE PRF AGILITY	1
General Net			
Voice Radio			

SECRET

TABLE IV-2-6 (d)

(S) EMITTER COLLECTION SYSTEMS (U)

EQUIPMENT	QUICK LOOK II		
PLATFORM	FIXED WING (ARMY)		
MISSION	ELINT (EOB); DETECT, LOCATE, CLASSIFY, ASSOCIATE		
IOC	1979		
EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES	11	SEE REPORT PAGE
Flat Face (FF) Acquisition	YES	13	SEE REPORT PAGE
Thin Skin (TS) Heightfinder	YES	13	
Pat Hand	YES		
Target Acquisition (TA)	YES		
Target Tracker (TT)	YES		
Missile Guidance (MG)	YES		
Data Link	YES	14b	DO NOT RECTIFY DEFICIENCY
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
SA-6	YES		
LT/FF/TS	YES	11 -LT 13	SEE REPORT PAGE
Straight Flush	YES		
TA	YES		
TT	YES	3 (CLASSIFICATION)	SEE REPORT PAGE
Target Illuminator	YES	RANGE LIMITED	SEE REPORT PAGE
Missile Receiver	NO	PASSIVE	PASSIVE
Data Link	YES	14b	DO NOT RECTIFY DEFICIENCY
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
SA-8	YES		
LT/FF/TS	YES	11 -LT 13	SEE REPORT PAGE
Land Roll	YES		
TA	YES		
TT	YES		
MG	YES		
Data Link	YES	14b	DO NOT RECTIFY DEFICIENCY
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
ZSU 23-4	YES		
Gundish	YES	3 RNG LMTD (CLASSIFICATION)	IMPROVED SENSITIVITY SEE RPT PAGE
General Net	NO	SEE NOTE ****	SEE NOTE ****
Voice Radio	NO	SEE NOTE ****	SEE NOTE ****

EQUIPMENT: TEREC ALQ-125

PLATFORM: RF-4 (AIR FORCE)

MISSION: ELINT (EOB): EWIRC SUPPORT, DETECT, LOCATE, ETC.

IOC: FIELDED

EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES	4, 11, 13 (AGILITY)	4 SEE REPORT PAGE
Flat Face (FF) Acquisition	YES	4, 13 (ASSOCIATION)	4 SEE REPORT PAGE
Thin Skin (TS) Heightfinder	YES	13	SEE REPORT PAGE
Pat Hand	YES		
Target Acquisition (TA)	YES		
Target Tracker (TT)	YES		
Missile Guidance (MG)	N/A		
Data Link	YES	14	14, ON AN INTERIM BASIS PENDING PLSS
Voice Link	NO		
SA-6	YES		
LT/FF/TS	YES	11-LT(AGILITY) 4,13 (ASSOCIATION)	4, SEE REPORT PAGE
Straight Flush	YES		
TA	YES		
TT	YES	5 (AGILITY)	5
Target Illuminator	YES		
Missile Receiver	N/A		
Data Link	YES	14	14 ON AN INTERIM BASIS
Voice Link	NO		
SA-8	YES		
LT/FF/TS	YES	1, 4, 13	1, 4 SEE REPORT PAGE
Land Roll	YES		
TA	YES		
TT	YES		
MG	YES		
Data Link	YES	14	14 ON AN INTERIM BASIS
Voice Link	NO		
ZSU 23-4	YES		
Gundish	YES		
General Net	NO		
Voice Radio	NO		

EQUIPMENT	AGTELIS
PLATFORM	GROUND MOUNTED SENSORS AND PROCESSOR (ARMY)
MISSION	DETECT, LOCATE, ASSOCIATE FEBA TO DEPTH OF 30km
IOC	1982

EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES		
Flat Face (FF) Acquisition	YES	13	13
Thin Skin (TS) Heightfinder	YES	13	13
Pat Hand	YES		
Target Acquisition (TA)	YES		15
Target Tracker (TT)	YES		15
Missile Guidance (MG)	YES		15
Data Link	YES	14b	MEET NEED THRU TACELIS/GUARDRAIL
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
SA-6	YES		
LT/FF/TS	YES	13	13
Straight Flush	YES		
TA	YES		15
TT	YES		15
Target Illuminator	YES	RANGE LIMITED	
Missile Receiver	NO	PASSIVE	PASSIVE
Data Link	YES	14b	MEET NEED THRU TACELIS
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
SA-8	YES		
LT/FF/TS	YES	13	13
Land Roll	YES		
TA	YES		15
TT	YES		15
MG	YES		
Data Link	YES	14b	MEET NEED THRU TACELIS
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
ZSU 23-4	YES		
Gundish	YES		
General Net	NO	SEE NOTE ****	SEE NOTE ****
Voice Radio	NO	SEE NOTE ****	SEE NOTE ****

EQUIPMENT	PLSS		
PLATFORM	AIRBORNE SENSORS AND GROUND PROCESSOR		
MISSION	ELINT/STRIKE: DETECT, LOCATE, ETC., FEBA TO LIMIT OF AIRPOWER		
IOC	1985		
EVALUATION	NEED*	DEFICIENCY	RECOMMENDATION
SA-4	YES		
Long Track (LT) Acquisition	YES	13 (ASSOCIATION)	13
Flat Face (FF) Acquisition	YES		
Thin Skin (TS) Heightfinder	YES	13	13
Pat Hand	YES		
Target Acquisition (TA)	YES		
Target Tracker (TT)	YES		
Missile Guidance (MG)	YES		
Data Link	YES	14a	14
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
SA-6	YES		
LT/FF/TS	YES	13 (ASSOCIATION)	13
Straight Flush	YES		
TA	YES		
TT	YES		
Target Illuminator	YES	NO CW CAPABILITY	ADD CW
Missile Receiver	N/A		
Data Link	YES	14a	14
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
SA-8	YES		
LT/FF/TS	YES	13 (ASSOCIATION)	13
Land Roll	YES		
TA	YES		
TT	YES		
MG	YES		
Data Link	YES	14a	14
Voice Link	NO	SEE NOTE ****	SEE NOTE ****
ZSU 23-4	YES		
Gundish	YES		
General Net	NO	SEE NOTE ****	SEE NOTE ****
Voice Radio	NO	SEE NOTE ****	SEE NOTE ****

NOTES

* NEED: Need is defined by the Panel to mean that the equipment should counter/intercept/analyze the particular threat. The particular threat should be in the mission of the equipment. This does not imply that there exists a written requirement to counter the particular threat or that it is within the design capability to do so. Rather the Panel made a subjective assessment that a "need" exists and that meeting the need would be highly beneficial.

** ALR-69 AND ALR-62: The Panel did not assess the ALR-46, ALR-63, APR-25/36. The ALR-69 and ALR-62 were grouped together due to very similar capabilities and limitations.

*** SELF PROTECTION JAMMING: The Panel evaluated numerous systems; however, only four are reported as being representative. Systems not depicted include F-15/ALQ-135, F-111/ALQ-94, Army ALQ-162, EF-111A/ALQ-137. Additionally, effects of self protection chaff were not evaluated.

**** VOICE INTERCEPTION FOR COLLECTION SYSTEM: It is recognized that the collection of these signal are an overall collection requirement. Most link signals are outside of the collection capability of the radar collection systems; accordingly, COMINT collection systems exist. The Panel recognizes that combining both radar and COMINT collection equipments may overly complicate a single collection system. The Panel recognizes that this function may be performed by a central collection/processing center.

TABLE IV-2-6 (e)

DEFICIENCIES // RECOMMENDATIONS

DEFICIENCY NUMBER	DESCRIPTION	RECOMMENDATION NUMBER	DESCRIPTION
1	ELECTRONIC WARFARE INTEGRATED REPROGRAMMING CONCEPT (EWIRC) DEPENDENT. SOFTWARE PROGRAMMABLE SYSTEM, DEPENDENT UPON TIMELY RECEIPT OF CHANGED THREAT DATA. DEPENDENT UPON TIMELY SOFTWARE CHANGES.	1	SET UP ARMY EWIRC. SYSTEM NEEDS TO BE SET UP BY IOC OF 1981.
2	CLASSIFICATION AMBIGUITIES MAY EXIST. OTHER THREAT SYSTEMS WITH SIMILAR SORT CRITERIA WOULD CONFUSE THE SYSTEM.	2	ADD ADDITIONAL SORTING TOOLS. MULTIPLE SORTING CRITERIA (RPF, RF, INSTANTANEOUS RF, SCAN, AOA) SHOULD BE USED TO ELIMINATE MABIGUITIES.
3	HEAVY PRF AGILITY IN DENSE ENVIRONMENT (JITTER WITH PATTERN WOBULATION) MAY CONFUSE THE SYSTEM.	3	ADD ADDITIONAL SORTING TOOLS.
4	EWIRC DEPENDENT.	4	IMPROVE EXISTING EWIRC. NEED TIMELY RESOLUTION OF THREAT CHANGES AND FIELD IMPLEMENTATION OF CHANGES.
5	HEAVY PRF AGILITY (MULTI-LEVEL STAGGER) CAN CONFUSE SYSTEM.	5	IMPROVE SOFTWARE, MULTIPLE SENSORS ARE AVAILABLE (TOA, AOA AND SCANNING RECEIVER); PROBLEM SHOULD BE WORKABLE IN SOFTWARE PROVIDED A DENSE, AGILE ENVIRONMENT DOES NOT OVERLOAD SYSTEM.
6	SA-6 TARGET TRACKER NOT BEING JAMMED DUE TO DIFFICULTIES (SWC, TRACK ON JAM, ETC). MISSILE RECEIVER BEING JAMMED AS EASIER LINK.	6	THREAT CHANGES IN MISSILE RECEIVER MAY PRECLUDE EFFECTIVE JAMMING OF MISSILE LINK. WORK SHOULD BE CONTINUED ON JAMMING OF TARGET TRACKER AS A BACK UP.
		7	TARGET ACQUISITION JAMMING TO DENY RANGE SHOULD BE INVESTIGATED DUE TO LACK OF EFFECTIVE SWC/ MONOPULSE TECHNIQUE FOR TT JAMMING.

TABLE IV-2-6 (e)

DEFICIENCIES // RECOMMENDATIONS (CONTINUED)

DEFICIENCY NUMBER	DESCRIPTION	RECOMMENDATION NUMBER	DESCRIPTION
8	DOES NOT JAM ACQ RADARS	8	THE PAYOFF OF JAMMING ACQ/HF/EW RADARS USING THE SELF PROTECTION JAMMER (ALQ-131) NEEDS TO BE INVESTIGATED. RANGE DENIAL, MULTIPLE STROBES FROM MANY AIRCRAFT AND CONFUSION FACTORS COULD NEGATE NET CONTROL.
9	IS NOT USED TO JAM TERMINAL THREATS FOR SUPPORT PURPOSES.	9	THE EF-111A ALQ-99 IS NOT BEING USED TO JAM TERMINAL THREATS ON PENETRATION MISSIONS. THE ALQ-99 COULD BE A CONSIDERABLE AID TO SELF PROTECTION JAMMING CONSIDERING KNOWN DEFICIENCIES OF SELF PROTECTION JAMMERS (E.G., MONOPULSE, SWC). ACCORDINGLY, USE OF SUPPORT JAMMING TO JAM TERMINAL THREATS NEEDS TO BE INVESTIGATED.
10	DOES NOT JAM DATA LINKS	10	INVESTIGATE PAYOFF FOR EF-111A DATA LINK JAMMING IN PENETRATION ROLE. CONSIDERATION SHOULD BE GIVEN TO A PRIORITY JAMMING (BARRAGE, NON-POWER MANAGED).
11	RF AGILITY MAY CONFUSE SCANNING RECEIVER AND PREVENT PROPER IDENTIFICATION AND CLASSIFICATION.	11	INSTALL ADDITIONAL SENSOR AS AN AID IN SORTING AND IDENTIFICATION.
12	ENEMY RF DISCIPLINE/EMISSION CONTROL (EMCON) WILL MINIMIZE THE TIME AVAILABLE TO IDENTIFY, CLASSIFY AND DESTROY.	12	JAMMING OF ACQUISITION NET WILL FORCE INCREASED AUTONOMOUS OPERATION; THEREBY REQUIRING LONGER PERIODS OF TARGET TRACKING OPERATION. JAM ACQUISITION NET USING EF-111A OR ALQ-131.
13	CANNOT ASSOCIATE A TYPE RADAR WITH A THREAT COMPLEX (E.G., LONG TRACK CANNOT BE ASSOCIATED WITH AN SA-4 COMPLEX DUE TO ITS USE WITH SA-6, ETC.	13	ADD SERIAL NUMBER IDENTIFICATION SUCH AS FMOP OR REQUIRES OTHER INTELLIGENCE ASSETS, E.G., COMINT COLLECTION, LRRP'S (LONG RANGE PATROL ACTION), PHOTO RECONN I.R., SLAR, ETC.

TABLE IV-2-6 (e)

DEFICIENCIES // RECOMMENDATIONS (CONTINUED)

DEFICIENCY NUMBER	DESCRIPTION	RECOMMENDATION NUMBER	DESCRIPTION
14	CANNOT RECEIVE AND PROCESS DATA LINKS.	14	EXTENDING CAPABILITY TO INCLUDE DATA LINKS WOULD ENHANCE MISSION CAPABILITY.
14a	CANNOT PROCESS DATA LINKS.		
14b	CANNOT RECEIVE AND PROCESS DATA LINKS BELOW 500 MHz. CAN RECEIVE AND LOCATE DATA LINKS ABOVE 500 MHz.		

frequency coverage is required, more sophisticated processing to cope with frequency and pulse train agilities, pulse doppler and CW radars, dense signal environments, etc., is required; yet unit costs must be tightly constrained to allow this capability to be provided to lower cost aircraft such as helicopters, A-10s and F-16s. As a result, the warning receivers will be less likely to sort out imminent threat emitters from background signals; that is, there will be more and more ambiguities in threat identification and more and more unprocessed residue in warning receiver data processors. The strong trend toward very low altitude penetration on the part of air-to-ground aircraft and attack helicopters is an important mitigating circumstance in our favor. Low altitude greatly reduces the pulse density which must be handled by the warning receivers.

(C) Recommendations (U)

(C) Concentrate on the equipment and procedures for quick in-theater reprogramming of threat tables in the warning receivers' digital processors.

(C) Consider equipping air-to-ground low-altitude penetrating aircraft (i.e., F-16, A-10, AAH) with a less sophisticated, less expensive suite than the aircraft which must fly at high or medium altitude for mission success (i.e., F-15, GUARDRAIL, MOHAWK, SOTAS, QUICK LOOK, TEREC, PLSS).

(C) Continue to band-aid present radar warning receivers, but initiate an analysis to determine the pulse density and threat sophistication beyond which it no longer makes sense to stay with the present architectural design, perhaps requiring a whole new approach.

(C) Consider the utility of in-flight reprogramming of warning receivers through PLSS and JTIDS links, thereby somewhat unburdening the self-contained processors in our warning receivers.

(C) Consider a totally distributed aircraft and helicopter warning system, using a JTIDS-like communication system; in which early warning information is provided from stand-off sensors such as PLSS and AGTELIS with self-contained warning of only the missile launch itself.

(S) (b) Jammers. Included in the present capability of jammers are the Air Force ALQ-119 and ALQ-131 self-protection jamming pods, the ALQ-135 internal self-protection jamming system on the F-15 and the EF-111/ALQ-99 support jamming aircraft. The nearest term Army radar jammer is the AN/ALQ-136(V)1, presently scheduled for an FY 81 IOC.

(S) Assessment (U)

(S) The Soviets have recently taken some significant steps to cope with our ECM program, which they apparently respect. These significant steps are: RF agility, home-on-jam, difficult-to-jam scan/processing techniques such as scan with compensation and forms of monopulse, and emission control with netting and optical tracking. This is a formidable array of techniques which tend to reduce the effectiveness of our ECM equipments. At the same time, the U.S. is moving very slowly in this area. Typical of the lack of ECM progress are the following:

(C) The EF-111 IOC is 1982, in spite of the fact that it is based on the EA-6B which went operational with the U.S. Navy almost a decade earlier.

(U) Much of our self-protection ECM capability is centered in externally-mounted pods which degrade aircraft performance, in spite of the fact that TAC has a requirement for internally-mounted ECM.

(U) The U.S. Army does not have an active airborne ECM jammer in the operational inventory.

(U) The Air Force QRC program has become dormant over the last four or five years as a reaction to the fact that it was abused prior to that time.

(C) Because of this evolving imbalance, the Air Force is being driven toward the ground, and must operate at extremely low altitudes where ground targets are difficult to find without external aids.

(S) Recommendations (U)

(C) Continue research and development to counter scan with compensation.

(S) Investigate the applicability of the AN/ALQ-131 to the mission of jamming the LONG TRACK/FLAT FACE as a supplement to EF-111.

(S) Evaluate the EF-111 in an exclusive role of jamming all LONG TRACKS/FLAT FACES and THIN SKINS in the area by concentrating all available Effective Radiated Powers (ERP) only against these radars in a barrage mode across the entire frequency ranges covered by the three radars.

(S) Consistent with Paragraph c above, investigate the applicability of a special-purpose narrow band, high power LONG TRACK jammer as an augmentation to the EF-111 suite.

(S) Investigate the possibility of including data link recognition and jamming equipment in the EF-111 suite.

(U) Support the Army development programs for light-weight jammers nomenclatured AN/ALQ-136(V)2, ALQ-162 and ALQ-XXX.

(C) Initiate an analysis to determine the threat sophistication level beyond which deception countermeasures are stressed to the point of reasonableness, and at which we should turn again to fundamental noise and random false target systems.

(S) (c) ELINT Collectors. (C) Included in the present capability of emitter collection systems are the Army QUICK LOOK II in the OV-1D aircraft and the TEREC ALQ-125 in the RF-4 aircraft. In the projected capability category are the Army AGTELIS system (IOC 1982) and the Air Force PLSS system (IOC 1985).

(S) Assessment (U)

(S) The QUICK LOOK and TEREC systems are DOA systems which must fly a baseline to obtain radar location information. This reduces their ability to locate accurately short on-time emitters, especially in case of the QUICK LOOK which is mounted on a slow-flying aircraft. The QUICK LOOK is further hampered by its inabilities to handle PRF jitter, stagger and wobulation. A Product Improvement Program (PIP) configuration will not reach IOC status until 1984. TEREC has many of the same difficulties as QUICK LOOK in terms of its ability to handle advanced counter-countermeasures such as RF agility and severe jitter and stagger modes.

(S) The AGTELIS and PLSS systems are TOA systems which can rapidly and accurately locate even short on-time emitters. Further, being more modern systems, they are better able to handle the more complex signal modulations. Some deficiencies exist in these systems also, such as the ability to handle CW emitters; however, these deficiencies are not fundamental and can be corrected.

(S) None of the four systems has any capability against the various data links associated with the enemy AD systems.

(S) Recommendations (U)

(U) Plan a long range strategy for phasing out QUICK LOOK II and TEREC ALQ-125 in favor of AGTELIS and PLSS.

(U) Reconsider the merits of the QUICK LOOK II PIP which will not reach the IOC stage until FY 1984, two years after the planned IOC for AGTELIS.

(C) As a long range substitute for QUICK LOOK, evaluate the substitution of an airborne component of AGTELIS, which would extend the line-of-sight capability of AGTELIS beyond 30 kilometers beyond the FEBA.

(S) Add a data link recognition and location component to both the PLSS and AGTELIS systems. For further discussion see the specially classified appendices.

(C) Insure interoperability of PLSS and AGTELIS data streams and formats.

(S) (d) Specialized Radar-Killing Systems. This report will not deal with conventional means of killing radars, when the radar is viewed as just another target, like a tank or an armored personnel carrier. We are concerned however with special purpose radar killing systems such as WILD WEASEL, PLSS weapons, SHRIKE (AGM-45), STANDARD ARM (AGM-78), HARM (AGM-88), and an advanced development of an anti-radar version of the COPPERHEAD and HELLFIRE systems.

(S) Assessment (U)

(U) The Task Group has not been able to evaluate the special purpose, radar-killing ordnance during the course of the summer study, including the Harassment Weapons System presently being planned by the U.S. and German Air Forces.

(S) The WILD WEASEL APR-38 system appears to rank in the marginal to adequate range in its ability to cope with the expected array of CCM.

(S) Recommendations (U)

(S) Upgrade the WILD WEASEL APR-38 to cope with the advanced threats in a self-contained manner.

(S) Integrate the WILD WEASEL fleet into the PLSS system so that WILD WEASEL strikes can be conducted under PLSS guidance.

(S) Determine the capability of the SHRIKE, STANDARD ARM and HARM missiles to operate against the advanced CCM techniques now postulated.

(S) Conduct an analysis to determine the level of seeker complexity beyond which it is unreasonable to expect that we can continue to home adequately in a self-contained mode, and at which we should rely on external guidance such as PLSS.

(S) 3. Proposed Concepts for Capability Improvement. The proposed concepts herein have been developed as recommendations in the previous section to overcome the deficiencies identified in the charts in Table IV-2-6(e). Our purpose here is to expand briefly the proposed concepts and assess their payoffs, technological implications, technical feasibility, estimated development cost/time and estimated implementation impact. Not all of the recommendations in the previous section will be translated into proposed concepts in this section; rather, we have sifted those recommendations down to a most important set expanded in Table IV-2-7.

TABLE IV-2-7

CONCEPT	PAYOFF	TECHNOLOGICAL IMPLICATIONS AND FEASIBILITY	DEVELOPMENT COST/TIME	IMPLEMENTATION IMPACT
In-theater* rapid reprogamming	Medium	Accelerates transition to software progammability; no question of technical feasibility	$2M/12 months	European Facility
Systems* Approach to Attack	High	Architectural and interoperability implications; no technical feasibility issue	$10M/18 months	Could be tied to All Source Analysis Center and Tactical Fusion Centers
Jamming of Early Warning, Target Assignment, Height Finder Radars	High	Three Options: (1) ALQ-131 expansion in role; (2) Spec. Purp. high power jammer on EF-111; (3) Tactical Emp. of EF-111 in exclusive role 1 and 2 must be judged for technical feasibility	1. $5M/12 months 2. $15M/18 months 3. Zero	Options 1 and 2 affect ongoing programs; weight, volume and power implication big effect on ALQ-131
Install Data Link jammers on EF-111	High	Need recognizers and jammers; Complete development program	$20M/24 months	Will have EMI, weight, volume and power implications on EF-111
Install Data Link Recognizer/ Location capability on PLSS and AGTELIS	High	Complete development program	$20M/24 months	Can be tied to ELS/ CELT programs

*Near Term Item

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CONCEPT	PAYOFF	TECHNOLOGICAL IMPLICATIONS AND FEASIBILITY	DEVELOPMENT COST/TIME	IMPLEMENTATION IMPACT
Stop PIP* on QUICK LOOK; add Airborne component to AGTELIS	Medium	No question of technical feasibility	$10M/18 months (Should save money in the long run)	Not significant
Integrate WILD WEASEL and PLSS	Medium/ High	No question of technical feasibility	Minimum (Should save money in the long run)	Not significant

* Near Term Item

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(S) 4. Technological Initiatives. On the assumption that we will continue to develop our EW arsenal along the same lines upon which it has been developed in the past, this Task Group suggests that the following compilation be used as a check list against which the technological base programs should be judged:

Receivers: Super fast scan channelized Receivers Instantaneous Frequency Measurement (IFM)

Processors: Agile Trackers
One Million Pulse/Second Density Processors

Components: Digital RF Memory
Higher Power solid state power sources
Electronic Scan Antennas

(U) This Task Group has not reviewed the technological base programs for relevancy to the identified deficiencies; this may be a worthwhile task at some future date. Further, the Task Group has not reviewed broad expansions of the frequency band including optical, laser, and millimeter bands.

(S) III. SUMMARY OF RECOMMENDATIONS (U)

(U) Table IV-3-1 summarizes the various recommendations made by the Task Group in the body of the report and appendices. It is included herein, in a prioritized tabular format and again summarized in terms of near and longer term programmatical impact.

TABLE IV-3-1 - RECOMMENDATIONS

(S) NEAR TERM IMPACT TIME FRAME (U)

PRIORITY	ACTION	BASIS
I	Develop special purpose collection and automatic processor for air defense data links..	Automatic association of COMINT will assist in rapid type classification of air defenses.
I	Emphasize rapid development of FMOP for "Off Line" operation against current radars.	FMOP has enjoyed sufficient success under a variety of conditions to warrant as rapid development as possible. This effort should be aimed at occasional (or off-line) checking for new locations of previously detected radars.
I	Develop a "precise" PRI data base on air defense radars.	The potential, ease of access, low cost and success of this approach in other arenas suggests that it receive careful evaluation. This requires a complete data base.
I	Provide for in-theater reprogramming of critical EW equipment such as RWR, jammers, etc.	It is apparent that the Warsaw Pact can change EW parameters faster than these systems can respond today -- an intolerable and repairable situation since NATO will have survivable collection systems that can observe such changes in near real term.

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PRIORITY	ACTION	BASIS
I	Investigate the applicability of a modified AN-ALP-131 POD to jam LONG TRACK FLAT FACE.	Denial of acquisition radars identified as extremely high priority task.
I	Evaluate the effectivenss and practicality of exclusively utilizing all jamming assets aboard EF-111 to barrage jam all LONG TRACKS/FLAT FACES in the threat area. Consistent with these results, investigate the applicability of a special purpose, high power jammer aboard EF-111 specifically designed to barrage jam the LONG TRACK band in a stand-off mode.	Denial of acquisition radars identified as extremely high priority task.
I	Develop and evaluate air defense peculiar data link detectors and jammers to augment the EF-111 suite.	Denial of critical data link operation can be virtually as effective as denial of the radar acquisition.
I	Rapidly determine if physical basis exists to overcome "scan with compensation" technique used to circumvent angle deception jammers.	Extend useful life of currently deployed angle deception equipment.
II	Support air defense location/movement detection ELINT with SOTAS; add direct communications if required.	SOTAS monitoring of both vehicle movements from air defense sites and antenna motions.

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PRIORITY	ACTION	BASIS
II	Determine need for active probing to activate air defenses and best approach to accomplishment.	Counter EMCON by jamming surveillance radar's or use of penetrating decoys.
II	Continue development of a "channelization" data base.	Although there is no known fundamental reason for the channelization that has been observed, our understanding of Soviet doctrine as well as EMI considerations suggest that this approach be continued.
II	Upgrade APR-38 as used in WILD WEASEL.	Cope with contemporary threats in self contained mode.
II	Analyze reasonable limits of Seeker complexity for ARMs.	Assist in future planning for balance between self guided vs. command guided arm developments.
II	Add GPS or Inverse GPS receivers to airborne ELINT platforms.	Significantly reduce major location error contribution of DOA systems at low cost.
II	Initiate analysis to determine the pulse density and threat sophistication beyond which new radar warning receiver architecture or approaches must be developed.	Future radar agility is tending to make present system architecture cumbersome and expensive.

PRIORITY	ACTION	BASIS
II	The continued rapid development and deployment of lightweight Army jamming assets is encouraged, e.g., AN/ALQ-136(V)2, ALQ-162, ALQ-XXX).	Army presently has no modern systems available in inventory. May be essential for helicopter operation in the mid 80s.
III	Consider equipping low altitude penetrating aircraft (i.e., F-16, A-10, AAH) with less sophisticated, less expensive radar warning receivers than A/C forced to operate at higher altitude, in a more electronically dense environment.	May be more cost effective.
III	Initiate an analysis to determine the threat sophistication level beyond which deception countermeasures become less attractive than fundamental noise and false target generation.	Increased sophistication of threat radars may cause smart jamming to become overly complex and costly.
III	Continue investigations of RINT--but at a low level.	With only few exceptions, the power level of RINT emission is too low for fingerprinting. It may be sufficient for ARM terminal homing.
I	Urgent determination of integration modes for PLSS/AGTELIS. Recommend joint USAF/USA task team.	Viability of both PLSS and AGTELIS is crucial. Integration can enhance survivability, availability, and capability of both systems.

PRIORITY	ACTION	BASIS
I	Add a data link recognition and location capability to PLSS and AGTELIS.	There is convincing evidence showing that these links provide highly significant--and largely nonperishable--information that complements the primary PLSS and AGTELIS product.
II	Phase out QUICK LOOK II and TEREC (ALQ-125) in favor of AGTELIS and PLSS. Then evaluate the feasibility and effectiveness of adding airborne elements to AGTELIS.	TDOA systems offer all the advantages of DOA systems plus considerably enhanced accuracy of location and, with respect to these particular programs, earlier IOC. Airborne platforms can extend the range of ABTELIS to 25km beyond the FEBA, a critical area of concern to the division commander. Such platforms would also be consistent with increased interoperability with PLSS.
II	Study the utility of in-flight reprogramming of warning receivers with information from PLSS, thru JTIDS.	The potential to unburden on-board warning receiver processors and hopefully reduce costs/complexity.
III	Study the utility of a distributed aircraft/helicopter warning system, using JTIDS-like communications to pass PLSS/AGTELIS derived threat emitters to involved units.	Potential to further simplify/restrict on-board warning receiver equipments. May not be practical for world-wide use.

PRIORITY	ACTION	BASIS
III	Provide for use of ASARS to assist in air defense unit characteristics determination or confirmation.	If ASARS on U2R provide 1-2 foot resolution at designated points, configuration recognition may be possible.
III	Provide means to control WILD WEASEL by PLSS.	Use of PLSS guidance will increase WW effectiveness.

* Priority Explanation

I Essential
II Urgent
III Important

APPENDIX A

(SNF) PROJECTED MANEUVER FORCE AIR DEFENSE CAPABILITIES (U)

TABLE IV-A-1

(SNF) GROUND MANEUVER FORCES - AIR DEFENSE CAPABILITIES FOR 1978 (U)

	GSFG	NGF	CGF	WESTERN MDS.
SA-4				
Army Bn (TEL)	21 (189)	3 (27)	3 (27)	31 (198)
Front Bde (TEL)	(6 Bn) 2 (54)	-----	-----	-------
Natl Bn (TEL 1/	3 (27)	3 (27)	3 (27)	-------
	29 (270)	6 (54)	6 (54)	31 (198)
SA-6				
Sov Reg (TEL)	9 (180)	1 (20)	3 (60)	4 (80) 2/
Natl Reg (TEL) 1/	1 (20)	2 (40)	2 (40)	--------
	10 (200)	3 (60)	5 (100)	4 (80)
SA-8				
Sov Reg (TEL)	2 (40)	-----	1 (20)	2 (40) 3/
SA-9				
Sov Div (TEL)	20 (320)	2 (32)	5 (80)	29 (464)
Natl Divs (TEL)	6 (96)	13 (208)	10 (160)	-------
	26 (416)	15 (240)	15 (240)	29 (464)

1 Table A-14 NSWP DIPP

2 29 Divs in WMDs is 17% of total Sov Force .17 x 21 SA-6 Reg in Sov U = 3.5; SA-6 Reg in WMDs = 4 Reg

3 29 Divs in WMDs is 17% of total Sov Force. 17 x 9 SA-8 Reg in Sov U = 1.5; SA-8 Reg in WMD = 2 Reg

	GSFG	NGF	CGF	WESTERN MDS
S-60 AAA				
Frt Bde/Army AAA Reg (S-60)	2 Bde/6 Reg (264)	1 (24)	2 (72)	----
Reg (S-60)	----	----	----	
Natl Reg (S-60)	3 (72)	10 (240)	7 (126)	
	9 (336)	11 (264)	9 (198)	____
ZSU-23-4				
Sov Div (Veh)	20 (320)	2 (32)	5 (80)	31 (496)
	6 (96)	13 (208)		
M-53/59-30 mm (Veh) Natl			10 (300)	
	26 (416)	15 (240)		31 (496)
SA-7				
Sov Div (Gripstock) 2/	20 (3500)	2 (320)	5 (890)	31 (5410)
Natl Div (Gripstock)	6 (432)	13 (936)	10 (720)	
	26 (3932)	15 (1256)	15 (1610)	31 (5410)

---

1 Continues assumption that Div S-60 will be moved to Front and Army

2 Assumes average TOE from DIPP 144-240 = 348 ÷ 2 = 192 (190) for MRD and 117 + 207 = 324 ÷ 2 = 162 (160)

TABLE IV-A-2

(SNF) GROUND MANEUVER FORCES - AIR DEFENSE CAPABILITIES FOR 1983 (U)

	GSFG	NGF	CGF	WESTERN MDS
SA-4				
Army Bn (TEL)	15 (135)	3 (27)	3 (27)	30 (270)
Front Bde (TEL)	2 (54)	---	---	2 (54)
Natl Bn (TEL) 1/	3 (27)	6 (54)	3 (27)	----
	24 (216)	9 (81)	6 (54)	32 (324)
SA-6				
Sov Reg (TEL)	11 (220)	1 (20)	3 (60)	11 (220)
Natl Reg (TEL) 1/	3 (60)	4 (80)	3 (60)	
	14 (280)	5 (100)	6 (120)	11 (220)
SA-8				
Sov Reg (TEL)	6 (120)	1 (20)	1 (20)	3 (60)
SA-9				
Sov Div (TEL)	20 (320)	2 (32)	5 (80)	31 (496)
Natl Reg (TEL)	6 (96)	13 (208)	10 (160)	----
	26 (416)	15 (240)	15 (240)	31 (496)

1 Assumes smallest # of regiments indicated in 83 column of Table A-14 NSWP DIPP

	GSFG	NGF	CGF	WESTERN MDS
S-60 AAA[1]				
Frt/Army Bde/Reg (S-60)[2]	2Bde/(216) 6Reg	1 (24)	2 (72)	-------
Reg (S-60)	9 (216)	1 (24)	1 (24)	23 (552)
Natl Reg (S-60)	5 (72)	10 (240)	7 (126)	-------
	20 (504)	12 (288)	10 (222)	23 (552)
ZSU-23-4				
Sov Div (Veh)	20 (320)	2 (32)	5 (80)	29 (464)
Natl Div (Veh)	6 (96)			
ZSU-57-2 (Veh) Natl		13 (46)		
M-53/59-30 mm Natl (Veh)			10 (300)	
	26 (410)			
SA-7				
Sov Div (Gripstock)	20 (2610)	2 (234)	5 (664)	29 (3798)
Natl Div (Gripstock)	6 (288)	13 (624)	10 (480)	

---

1 Based on TOE count minus divisions with SA-6/SA-8.

2 Assumes divisional S-60 replaced by SA-6 or SA-8 have been moved to Front/Army as independent AAA regiments of 36 guns each.

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TABLE IV-A-3

(SNF) GROUND MANEUVER FORCES - AIR DEFENSE CAPABILITIES FOR 1993 (U)

	GSFG	NGF	CGF	WESTERN MDS
SA-4				
Army Bn (TEL)	15 (135)	3 (27)	3 (27)	30 (270)
Front Bde (TEL)	2 (54)	------	------	2 (54)
Natl Bn (TEL) 4/	6 (54)	9 (81)	6 (54)	------
	27 (243)	12 (108)	9 (81)	32 (324)
SA-6				
Sov Reg (TEL)	11 (220)	1 (20)	3 (60)	11 (220) 1/
Natl Reg (TEL) 4/	6 (120)	8 (160)	4 (80)	
	17 (340)	9 (180)	7 (140)	11 (220)
SA-8				
Sov Reg (TEL)	9 (180)	1 (20)	1 (20)	4 (80) 2/
SA-9				
Sov Div (TEL)	20 (320)	2 (32)	5 (80)	31 (496)
Natl Div (TEL) 3/	6 (96)	13 (208)	10 (160)	------

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1 Assumes continued deployment of 2 reg per year through 93. Will probably be SA-6 follow-on, SA-X-11.

2 Assumes continued deployment of 2 reg per year through 93.

3 NSWP DIPP Table A-1.

4 Assumes largest number of reg indicated for 87 column on Table A-14.

APPENDIX B

(SNF) USE OF IMAGERY FOR AFFILIATION (U)

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(SNF) USE OF IMAGERY FOR AFFILIATION (U)

(SNF) 1. Soviet AD organizations assigned to front and lower units have a certain commonality of equipment in command and control activities which will identify Brigade, Regimental and Battalion headquarters. Resolution of imagery utilized for identification must be able to distinguish major pieces of equipment, possibly as low as 3 feet. Table IV-B-1 shows the major equipment associated with each headquarters. Utilizing box bodied vehicles as identification indicators

TABLE IV-B-1 (S) HEADQUARTERS UNIT EQUIPMENT RELATIONSHIP (U)

HQ UNIT	LONG TRACK	THIN SKIN B	FLAT FACE	URAL 375 C&C	GAU 1	GAU 2	GAU 3	4
SA-4 Bde	2	1	0	1	0	1	1	1
SA-4 Bn	1	0	0	0	1	1	1	0
SA-8 Rgt	1	1	1	1	0	0	0	1
SA-6 Rgt	2	1	0	1	0	0	0	1
S-60 Gun (Div)	0	0	2	0	0	0	0	0
S-60 Gun (Army)	0	0	3	0	0	0	0	0

appears to be valid as the GAU series of vehicles are similar in configuration to other electronic associated box bodied vehicles. The presence of the URAL-375, 6x6, command and control vehicle will, if distinguishable, add creditability to the location of the SAM headquarters.

(S) a. The association of two LONG TRACK and one THIN SKIN B radars will indicate a SA-4 Brigade or a SA-6 Regimental headquarters. The absence of additional radars within a 350 meter diameter will eliminate the possibility that this sighting is that of an early warning radar site.

(S) b. The presence of a single LONG TRACK without other radars, and three box bodied vehicles (i.e., GAU 1, 2 and 3) in close proximity indicates the signature of a SA-4 Battalion headquarters. Three SA-4 fire units (Batteries) should be located 1-2 kilometers away.

(S) c. The SA-8 Regimental headquarters is unique in that its signature consists of a LONG TRACK radar, a new FLAT FACE variant radar, and a THIN SKIN B height finder radar. The use of the LONG TRACK and FLAT FACE variant, in the absence of other early warning and acquisition radars will be the key to identification.

(S) d. The presence of two FLAT FACE radars in close proximity of each other, without other radars being present is a high indicator for a Motorized Rifle or tank division S-60, 57mm AA gun Regimental headquarters. The S-60, 57mm AA gun Regimental headquarters assigned to an Army or Front are believed to have three FLAT FACE radars assigned. The field configuration of the Army and Front subordinated AA gun Regimental headquarters is not known at the present time.

(S) e. An additional key to SAM and AA headquarters subordination will be their deployment distances of the radars from the FEBA. Table IV-B-2 shows this relationship. This Table is a guide, as units will be deployed in accordance with the tactical situation.

TABLE IV-B-2 (S) LOCATION OF HEADQUARTERS FROM FEBA (U)

HQ UNIT	LOCATION FROM FEBA			
	OFFENSE		DEFENSE	
SA-4 Bde	18-70km	(40)*	45-95km	(70)*
SA-4 Bn	10-50km	(25)*	35-75km	(50)*
SA-8 Rgt	5-21km	(20)*	5-21km	(20)*
SA-6 Rgt	20-25km	(20)*	25-35km	(30)*
S-60 Gun (Div)	15-20km	(20)*	15-20km	(20)*
S-60 Gun (Army)	Unknown		Unknown	

*Optimum location

(U) 2. SAM and AA fire units will be more difficult to identify due to their mobility, which is their key to survivability. Each fire unit has system peculiar equipment with separate configurations.

(S) a. The SA-4 fire unit (Battery), consists of a full tracked PAT HAND fire control radar and three full tracked SA-4/GANEF TELs carrying two missiles on each. The three TELs will be pointing towards the direction of perceived threat, with the PAT HAND radar located up to 140 meters in the rear. The FIRE UNIT location will be an open area, clear of obstructions, with radar line of sight to the target and adequate room to launch the missiles. Field positions will initially be hastily prepared with berms and other improvements added with time. The most prominent identification feature of this fire unit will be the PAT HAND radar. The SA-4/GANEF vehicle chassis has been adapted to form the basic chassis for the armored mine layer and 152mm SP howitzer, both subordinate to divisions. Photo interpreter keys should be used to avoid confusion between the SA-4 TEL and other adapted chassis. The SA-4 wheeled transloader, on a URAL-375, 6x6 truck chassis, will provide an additional significant signature item within the fire unit area.

(S) b. The SA-6 fire unit (Battery) consists of a STRAIGHT FLUSH acquisition and fire control radar on a full track chassis. Four TELs of the SA-6/GASKIN system are also on a full track chassis and each mount three GAINFUL missiles. It is possible to confuse the canvas covered SA-6 TEL with the ZSU-23-4. The most prominent identification feature will be the STRAIGHT FLUSH radar. The SA-6 transloader, on a ZIL-131, 6x6, truck chassis has a unique rear mounted crane which will serve as an additional identification item.

(S) c. The SA-8 fire unit vehicle provides the most unique identification feature on the battlefield. The four SA-8 fire unit vehicles in a battery are mounted on an unusual amphibious wheeled 6x6 vehicle with three axles evenly spaced and acquisition, fire control, and launchers mounted on top. The transloader vehicle uses the same chassis except it has missile storage on top. This unusual vehicle, used as the basic chassis for the SA-8 battery components will provide a positive identification of this unit on the battlefield. The BTR-60PA command and control vehicle is common to other combat units and will not provide a positive unit identification by itself. The only other known combat system presently in Soviet inventory utilizing the SA-8 6x6, three axle vehicle is the SS-21 missile, which is expected to be on the battlefield during this time period under consideration.

(S) d. The ZSU-23-4 SHILKA self-propelled anti-aircraft gun system will be difficult to spot on the battlefield. This weapon, four of which are organic to each motorized rifle and tank Regiment, will be in close proximity of other tracked and/or wheeled vehicles. The full tracked basic chassis, mounting a rotating turret, is capabile of firing at aircraft while on the move. The key identification feature of the ZSU-23-4 will be its GUN DISH radar, when it is erected, on top of the turret. Normal unit integrity of four vehicles in close proximity, with a normal interval of 150-250 meters between vehicles will be maintained. Two ZSU-23-4 configurations may be encountered. The four companion SA-9/GASKIN vehicles will be located about 1.5 to 3 kilometers behind the ZSU-23-4s. The SA-9 vehicle will be easily confused with similarly configured BRDM-2rkh and BRDM-2/AT-5 vehicles which will also be present on the battlefield. The BTR-60PA command and control vehicle is common to other combat units and will not provide a positive unit identification by itself. The ZSU-23-4 ammunition reload vehicle is based on a ZIL-131, 6x6 cargo truck, common item, and thus will not help in identification.

(S) e. The S-60, 57mm AA gun battery is organized with six towed guns and a FLAP WHEEL fire control radar. In march column the guns are normally towed by URAL-375, 6x6, cargo trucks with the FLAP WHEEL and mess vehicle bringing up the line. In the tactical configuration the six guns are normally arranged in a circle, with a maximum radius of 50 meters (cable limited) and the FLAP WHEEL radar displaced up to 500 meters from battery center. The FLAP WHEEL radar must be located in a position which is not more than 300 meters higher or 300 meters lower than the gun positions. The battery is capable of displacement in three gun echelons.

(S) f. Additional aid to subordination will be the location of the fire unit from the FEBA. Table IV-B-3 shows the relationship of each fire unit, however, this figure by itself will not prove positive subordination, and is presented here only as a guide.

TABLE IV-B-3 (S) LOCATION OF FIRE UNITS FROM FEBA (U)

UNIT	LOCATION FROM FEBA OFFENSE		DEFENSE	
SA-4 Btry	10-50 km	(25)*	35-75km	(50)*
SA-6 Btry	2-5km	(3)*	5-16km	(10)*
SA-8 Fire Unit	3-5km	(4)*	3-5km	(4)*
ZSU-23-4 Veh	.4-.5km	(.4)*	1.5-2km	(1.5)*
S-60 Btry	10-20km	(10)*	10-20km	(10)*

*Optimum Location

APPENDIX C

(S) UNINTENTIONAL EMISSIONS (FMOP and RINT) (U)

(S) FMOP is based on the premise that the time varying instantaneous frequency (FM) of a radar pulse is stable and unique to the particular radar. If the premise is true and if the FM waveform can be measured with sufficient accuracy, the technique can be usefully applied to certain areas of EW, as noted in the body of the report. Information to date suggests that the uniqueness is related to certain fundamental components of the radars, particularly to the power amplifier tube and PFN, rather than easily adjusted parameters such RF, PRF, etc.* Magnetron driven radars seem to be particularly vulnerable to FMOP identification, while other radars driven by TWTS or klystrons have, in fact, received little investigation. Obviously, FMOP identification of such radars deserves study.

(S) Of special interest is the fact that the FMOP is generally independent of operator adjustments. Tests indicate specifically that there is no significant change in the FMOP waveform with change in PRF. Tests have also been made with respect to operator adjustments to RF operating frequency, scan rate and pulse width with minimal effect on FM waveform. This is important since we are virtually certain that when war starts, the enemy will modify his operating parameters sufficiently to confuse standard emitter characteristics wherever possible. In practically all cases, FMOP could be uniquely associated with the radar in spite of these changes.

(S) Maintenance changes have been investigated by HRB Singer include the following:

a. Pulse forming network exchange.

b. Magnetron exchange.

---

* Recent work at RAND, not reviewed by this group, suggests that significant FM variation may occur as a function of antenna angle. Clearly, the allegation should be investigated.

c. Pulse transformer replacement.

d. Trigger thyratron interchange.

e. High voltage power supply exchange/ adjustment.

f. RF match adjustment.

g. Antenna change.

The first two of these, which are rather significant changes to the transmitter itself, produce significant changes in the FM signature. That is, given two transmitters of the same type with different FM waveforms, if both the pulse forming network and the magnetron were exchanged between the two radars, the FM signature from the first would appear at the second and vice versa. This test was actually conducted using the Army developed RSS (Radar Signal Sorter) system at Eglin AFB, Florida, and subsequently at the Naval Post Graduate School, Monterey, California, under Air Force sponsorship. As part of the same investigation, the rest of the items on this list were also investigated. The results show that changes in these devices, without changing the normal operation of the transmitter, do not effect FM waveform perceptably. Included in the antenna change, the last item on the list are cable length changes, polarization changes, and even intestigation of the main-lobe versus a back-lobe on the antenna. As long as the waveform could be identified - that is, as long as the receiver was capable of detecting the signal clearly - the waveform could be associated uniquely.

(S) FMOP should not be confused with unintentional emissions that are not directly associated with band pass modulations of the carrier frequency. Emissions outside the band pass (RINT) appear to be far too low for useful fingerprinting, whereas the energy contained in the unintentional modulations in the band pass (FMOP) are only 15 to 25 dB down from the total energy in the pulse.

(S) The essence of the concept is to convert the FM waveform to the Fourier domain using the FFT technique at sampling rates consistent with the pulse width and the desires to extract over 10 Fourier coefficients for each pulse. It appears that these coefficients, after suitable rotation in the complex plane to compensate for variation in sampling start time and when subjected to standard statistical analyses, provide (in many cases) a unique description of a particular radar. Subsequent measurement and comparison (presumably in less than 24 hours) of new coefficients to a library of coefficients should provide either (a) identification, or (b) recognition that an identification cannot be made, i.e., a false identification can often be avoided by (automatic) recognition that the uniqueness of the coefficients is insufficient for identification.

(S) Multipath could reduce the effectiveness of FMOP by distorting the received radar pulse. The effect has not been overly serious in past measurements, but additional study of multipath effects in a PLSS deployment in Europe should be made. Because it appears that the grazing angle for PLSS reception of the radar pulse is greater than 5° and because much of the FMOP information is contained in the leading edge of the pulse, it is anticipated that multipath distortion will not impose serious limitations. Figure IV-C-1 illustrates this point and is based on tests made by AIL.

(S) The emperical evidence is encouraging. Bunker Ramo equipment has identified (84 to 100% of the time) particular US and Soviet radars during peripheral reconnaissance in various parts of the world. A representative number of FMOP unique signatures obtained in these tests is shown in Figure IV-C-2. Each of the six diagrams shown is a copy of what is displayed on the monitor scope. Comparison of the displays with respect to the AM, FM, and in particular, the coefficients of the FM pulse, serve to illustrate the unique signature obrained for each of the six radars intercepted and results obtainable by application of the FMOP technique.

(U) While there is much to be learned before operational equipment can be deployed, support in the 6.3 category at the $1-2M a year level appears justified. Unit cost has been estimated at less that $100K.

FIGURE IV-C-1

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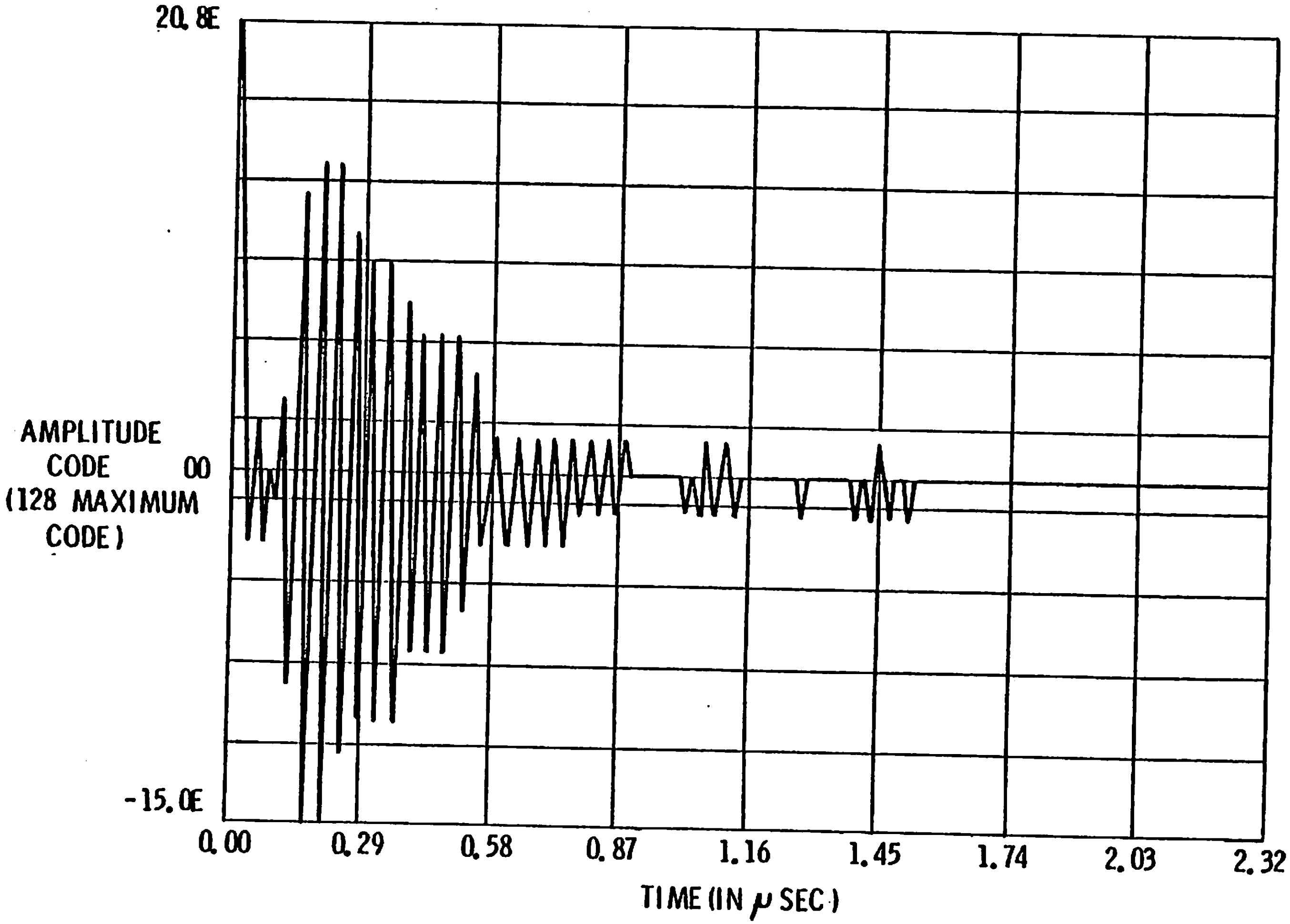
RECONSTRUCTED IF (PRE-DETECTION) INCLUDING TYPICAL MULTI-PATH EFFECTS



UNCLASSIFIED

SECRET

TEST DATA—UNIQUE EMITTER IDENTIFICATION BY FMOP

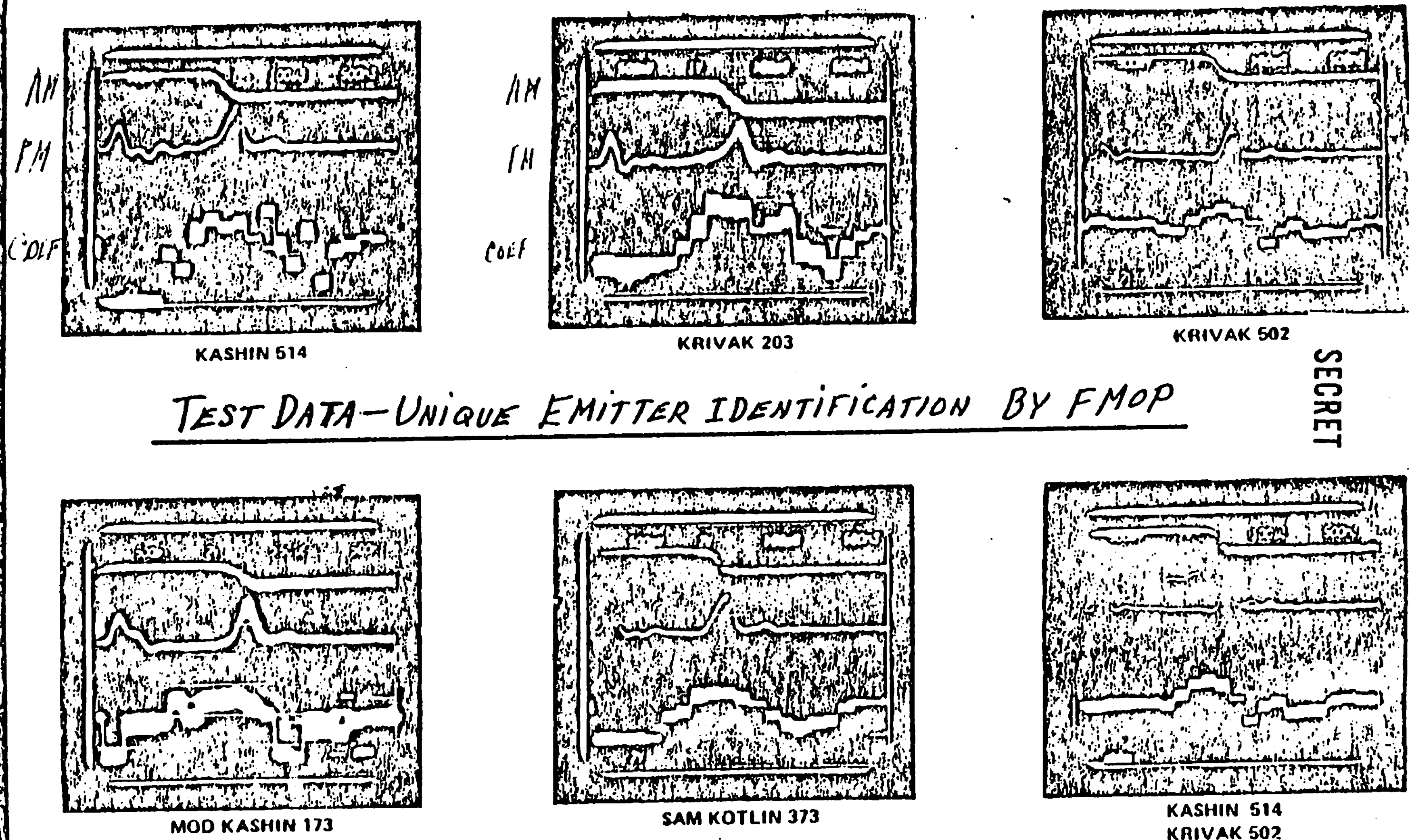


FIGURE IV-C-2

(BR)

SECRET

APPENDIX D

REFERENCES

IV. (U) REFERENCES

1. DST-1170R-395-77-SI-SPR 4 SA-4 and SA-6 Command and Control Technical Vulnerability (U); DIA (MIA) December 1977.

2. DN-TCS-G-1001/78 Intelligence Capabilities for Theater Nuclear Warfare in Europe (U) (Review Draft); Defense Nuclear Agency January 1978.

3. Electronic Warfare Management Agility Task Force Minutes (U); HQ USAF Systems Command 8 December 1977.

4. "HYDRA", A Handbook on Soviet Ground Based Air Defense Systems (U); HQ USAFTAC/USATRADOC 15 June 1977.

5. Reconnaissance Mission Area Analysis (U); HQ USAFTAC/USATRADOC 15 December 1977.

6. Defense Suppression Mission Area Analysis Threat Assessment (U) HQ USAFTAC/USATRADOC 15 December 1977.

7. DST-1060S-414-76 Soviet SA-4 Surface to Air Missile Systems (U); DIA (MIA) September 1976.

8. DST-1060S-307-76/77 SA-6 Surface to Air Missile System (U) Volumes 1-3; DIA (MIA) July 1976-January 1978.

9. DST-1060S-391-77 Soviet SA-8 Surface to Air Missile System (U); DIA (MIA) August 1977.

10. Defence Science Board Summer Study on Approaches to the Countering of Warsaw Pact Command, Control and Communications Systems (C^3), Vol III, December 1977.

11. Air Force/Army Reconnaissance Force Study, 1 December 1977.

ANNEX A

STUDY PARTICIPANTS

ANNEX A
STUDY PARTICIPANTS

Since this Summer Study was a joint activity of the Army Science Board and the Air Force Scientific Advisory Board, the participants and leadership for the study were originally selected from the two boards. To maintain the needed balance in perspective, the study was directed by co-chairmen -- one from each board. Each of the four Task Groups were similarly balanced between the boards, with each having a balance in chariman and vice-chairman assigments and in group membership. To this base were added a number of senior knowledgeable individuals from both Services -- civilian and military -- to provide the needed liaison, operationally-oriented experience, etc.

The final configuration of the study organization is shown in Table 1. The Steering Group was established to provide overall initial direction and progress reviews to the study and was ably assisted by the senior Service personnel listed for the Advisory Committee. In particular, the general officer participants on the Steering Group, Major General Dickinson and Major General Leaf, were of great value in attempting to vector the studies toward targets of practical value. Each Task Group Board membership was also supplemented by the Service personnel shown. All of the personnel listed spent a substantial amount of preparatory effort prior to the actual two-week study and made strong contributions to the final output of the study.

Table 2 lists other personnel who provided substantial additional inputs to the study, either to individual Task Groups or at an overview level.

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TABLE 1

ASB - SAB SUMMER STUDY

ADMINISTRATION

COL McNutt, SAB
LTC Dunderville, SAB
LTC Sweeney, ASB
MAJ DeBerg, SAB
MAJ Jenne, SAB
CPT Beam, SAB
Mrs. Amundson, ASB
Ms. Barrett, SAB
Mrs. Lackey, SAB
Ms. Pernat, SAB
Mrs. Pipon, ASB
Ms. Thomas, ASB

CO-CHAIRMEN

Mr. Lockerd, ASB
Mr. Greene, SAB

STEERING COMMITTEE

Mr. Greene, SAB
Mr. Lockerd, ASB
MG Dickinson, GO Participant
MG Leaf, GO Participant
Dr. Naka, SAB
Dr. Yang, ASB

ADVISORY COMMITTEE

Dr. Kahal, SAF/ALR
Mr. Friedrich, OASA(RDA)
Dr. Lasser, ODCSRDA
Mr. Christman, TRADOC
COL Corum, TAC/DRC
Mr. Trask, AFTEC/XRH

TASK GROUP I
AIR DEFENSE

Dr. Stear, Chairman SAB
Dr. Yaru, Vice-Chairman ASB
Dr. Davis SAB
Mr. Holter SAB
Dr. Hundley ASB
Dr. Honey ASB

Mr. Pfeiffer
Army Tech Member
COL Rhinehart
TRADOC Member

COL Gillette
TAC Member
MAJ Oakes
AFTEC

TASK GROUP II
FIRE SUPPORT

LTG Kent, Chairman
Dr. Fried, Vice-Chairman
Dr. Blair
Dr. DePoy
Dr. McMillan
Dr. Renier
Mr. Everett
Dr. Gibson

Mr. Gale
Army Tech Member
COL Donohue
TRADOC Member

MAJ May
TAC Member
LTC Hegstrom
AFTEC

TASK GROUP III
C3 INTERDICTION

Mr. Shore, Chairman
Dr. Flax, Vice-Chairman
Dr. Braddock
Dr. DeBra
Dr. Tooley
Dr. Ware

Dr. Wiseman
Army Tech Member
COL Bindrup
TRADOC Member

LTC Tatum
TAC Member
MAJ Richards
AFTEC

TASK GROUP IV
AIR DEFENSE EWI

Mr. Kresa, Chairman
Dr. Naka, Vice-Chairman
Dr. Montgomery
Mr. Simon
Dr. Smith

Mr. Speakman
Army Tech Member
COL Koenig
TRADOC Member

COL Barrows
TAC Member
LTC Davis
AFTEC

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TABLE 2
ADDITIONAL PARTICIPANTS

Dr. Starr, IDA
Mr. Muehe, MIT Lincoln Lab
LTC Bender, USAFE
CW4 LeGere
Mr. Kennedy, ITT
COL Gagen, USMC
MAJ Ryan, USMC
LTC Mellon, ODCSRDA
COL Gorman, V Corps
COL Bryan, V Corps
LTC Hertel, V Corps
Dr. Mirman, STC
Mr. Fowler, MITRE
Mr. Dudley, NSA
LTC Cheney, PLSS PMO
Mr. Rueck, NSA
Mr. Hall, Bunker-Ramo
Mr. Schwartz, Loral
Mr. Larocca, Dalmo Victor
CPT Ritter, TAWC
MAJ Niebauer, Andrews AFB
Mr. Stephenson, ERADCOM
Mr. Giordano, ERADCOM
MAJ Cook, Field Station Berlin
Mr. Neighbors, Hughes

ANNEX B

BRIEFINGS AND DISCUSSIONS IN PREPARATION FOR THE JOINT SUMMER STUDY

ANNEX B
BRIEFINGS AND DISCUSSIONS IN PREPARATION FOR THE JOINT SUMMER STUDY

Members of the Joint Summer Study received a number of briefings and participated in various technical discussions to obtain background and detailed technical information pertaining to the study. A subset of the Study Group made a five-day visit to major U.S. Command Headquarters in West Germany to become familiar with the perceptions of the commanders and staffs currently most directly concerned with the topics addressed in the Study.

This Annex lists the briefings and discussions attended by Members of the Study Group and presents a brief report on the European visit.

FULL SUMMER STUDY BOARD MEETING

BRIEFERS

NAME	ORGANI-ZATION	TOPIC	DATE/PLACE OF BRIEFING	
LTC Muschek	DLA	Threat in Central Europe	13-14 April,	Pentagon
MAJ Tash	AF/XO	AF Checkmate	"	"
MAJ Downer	AF/XO	Force Structure for late 1980's	"	"
MAJ Barber	AF/RD	AF R&D Programs	"	
LTC Martin	Army/ ODCSOPS	Army Concepts of Ops to counter the Pact Threat	"	"
LTC Hoaas	Army/ ODCSOPS	US Army in 1988	"	"

EXECUTIVE COMMITTEE MEETING

24 May 1978
Pentagon

No briefings held; planning session only

ATTENDEES:

Mr. Lockerd
Mr. Greene
Mr. Kresa
Dr. Stear
Mr. Shore
LTG Kent

MG Dickinson
Mr. Pfeiffer
Mr. Christman
COL Curry
Mr. Trask
COL Bryant
COL Corum

Dr.Yang
Dr. Naka
Dr. Kahal
Mr.Friedrich
COL McNutt
LTC Sweeney
CPT Beam

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SEMINARS HELD DURING THE SUMMER STUDY

Optional seminars on five topics of general relevance to the Summer Study were held after regular working hours at the US Air Force Academy. Speakers and topics are listed below.

Monday, July 17: Dr. Braddock, Soviet Military Operations

Wednesday, July 19: Dr. McMillan, The Battle of Kursk and Passive Defense

Monday, July 24: Mr. Greene, Attack Helicopter Operations; AWACS Testing

Tuesday, July 25: Mr. Greene, Dr. Braddock, Theater Nuclear Warfare Issues

Wednesday, July 26: Ms. Hoeber, Soviet Chemical Warfare

TASK GROUP I AIR DEFENSE

BRIEFERS

NAME	ORGANIZATION	TOPIC	DATE/PLACE OF BRIEFING
Cpt Baker	USAADS	Concept Paper, IFF	18-19 May, Ft Bliss, TX
Col Evans/Mr Grossman	USACSTAL	Materiel Dev, IFF & CS&TA LAB	" "
Maj Heebner	USAADS	AWACS/ADA Interoperability	" "
Maj Humphrey	USAADS	DADS-C^2	" "
Maj Jellett	USAADS	Army AD Systems	" "
Col Lawrence	USAADS	Tng Dev Overview	" "
Mr LoPresti/Cpt Scanlon	USAADS	Stand Off Jammer Killer	" "
Maj Moriarity	USAADS	C&C in NATO	" "
Cpt Morreale	USAADS	AD Doctrine & Air Space Mgt	" "
Maj Sewell/Cpt Knox	USAADS	Threat	" "
Dr Starr	IDA	C&C & How it Impacts Utilization of AD Resources; Evolution of IFF; Major Issues of IFF	15-16 Jun, Pentagon " " " "
Col Gillett	TAC	Role of CRC; Current of Engagement	" "
Maj Sakahara	AF/XOORT	Future ROE	" "
Maj Bourgies	AF/XOOIC	TACS/TADS	" "
Mr Robertson	TAFIG	TADIL-A&B	" "
Cpt Parkhill	AF/XOOIC	SALTY NET	" "
Mr Lidy	PLRS PMO	PLRS	" "
Mr Ellingson	MITRE	JTIDS	" "
Mr Greinkel	OSD	DSB Thoughts of AD/IFF	" "
Maj Pearce	AF/XOOIC	AWACS-Overview of Operl Procedures & Capabilities	" "
Cpt Lafamme	AF/RDPV	Non-Coop IFF	" "
Lt Col Carr	DAMO-TCD	JINTACCS	" "
*Dr Varona/Mr Tross/ Mr Boyd	DIA	Jet Engine Modulation	22 Jun, Pentagon
**Dr Singer	Hughes	PLRS/JTIDS	27 Jun, Pentagon
***Mr Bishop	NRL	Deficiencies & Future of Mark XII	10 Jul, Pentagon
Maj Humphrey	USAADS	DADS C^2	12 Jul, Pentagon

Maj Adams	ESD	Future ID Sys	12 Jul,	Pentagon
Mr Micol	ESD	"	"	"
Mr Boatman	ESD	"	"	"
Mr Barthel	ASD/XRE	"	"	"
Mr McKee	RADC/OCT	"	"	"
Mr Keller		Future NATO IFF	"	"
Mr Barley	MIRADCOM	Missile Millimeter Wave Tech	17-28 Jul,	USAFA
Mr Blanton	MIRADCOM	"	"	"
Mr Gould	FTD	Foreign IFF	"	"

*Only Mr. Holter received this briefing
**Only Dr. Davis and Mr. Holter received this briefing
***Only Dr. Davis and Dr. Honey received this briefing

TASK GROUP II FIRE SUPPORT

BRIEFERS

NAME	ORGANIZATION	TOPIC	DATE/PLACE OF BRIEFING
Dr. Dickinson	HDL	BETA	2 May Pentagon
Mr. Anderson	Hughes Fullerton	PLRS	" "
Mr. Entzminger	Rome Air Dev Cen/AFSC	Tgt Tck Wpn Guidance	" "
CPT Conroy	AF/TFWC	Offset Beacon Bombing	" "
COL Donohue	USAFACFS	FIST/FAC Ops	" "
Mr. Ellingson	MITRE	Common Elect Bombing	6 Jun Pentagon
COL Morgan	PM PLRS/ JTIDS	Common Elect Bombing	" "
COL Donohue	USAFACFS	Allocation & Engagement Proc	*22 Jun Ft Sill
Mr. Gale	ODCSRDA	Army Arch Studies	10 Jul Pentagon
COL Gagen/ MAJ Ryan	USMC	CAS	17-28 Jul USAFA
LTC Foley	TAC	FAC Ops	" "
LTC Mellon	ODCSRDA	AAH	" "

*Dr. Blair and Dr. Fried only

TASK GROUP III. C^3 INTERDICTION

BRIEFERS

NAME	ORGANIZATION	TOPIC	DATE/PLACE OF BRIEFING	
Mr. Fowler	MITRE	DSB C-C^3 Summer Study	22-23 Jun	Pentagon
MAJ Allman	DIA	Threat	"	"
MAJ Grimes	ATSI-CS	Cmd Post Templating & European Demo	"	"
Mr. Hayden	Sig War Lab	Current Army Assets	"	"
COL Rhude	ESD	Countermission Analysis	"	"
Mr. Stiglitz	MIT Lin Lab	CW Emitters	17-28 Jul	USAFA
COL Riley	ESD	OASIS	"	"
CPT Batie/ LTC Cheney/ Mr. Manard/ LTC Aube/ Mr. Haywood	PLSS PMO	PLSS	"	"
CPT Barrazzatto	RPV PMO	RPV's	"	"
LTC Russell	TACATA	TACATA	"	"
Dr. Dickinson	HDL	BETA	"	"
Dr. Starr	IDA	Need for IFF	"	"

TASK GROUP IV. AIR DEFENSE EWI

BRIEFERS

NAME	ORGANIZATION	TOPIC	DATE/PLACE OF BRIEFING	
LTC Nunn	DARCOM	Current cap to Identify SAM/AAA Emitters	17-18 May	Pentagon
Mr. Taylor/ Mr. Allen	RDA TRW	Dev & Concepts Applic to Identifying Emitters (non-government)	"	"
LTC Bannach	RDQM	TEREC	"	"
LTC Frasher	RDPV	PLSS	"	"
LTC Musak/ MAJ Bennet	DIA	Update of AD Threat	"	"
Mr. Amato/ Mr. Reuck	NSA	Natl SIGINT Data Base Support to Tactical Ops	"	"
Dr. Dickinson	HDL	BETA	"	"
COL Federhen/ Dr. Foley	ARPA PAR	Emitter Identification	"	"
Mr. Reuck	NSA	Expanded NSA Brf on SIGINT Data Base	19-20 Jun	LA, CA
LTC Cheney	AFSC	PLSS	"	"
Mr. Upton	USAADS	US AD Sys (OR)	"	"
Mr. Sowell	Ft Hood	ELING Processor	"	"
CPT Ritter	USAFTAWC	EW Reprograming	"	"
MAJ Monteith	NSA	RUFFER	"	"

NAME	ORGANIZATION	TOPIC	DATE/PLACE OF BRIEFING
Dr. Ewell	Ga Tech	RINT	19-20 Jun LA, CA
MAJ Kawski	AFSC	HAVE GLIB	" "
Mr. Colby	Lockheed	RPV's	17-28 Jul USAFA
CPT Batie/ LTC Cheney/ Mr. Manard	AFSC	PLSS	" "
LTC Russell	TACATA	TACATA	" "
Mr. Rueck	NSA	PLSS	" "
Mr. Shilkoff/ Mr. Wanty/ Mr. Melton Mr. Newberg	AIL	PLSS	" "
Dr. Foley/ Mr. Breda	PAR	PLSS	" "
Mr. Hall/ Mr. Nichols	Bunker-Ramo	PLSS	" "
Mr. Wood	AGTELIS PMO	AGTELIS	" "
Mr. Schwartz	LORAL	EW Reprograming	" "
Mr. Larocca/ Mr. Burkdall	Dalmo-Victor	EW Reprograming	" "
CPT Ritter	TAWC	EW Reprograming	" "
MAJ Cook	Fld Sta Berlin	SIGINT	" "
Mr. McFolin	Dalmo-Victor	EW Reprograming	" "

EUROPEAN FACT-FINDING TRIP

As the initial study activities proceeded through May 1978, it was recognized by members of the Steering Committee that exposure to the "real world" European environment would be of great benefit to the work of all Task Groups. Accordingly, a European fact-finding trip was set up, with the agenda shown in Table 1. The membership of the team making the trip was initially intended to include the chairman of each Task Group plus the study cochairman; and was finalized as shown in Table 2 after accommodating the short-notice availability of those concerned.

The major thrust of the trip was to allow each Task Group representative to collect needed inputs on current practices and requirements. To this end, the group received a minimum of "pre-packaged" briefings; and usually separated into working groups centered around the Task areas. Typically, the team left behind written question lists for later written reply by each hosting function. Informal discussions were also scheduled with the local commanders to obtain the command perspective; including very produtive sessions with GEN Blanchard at USAREUR, GEN Pauly at USAFE and GEN Heiser at EUCOM.

At the conclusion of this trip, the two study co-chairmen summarized their predominant impressions obtained from all the sources contacted, as shown in Table 3.

TABLE 1

EUROPEAN FACT-FINDING TRIP
ITINERARY

28 JUNE 1978	HQ USA V CORPS - HQ 3 AD	FRANKFURT DRAKE KASERNE
27 JUNE 1978	HQ USA - EUROPE	HEIDELBERG
28, 29 JUNE 1978	HQ USAF - EUROPE	RAMSTEIN AFB
30 JUNE 1978	HQ EUROPEAN COMMAND	STUTTGART
28, 29 JUNE 1978*	FIELD STATION	BERLIN

*SHORE, SMITH ONLY

TABLE 2

EUROPEAN FACT-FINDING TRIP
TRAVELING TEAM

TERRY GREENE	SUMMER STUDY CHAIRMAN - SAB	
MIKE LOCKERD	SUMMER STUDY CHAIRMAN - ASB	
ED STEAR	CHAIRMAN - GROUP I	AIR DEFENSE
DAVE FRIED	VICE CHAIRMAN - GROUP II	CLOSE SUPPORT
DAVE SHORE*	CHAIRMAN - GROUP III	C^2 INTERDICTION
HAROLD SMITH	MEMBER - GROUP IV	RED AD
DICK TRASK	USAF TEC REPRESENTATIVE	
COL GLEN McNUTT	USAF SAB SECRETARIAT	
LTC LLOYD LANGSTON	USAF TAC REPRESENTATIVE	

*SPECIAL ITINERARY

TABLE 3

(C) EUROPEAN FACT-FINDING TRIP
KEY IMPRESSIONS (U)

GOOD ATTENTION ON MANY ASPECTS OF "REAL-WORLD" CAPABILITY IMPROVEMENT, E.G.:

- DALFA (DIRECTORATE OF AIR/LAND FORCE APPLICATIONS
- CENTER CHASE

MANY REMAINING SERIOUS, POTENTIALLY CRIPPLING PROBLEMS

- SURVIVABILITY OF BLUE C^2 IN INTENSE WAR
- LACK OF ADEQUATE IFF (GROUND-TO-AIR) - QUALITY AND QUANTITY
- LACK OF ADEQUATE TACTICAL COMMUNICATION
  - AJ CAPABLE
  - SECURE
  - DATA CAPABLE
- POSSIBLE LOSS OF FEBA-ZONE AIR SUPERIORITY
  - AD SUPPRESSION CAPABILITY
  - BLUE AIR SELF PROTECTION
  - AIR-TO-AIR VS ROTARY WING
- LACK OF COUNTER - C^2/C^3 CAPABILITY
  - PRIORITY AND DOCTRINE
  - ABILITY FOR (QUALITATIVE OR QUANTITATIVE)
- LACK OF REAL PLANS FOR USE OF NEW SYSTEMS, E.G.:
  - LASER DESIGNATED ORDNANCE
  - PATRIOT SYSTEM
  - ETC.

EUROPE TRIP

BRIEFERS

NAME	ORGANIZATION	TOPIC	DATE/PLACE OF BRIEFING
Gen Berry/ COL Winn/ COL Stewart/ COL Gorman COL Bryan/ LTC Hertel	V Corps	V Corps Defense Plan; discussion of all study topics	26 Jun Frankfurt
LTC Sheridan/ LTC Swindells	3rd Armored Division	CAS Ops Div AD Ops	" "
Gen Blanchard/ MG Duqueman/ Staff Members	HQ USAREUR	USAREUR Org & mission; discussion of all study topics	27 Jun Heidelberg
COL Cottingham/ LTC Tutless/ Staff Members	32nd ADCOM DALFA	DALFA	" "
LTG Pauley/ MG Clement/ Staff Members	HQ USAFE	Detailed brfing & discussions on all study topics; brfings & disc at COIC	28-29 Jun Ramstein
LTG Heyser/ Staff Members	HQ EUCOM	Informal Brfings by Mr. Lockerd & Mr. Greene; discussions of study topics with staff	30 Jun Stuttgart
MAJ Cook	Fld Station Berlin	SIGINT	29 Jun Berlin*

*Dr. Smith and Mr. Shore only.

ANNEX C

STUDY CHARTER AND STUDY PLANS

ANNEX C
STUDY CHARTER AND STUDY PLANS

The four study topics as defined jointly by TAC and TRADOC are presented in this Annex. Following these task statements, the study plans developed jointly by the four Working Groups and the Executive Committees are presented.

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS TACTICAL AIR COMMAND
LANGLEY AIR FORCE BASE, VIRGINIA 23665

OFFICE OF THE COMMANDER

4 JAN 1978

Lieutenant General Alton D. Slay
Military Director, Scientific Advisory Board
United States Air Force

Dear Al

I indicated to Bob Naka in October that TAC would support a joint ASAP/SAB Summer Study on specific issues identified by TAC and TRADOC. Four issues--of concern to both TAC and TRADOC--are recommended for study. They are listed in the enclosure with an expanded discussion on each to aid you or Bob Naka in deliberations with the ASAP. A related requirement--also of joint concern--is described for consideration when proposing solutions to the study issues.

Solutions to the identified issues are technical; however, any SAB/ASAP effort to find joint solutions to Command, Control, and Communication issues in the European Central Region must consider the NATO/US interface. Therefore, I recommend that the proposed study be coordinated with EUCOM and that they be requested to participate in the study.

Tom McMullen and his staff--with TRADOC participation--will continue to work the issues and final task statement. Tom will also keep in touch with Bob Naka.

Sincerely

ROBERT J. DIXON, General, USAF
Commander

1 Atch
Recommended Joint Study Issues

C/C Gen Evans USAFE CC
Gen Huyser, DCINCEUR
Gen Starry, TRADOC
Gen Kroesen, [illegible]

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RECOMMENDED ISSUES FOR JOINT ASAP/SAB SUMMER STUDY

STUDY AREA I: COMBINED AIR DEFENSE

ISSUE: Passive capability to make identification of friendly vs enemy aircraft to provide "safe passage" and prevent fratricide.

ISSUE STATEMENT: Current rules of combat engagement normally call for visual identification of a target as hostile before weapon firing is initiated. The necessity for the visual rule is obvious; it is the only positive identification technique available. Because of this limitation many weapon systems cannot be operated at optimum range. This limitation reduces the probability of kill (P_k) and increases the vulnerability of the weapons delivery platform. This is especially true in air-to-air engagement. Tests with current weapons systems indicate that the first to acquire, identify and fire will be the victor. The problems of positive and early identification carry over to air-to-ground and ground-to-ground engagements. In fact, identification drives the engagement decision at all levels of combat. The inadequacy of current active and passive means to identifying friendly air and ground vehicles will probably result in a high fratricide rate. Current identification systems are inadequate because they are susceptible to countermeasures and enemy duplication. The proliferation of US and Allied arms among potential adversaries raises doubts as to the effectiveness of proposed technologies based on engine or system characteristics to provide positive identification of noncooperative aircraft. Active means of identification require actions by combat crews that may not be accomplished correctly. Therefore, a passive, positive capability to identify friendly and noncooperative aircraft is an essential and immediate requirement. It must be: integral to the weapon system's surveillance/acquisition/tracking system; 100 percent capable at optimum weapon effectiveness range; and, operate in a high Electronic Counter Measure (ECM) environment. Panel should review present identification developments and available technologies and identify the one(s) promising the earliest solution.

STUDY AREA II: CLOSE AIR SUPPORT IN CONJUNCTION WITH FIRE AND MANEUVER

ISSUE: Improved line-of-sight capability for ground target acquisition and designation to enable employment of diverse weapons systems.

ISSUE STATEMENT: The lethality of mobile air defense typified by PACT Armies has drastically limited the use of inventory Forward Air Control aircraft and artillery spotter aircraft. This decreased capability of current systems to acquire and designate targets has a comparable impact on the effectiveness of munitions which require terminal guidance, constant target illumination, and/or precise target location. The enemy's increased mobile air defense capability also drastically increases the vulnerability of fixed-wing and rotary-wing aircraft when required to make multiple passes on targets. Improvement of enemy counter-fire systems and their numerical superiority make first-round artillery kills by Allied fire elements essential. Numerical superiority of enemy ground forces can only be countered by the most efficient use of all available fire support. Full utilization of the diverse weapons systems and munitions available requires a line-of-sight target acquisition, tracking and designation system. This system must be compatible with current and programmed surface and airborne platforms. This system must be capable of designating, and providing precise targeting data on moving targets. Target information must be transmitted directly to the strike weapon's (ground or airborne) fire control system in a form compatible with its real time requirements for target acquisition, munition guidance data or artillery fire coordinates. Panel should study inventory and programmed Air Force and Army sensor, targeting, strike and fire systems and determine how, or if, a current technology can be utilized to develop interface equipments/ systems that will enable direct exchange of target data from either service's sensor/targeting systems to either service's strike/fire system.

STUDY AREA III: INTERDICTION WITHOUT FIRE AND MANEUVER COORDINATION

ISSUE: Capability to identify and negate key command and control elements of the enemy's engaged and reserve forces.

ISSUE STATEMENT: Soviet and PACT emphasis on the capability to mount a massive thrust indicates their strategy against NATO forces is to initiate rapid, deep penetration of Western Europe by overrunning initial and secondary defense lines before NATO can be reinforced by US-based ground and air units. In order to increase the overall capability of their Tank and Combined Army Armies, they have integrated Electronic Warfare (Electronic Countermeasure and Electronic-Counter Countermeasures) and signals intelligence (SIGINT) exploitation capability into all elements/echelons of their assault forces. To provide an air defense umbrella for their armor and Electronic Warfare and Intelligence (EWI) units, mobile surface-to-air missile and radar-controlled anti-aircraft artillery units are integral to lower echelon assault and maneuver units. Effective use of this highly mobile, combined offensive firepower, EWI and air defense capability requires continuous, positive command and control. A system capable of identifying and/or monitoring these mobile command and control elements would enable their destruction or exploitation and constitute a major force effectiveness multiplier. Such a system must be capable of providing real-time information to commanders/decision makers/planners at all operational levels from ground units in contact to the Joint Theatre Commander. Panel should review current inventory systems and study available technology to determine if present systems can be modified to accomplish this task; and, if not, recommend what technology should be pursued to develop such a capability in the near term.

STUDY AREA IV: ELECTRONIC WARFARE/INTELLIGENCE

ISSUE: Capability to identify; fingerprint, and track mobile, surface-to-air missile (SAM) units and radar controlled anti-aircraft artillery (AAA).

ISSUE STATEMENT: One of the immediate and critical tasks at the outbreak of hostilities will be to determine the new values and ranges of SAMs, AAAs, and other emitters so they can be "fingerprinted." If this task is not performed, the capability to suppress enemy air defenses, counter armor attacks and to determine the enemy's electronic order-of-battle (EOB) will be seriously impaired. The inability to identify and suppress integral air defenses will preclude effective concentration of airborne firepower against armored elements. This "fingerprint" capability is also essential to the maintenance of the threat data base for mission planning and the identification of enemy forces, their location and determination of probable employment. The current parameters programmed in the data processors of automated ELINT systems are from peacetime collection. At the onset of hostilities, SAM, AAA and other emitters are expected to switch to wartime modes of operation. These new signal parameters will not match the "in-program" parameters and will be declared "unknowns." A tactical sensor system capable of near real time detection and tracking of such emitters is required. The system must include an automatic data processing capability designed specifically to assist intelligence analysts in recognizing, analyzing, and identifying signals operating in previously undetected modes. Panel should review current inventory sensors and associated processors to determine improvements required to provide a solution. If modification of current systems is not feasible, then a new technological solution should be identified.

ADDENDUM

ISSUES IN C^3 CAPABILITY TO SUPPORT INTEGRATION OF TACTICAL BATTLEFIELD SYSTEMS

Command, Control Communications requirements for Battlefield Management have been repeatedly studied. Technological recommendations for improved C^3I systems have been made, validated and implemented. Current technology, with few exceptions, can provide the communications capabilities required, provided sufficient funds are made available. However, the universal availability of high-speed, high-volume, secure, anti-jam, point-to-point, ground-air-ground, air-air communications and data processing capability will not solve the problem of Command and Control of Land and Air Forces engaged in combined and/or mutually supporting operations. The final solution is dependent upon resolution of procedural and doctrinal issues. It is in those areas that the TAC-TRADOC effort can be most productive if allowed to proceed unrestricted by guidelines and direction from external sources. Payoffs will be realized in manpower and weapons systems costs by eliminating duplicative capabilities and functions. Final resolution of these issues is not in sight, but a firm roadbed for rapid progress is being laid. In the interim, all services have an immediate requirement for a system capable of assisting Battle Commanders at all operational levels in the decision-making process. The following is a description of factors bearing on the problem.

a. General: Modern technology has drastically improved the collection and reporting capabilities of various sensor and information systems; however, little assistance has evolved for the decision-maker forced to cope with increased volumes of data. Improvements can be effected in data handling systems, but they must be keyed to specific functions and command responsibilities of individuals being supported. Data selection and presentation must be matched with functional requirements to support decision-making in the areas of combined air defense, close air support/fire support, interdiction/fire support, and electronic warfare/intelligence.

b. Inferential Aids: Decisions can sometimes be made on the basis of a few, or even a single information input. Large volumes of information can cloud the significance of specific events. Decision-makers require assistance to draw realistic inferences from the patterns and trends recognized by analysis software. Data presented must encompass all aspects of resource management weighed in the decision-making process. Data presented must be keyed to the timeliness and response requirements of each echelon of command.

c. Computational Aids: Battle managers generally base decisions on personal experience and understanding of the operational modus operandi. Assistance is required to determine required level of effort, measure of anticipated effectiveness, and probable risk associated with different courses of action. A display capable of presenting probable tactical results as well as probability of success percentages for various alternative force deployments is required.

d. Option Aids: Rapid decisions must often be rendered on events or activities which are not critical to the ongoing combat situation. Decision-makers can ordinarily select from various options when dealing with such a situation; e.g., jam, exploit, or destroy. Weighing consequences and factors relative to the options delays the decision-making process. Assistance is needed to provide a "best" decision in situations involving multiple courses of action for noncritical events or activities. Such aids cannot replace the man in the decision process but can define consequences associated with each option and prioritize alternatives based on criteria imposed by the decision makers.

STUDY PLANS FOR WORKING GROUPS OF JOINT ASB/SAB SUMMER STUDY

Revised 31 May 1978

GROUP I: IFF in Combined Ground-to-Air and Air-to-Air Air Defense

General Issue: Reliable classification of aircraft as friendly, enemy, or neutral, by air defenses. Real-time classification at the air defense firing unit will be considered as the highest priority need. Collateral information from a variety of sources will be considered, but particular emphasis will be placed on the potential for passive means of performing this function.

Tasks will include the following:

1. Review Defense Science Board IFF study report (1978) and Army Science Board IFF study report (1975) and other relevant analyses of IFF issues.

2. Review technical characteristics of current IFF and other target classification systems, planned operational employment, and their effectiveness and limitations.

3. Review current and projected developments and available technologies which might be exploited to improve the ability to classify airborne targets reliably.

4. Identify those developments, technologies, and system concepts that promise effective solutions to the problem of reliable classification of airborne targets.

Primary emphasis will be on reliable classification of targets in surface-to-air air defense system operations; secondary emphasis will be on air-to-air defense operations. Potential fallout or extension of concepts for IFF of ground vehicles will be considered if time permits.

GROUP II: Supporting Fire for Friendly Forces From Fixed-Wing Aircraft, Helicopter, and Artillery

General Issue: What are potential improvements in procedures/systems/interface equipment to enhance the timely application of fire power on enemy maneuver units. Particular emphasis will be given to improving the capability for airborne strike assets of either service to use the sensor/targeting assets of either service.

Tasks will include examination of the following types of operation:

1. Offset radar beacon bombing: improved accuracy; employment with various types of aircraft, especially the F-16; streamlining C^3 for this function; more effective munitions to support this concept; ways of reducing the exposure of the strike aircraft.

2. Delivering firepower on targets fixed in electronic coordinate systems. Delivery of a pattern of fire quickly at a time and place designated by the ground commander day/night/all-weather; choice of coordinate systems and interaction among systems such as JTIDS and PLRS; employment of various firepower assets--aircraft, helicopters, artillery.

3. Common reference systems for cueing: improvement of ability of the pilot in an aircraft or helicopter to acquire a target for weapon delivery; reduction of aircraft/helicopter vulnerability; adequacy of the Army's All Source Analysis Center (ASAC) and the Air Force's Tactical Fusion Division (TFD) for cueing; improving distribution of information for this function.

4. Use of the Air Force's Precision Location/Strike System (PLSS) to direct artillery fire at defenses; effectiveness of artillery in this role; handoff from PLSS to artillery.

5. Laser designation: adequacy of various ground laser designators for use with air and ground delivered weapons; impact of smoke and dust obscuration; value of (Long-Wavelength Infra Red) LWIR; communications and control for handoff; reducing exposure of ground laser operator.

GROUP III: Interdiction of Enemy C^2.

General Issues: Assessment of the feasibility and capability of existing assets to identify, locate, and neutralize key command and control elements of the enemy's engaged and reserve forces, with particular emphasis on mobile command posts; identification of means to improve the ability to perform this function.

Tasks include the following:

1. Review last year's Defense Science Board study on this topic plus follow-on efforts since that time and consult with key personnel of NSA; use this information base as the starting point for the study.

2. Assess criticality and vulnerability of potential enemy C^2 targets.

3. Assess alternative methods for locating, identifying, and negating--by jamming or physical attack--C^2 targets.

4. Recommend means of improving current capabilities to interdict enemy C^2.

GROUP IV: Air Defense Emitter Detection, Location, and Classification.

General Issue: A critical task at the outbreak of hostilities will be the detection and location of enemy air defense assets. The enemy will attempt to frustrate our ability to effectively counter his air defense radar capability by continuous rapid redeployment and by the use of wartime frequencies and operational modes unobserved in peacetime. There is concern that the allied ability to identify and locate these assets may be inadequate.

Tasks include the following:

1. Evaluate our understanding of the extent to which Soviet air defense radars and other electromagnetic signatures can realistically be altered in wartime and determine if present collection assets can adequately cope with these changes in a timely manner.

2. Based on (1), investigate the impact that variations in air defense wartime electromagnetic signatures may have on the effectiveness of aircraft ECM and Radar and Homing Warning devices.

3. Review U.S. capability to detect, locate and classify air defense assets. Determine to what extent unit classification is possible to aid in understanding which emitters have moved to new locations. Consider US capability in four cases: (a) present organic capability; (b) present optimum capability using both organic, other service, and National assets; (c) near-future optimum capabilities, and (d) future capabilities if new technologies are exploited.

4. Develop specific recommendations to improve capabilities for this function.

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ANNEX D

STUDY SCHEDULE AND 28 JULY FINAL BRIEF
AGENDA AND GUEST ATTENDEES

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ANNEX D

This Annex contains the overall Joint Study schedule, the agenda for the July 28 final briefing, and a list of guest attendees at that briefing.

ASB/SAB JOINT SUMMER STUDY SCHEDULE

JULY 1978

	MONDAY - 17	TUESDAY - 18	WEDNESDAY - 19	THURSDAY - 20	FRIDAY - 21
0800 to 1200	0800: All participants convene Room L-1 1000: Work Sessions	Work Sessions	Work Sessions	Work Sessions 1000: Progress Report Group I, Rm 4H45	Work Sessions 1000: Progress Report, Group III Rm 4H54
LUNCH	Mitchell Hall (Across from Fairchild Hall) or Officers Club				
1245 to 1630	Work Sessions	Work Sessions	Work Sessions	Work Sessions 1400: Progress Report Group II, 4H53	Work Sessions 1400: Progress Report Group IV, 4H62
1645 to 1800	Soviet Mil* Ops-Dr Braddock L-1		Battle of Kursk* & Passive Defense Dr.McMillan, L-1		
EVE	Get Acquainted Social: Officers Club	See Note 5	See Note 5	Dinner & Show Flying W Ranch	See Note 5
	MONDAY - 24	TUESDAY - 25	WEDNESDAY - 26	THURSDAY - 27	FRIDAY - 28
0800 to 1200	Work Sessions	Work Sessions	Work Sessions	Briefout Dry Run Room L-1	Final Briefout, Room L-1
LUNCH	Mitchell Hall or Officers Club				
1245 to 1630	Work Sessions	Work Sessions	Work Sessions	Briefout Dry Run Room L-1	Wrap-up Session 1500: Gen Session, Rm L-1
1645 to 1800	Videotapes* 1. Attack Helicop 2. AWACS Test	TNW Issues*(Joe Braddock, T. Greene), L-1	Soviet CW*(Ami Hoeber), L-1	Written Drafts of Report Sections Due at COB today	
EVE	See Note 5	See Note 5	See Note 5	Reception & Dinner Officers Club	

ROOM ASSIGNMENT AT USAFA

Fairchild Hall (Bldg 2354)
General Sessions-Room L-1, 3rd Fl.
Working Sessions, 4th Fl.:
Group I-Room 4H45
Group II-Room 4H53
Group III-Room 4H54
Group IV-Room 4H62
ADMIN OFFICE FOR STUDY, 4th Fl., Room 4J12
LOUNGE FOR STUDY GROUP, 4th Fl., Room 4J10

GENERAL NOTES:

1. Ladies are invited to all social functions.
2. Casual dress for all work sessions.
3. Normal security level for Fairchild Hall sessions is SECRET.
4. Specially classified work areas will be at Chidlaw Bldg., Colorado Springs.
5. Evening work sessions may be arranged with prior notice to Captain Beam.

*Optional seminar for all participants.

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DETAILED AGENDA FOR BRIEFOUT
FAIRCHILD HALL, 3L3
Friday, 28 July

Time	Minutes	
0800	(5)	Welcomes - Security reminder - Thanks to AFA
0805	(10)	Introduction - Guests - Study Steering Group
0815	(10)	Scene Setting - Study Evolution - Task Summaries - Inputs/Sources - Study Schedule - Report Schedule
0825		Group I
	(5)	Introductions of Participants (by Study Co-Chairman)
	(30)	Presentation) Task Group
	(10)	Discussion/Questions) Task Group
0915	(45)	Group II
0955	(5)	Stretch Break
1000	(45)	Group III
1045	(45)	Group IV
1130		Closing Remarks
	(10)	- General Officer Participants
	(5)	- USA
	(5)	- USAF
	(10)	- Study Chairmen
1200		Special Supplementary Briefing, Group III and IV (Room TBD)

1245-1300	(10)	Enroute to Officers' Club
1300-1345	(50)	Lunch - Guests - Steering Group - All ASB and SAB participants

SENIOR OFFICIALS PRESENT
ASB/SAB BRIEFOUT - 28 July 78

ARMY

General Donn A. Starry
Commander
US Army Training & Doctrine Command
Fort Monroe, Virginia

General John R. Guthrie
Commander
US Army Materiel Development
and Readiness Command
Alexandria, Virginia

Dr. Percy A. Pierre
Assistant Secretary of the Army
(Research, Development & Acquisition)
Department of the Army
Washington, D.C.

Lieutenant General Edward C. Meyer
Deputy Chief of Staff for Operations
and Plans
Department of the Army
Washington, D.C.

Lieutenant General Donald R. Keith
Deputy Chief of Staff for Research,
Development and Acquisition
Department of the Army
Washington, D.C.

Lieutenant General Robert J. Baer, Jr.
Deputy Commander for Materiel Development
US Army Materiel Development and
Readiness Command
Alexandria, Virginia

ARMY (Cont'd)

Dr. Joseph H. Yang
Principal Deputy Assistant Secretary
of the Army (Research & Development)
and Executive Director, Army Science
Board
Office, Assistant Secretary of the Army
Department of the Army
Washington, D.C.

Major General Charles R. Myer
Director, Telecommunications and Command
and Control
Office, Deputy Chief of Staff for
Operations and Plans
Department of the Army
Washington, D.C.

Major General Hillman Dickinson
Commander
US Army Communications, Research & Development Command
Fort Monmouth, New Jersey

Mr. Norman Klein
Assistant Deputy for Science and
Technology
Office, Deputy Command for Materiel
Development
US Army Materiel Development and
Readiness Command
Alexandria, Virginia

Dr. J. Ernest Wilkins
Chairman
Army Science Board

MARINE

Lieutenant General Thomas H. Miller
Deputy Chief of Staff, Aviation
Headquarters, US Marine Corps
Washington, D.C.

MARINE (Cont'd)

Brigadier General William A. Scott
Director
Command, Control, Communications
and Computer (C^4) Systems Division
Headquarters, US Marine Corps
Washington, D.C.

AIR FORCE

General Wilbur L. Creech
Commander
Tactical Air Command
Langley AFB, Virginia

Dr. Kenneth L. Jordan
Principal Deputy Assistant Secretary
for Research and Development
Department of the Air Force
Washington, D. C.

Lieutenant General Thomas P. Stafford
DCS/Research and Development
Headquarters, US Air Force
Washington, D.C.

Lieutenant General Robert C. Mathis
Vice Commander
Air Force Systems Command
Andrews Air Force Base, Maryland

ANNEX E

DEFINITIONS

AAA	Anti-Aircraft Artillery
AAD	Army Air Defense
AAFCE	Allied Air Forces Central Europe
AAH	Advanced Attack Helicopter
ACE	Allied Command Europe
AD	Air Defense
ADA	Air Defense Area
ADAM	Artillery Delivered Anti-Personnel Mine
ADGE	Air Defense Ground Environment
ADTC	Armament Development and Test Center
AEELS	Automatic Electronic Emitter Locating System
AEW	Airborne Early Warning
AFCENT	Air Force Central Europe
AFOSR	Air Force Office of Scientific Research
AGTELIS	Automatic Ground Transportable Electronic Location and Identification System
AIMS	Altitude Identification and Military System
AJ	Anti-Jam
ALO	Air Liaison Officer
AOC	Automatic Overload Control
APPS	Analytical Photogrammetric Positioning System
ARM	Anti-Radiation Missile
ASAC	All Source Analysis Center
ASARS	Advanced Synthetic Aperture Radar System
ASB	Army Science Board
ASR	Airport Surveillance Radar
ATAF	Allied Tactical Air Force
ATDMA	Advanced Time Division Multiple Access
ATOC	Air Tactical Operations Center
AWACS	Airborne Warning and Control System

BAI	Battlefield Air Interdiction
BETA	Battlefield Exploitation and Target Acquisition
BOC	Battalion Operations Center

CAP	Combat Air Patrol
CAS	Close Air Support
CBU	Cluster Bomb Unit
C^2/C^3	Command and Control/Command, Control and Communications
C^3I	Command, Control, Communications/ Intelligence
$C-C^3$	Counter-Command, Control and Communications
C&D	Cover and Deception
CEP	Circular Error Probabilities
COIC	Combat Operations Information Center
COMINT	Communications Intelligence
CNI	Communication, Navigation and Identify
CP	Command Post
CRC	Control and Reporting Center
CRP	Control and Reporting Post
DAD	Division Air Defense
DALFA	Director Air Land Forces Agency
DEFREPs	Defense Readiness Postures
DF	Direction Finding
DME	Distance Measuring Equipment
DMED	Digital Message Device
DMR	Dual Mode Recognizer
DOD	Department of Defense
DSCS III	Defense Satellite Communication System
DTDMA	Distributed Time Division Multiple Access
ECCM	Electronic Counter-Countermeasures
ECM	Electronic Countermeasures
EIFF	Enemy Identification Friend or Foe
ELINT	Electronic Intelligence
ELS	Emitter Location System
EMP	Electro Magnetic Pulse
EOC	Electronic Order of Battle
ERIM	Environmental Research Institute of Michigan
ERP	Effective Radiated Power
EW	Electronic Warfare
EXPELS	Expendable Emitter Location System

FAAR	Forward Area Alerting Radar
FAC	Forward Air Controller
FAC-A	Airborne Forward Air Controller
FAE	Fuel Air Explosives
FDMZ	Forward Missile Deployment Zone
FEBA	Forward Edge of Battle Area
FIS	Future Identification System
FIST	Fire Support Team
FLIR	Forward Looking Infrared
FLOT	Front Line of Own Troops
FMOP	Frequency Modulation Pulse
FO	Forward Observer
FRG	Federal Republic of Germany
FSCL	Fire Support Coordination Line
FSS	Fire Support System
GCI	Ground Controlled Intercept
GEADGE	German Air Defense Ground Environment
GEOREF	World Geographic Reference System
GLLD	Ground Laser Locator Designator
GOC	Group Operations Center
HICAP	High Combat Air Patrol
HIMEZ	High Missile Engagement Zone
HIPAR	Hercules High Power Acquisition Radar
HRR	High Range Resolution
HTDMA	Hybrid Time Division Multiple Access
HUD	Heads Up Display
I&W	Indications and Warning
ICM	Improved Capability Missile
ICWAR	Improved Continuous Wave Acquisition Radar
IHADP	Improved Hawk Automatic Data Processor
IFF	Identification Friend or Foe
IFM	Instantaneous Frequency Measurement
IFR	Instrument Flight Rules
IMINT	Imagery Intelligence
INS	Inertial Navigation System
IP	Initial Point
IPAR	Improved Hawk Pulse Acquisition Radar
JTIDS	Joint Tactical Information Distribution System

LCAP	Low Combat Air Patrol
LLTR	Low Level Transit Routes
LOMEZ	Low Missile Engagement Zone
LPI	Low Probability of Intercept
LTD	Laser Target Designator
MANPADS	Man Portable Air Defense System
MFR	Multi-Frequency Radar
MNBA	Minimum Normal Burst Altitude
MNC	Major NATO Commander
MPC	Message Processing Center
MSS	Movement Sensing Systems
MTBF	Mean Time Between Failure
MTI	Moving Target Indicator
NSOC	NATO Sector Operations Center
OAS	Offensive Air Support
ODO	Defensive Operations Division
OSD	Office Secretary of Defense
OT&E	Operational Test and Evaluation
PIP	Product Improvement Program
PLRS	Position Locating and Reporting System
PLSS	Precision Location and Strike System
PPRI	Precision Pulse Repetition Interval
PRF	Pulse Repetition Frequency
PRI	Pulse Repetition Interval
PUP	Pull Up Point
QRC	Quick Reaction Capability
RAP	Rocket Assisted Projectile
REC	Radio Electronic Combat
RINT	Radiation Intelligence
ROI	Return on Investment
RPV	Remotely Piloted Vehicle
RSS	Radar Signal Sorter
RTT	Round Trip Timing
RWR	Radar Warning Receiver

SAB	Air Force Scientific Advisory Board
SAR	Synthetic Aperture Radar
SEAD	Suppression of Enemy Air Defense
SFL	Sanctuary Flight Level
SHORADEZ	Short Range Air Defense Equipment Zone
SHORADS	Short Range Air Defense System
SIF	Selective Identification Feature
SIGINT	Signal Intelligence
SLAR	Side Looking Radar
SLP	Sanctuary Level Procedures
SOC	Sector Operations Center
SOTAS	Stand-off Target Acquisition System
SPECS	Software Programmable Engine Analysis Techniques System
STANAG	Standardization Agreement
SWHQ	Static War Headquarters
TAC	Tactical Air Command
TACFIRE	Tactical Identification Fire System
TACP	Tactical Air Command Post
TACS/TADS	Tactical Air Control System/Tactical Air Defense System
TADDS	Target Alert Data Display Set
TAF	Tactical Air Force
TDMA	Time Division Multiple Access
TDOA	Time Difference of Arrival
TEL	Transporter Erector Launchers
TEREC	Tactical Electronic Reconnaissance
TFC	Tactical Fusion Center
TIPI-II	Tactical Information Processing and Information System
TISEO	Target Identification System Electro Optical
TOA	Time of Arrival
TO&E	Tables of Organization and Equipment
TRADOC	Training and Doctrine Command
TRDL	Tactical Reconnaissance Data Link
TRISAT	Target Recognition Through Integral Spectral
TST/IDL	Transmission Scheme Translator/Interactive Display Terminal

UE	Unattended Expendables
USAREUR	United States Army Europe
USDR&E	Under Secretary of Defense Research and Engineering
WAAM	Wide Area Anti-Armor Munitions
WDU	Weapons Direction Unit
WP	Warsaw Pact

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Military Director, SAB	1
Chief Scientist, USAF	1
SAB Secretariat	1
The Inspector General	1
Deputy IG for Inspection & Safety	1
Director of Inspection	1
Director of Aerospace Safety	1
Director of Nuclear Safety	1
Assistant Chief of Staff, Intelligence	1
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Director of Operations and Readiness	1
Director of Command, Control and Communications	1
Deputy Chief of Staff, Research, Development and Acquisition	
Assistant for International Programs	1
Directorate of Development and Programming	1
Electronic Systems Division	1
Aeronautical Systems Division	1
Science and Technology Division	1
Avionics Division	1
Directorate of Operational Requirements	1
Management Group	1
Deputy Director for General Purpose Forces	1
Airlift and Training Division	1
Armament Systems Division	1
Tactical Division	1
Deputy Director for Strategic Forces	1
Aircraft Division	1
Strategic Defense and Support Division	1

Missile and Nuclear Programs Division	1
Directorate of Command, Control, Communications and Information	1
Plans and Technology Division	1
Communications and Navigation Division	1
Space Defense Division	1
Joint Environmental Satellite Coordinating Group	1
Directorate of Contracting and Acquisition Policy	1
Production Resources Division	1
Congressional Liaison Division	1
Management Policy and Control Group	1
Programming Division	1
Test and Evaluation Division	1
Air Force Systems Command	
Commander	1
Vice Commander	1
Inspector General	1
DCS/Intelligence	1
DCS/Engineering and Services	1
Director of Science and Technology	1
Scientific Advisory Office	1
DCS/Logistics	1
Staff Meteorologist	1
DCS/Test and Evaluation	1
DCS/Development Plans	1
DCS/Systems	1
AFSC Sub-Commands	
Air Force Flight Test Center	1
Armament Development and Test Center	1
Aeronautical Systems Division	5
Electronic Systems Division	1
Foreign Technology Division	1
Rome Air Development Center	1
Space and Missile Systems Organization	1
Air Force Wright Aeronautical Laboratories	1
Avionics Laboratory	1
Flight Dynamics Laboratory	1
Aero Propulsion Laboratory	1
Air Force Weapons Laboratory	1
Air Force Armament Laboratory	1
Air Force Human Resources Laboratory	1
Air Force Office of Scientific Research	1
Air Force Communications Service	1
Tactical Air Command	10

Aerospace Defense Command	2
Alaskan Air Command	2
Air Force Test and Evaluation Center	5
Military Airlift Command	2
Air Weather Service	1
Air Force Global Weather Central	1
Technical Library	1
Air Training Command	2
US Air Force Academy	
Dean of Faculty	1
Library	1
Air University	
AU/CC	1
AU/Library	1
Air Force Institute of Technology	1
US Air Forces in Europe	10
Pacific Air Forces	2
Under Secretary of Defense for Research and Engineering	1
Defense Advanced Research Projects Agency	1
Department of the Navy (OASN/R&D)	1
The RAND Corporation	
California Office	1
Washington Office	1
The Aerospace Corporation Library	1
The MITRE Corporation Library	1
Lincoln Laboratory Library	1
Analytic Services (ANSER)	1

ARMY

	No. Cys
Assistant Secretary of the Army, Research Development and Acquisition	20
HQDA, ODCSPER (DAPE-ZA)	2
HQDA, OACSI (DAMI-ZA)	2
HQDA, ODCSOPS (DAMO-ZA)	9
HQDA, ODCSLOG (DALO-ZA)	2
HQDA, ODCSRDA (DAMA-ZA)	6
HQDA, OACSAC	2
US Army Operation, Test and Evaluation Agency	2
CDR, DARCOM	16
CDR, TRADOC	16
CDR, FORSCOM	2
CDR, USAREUR	10
CDR, EUSA	2
CDR, ERADCOM	2
CDR, CORADCOM	2
CDR, AVRADOM	2
CDR, ARRADCOM	2
CDR, MERADCOM	2
CDR, DARCOM, Joint Activities (DRCSA-JS)	2
CDR, DARCOM, Battlefield Systems Integration (DRCBSI)	2
CDR, US Army Combined Arms Center	3
CDR, US Army Administrative Center	2
CDR, US Army Logistics Center	2
CDR, US Army Infantry Center	2
CDR, US Army Armor Center	2
CDR, US Army Air Defense School	4
CDR, US Army Engineer School	2
CDR, US Army Field Artillery School	2
CDR, US Army Aviation School	4
CDR, US Intelligence Center and School	2
CDR, US Army Signal School	2