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A TRIAL DISCUSSION OF ELECTRONIC WARFARE COUNTERMEASURES IN FUTURE LIMITED WARS

by

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ABSTRACT Discusses the fundamental definitions associated with electronic warfare system countermeasures and the basic principles of electronic warfare system countermeasure applications, probes offensive and defensive modes associated with system countermeasures, finally synthesizing new air defense systems, and discusses the contents of electronic warfare system countermeasures.

KEY TERMS Electronic warfare Systems countermeasures Air defense system

GRAPHICS DISCLAIMER

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1 INTRODUCTION

As is widely known, electronic warfare involves contents in the eight realms of reconnaissance and antireconnaissance, jamming and counterjamming, stealth and antistealth, destruction and antidestruction, and so on. Seen from the view point of frequency zones, it has already expanded from meter wave ranges to visible light, as well as ultraviolet wave bands. Seen from the view point of tactics, it has evolved from "one on one" countermeasure tactics into comprehensive countermeasures associated with the synthesizing of numerous "system on system" tactics. All previous limited wars as well as the recent Gulf War made clear in each case that both sides engaged in combat first of all carried out a trial of strength in the realm of electronic countermeasures. Whoever holds the advantage in the realm of electronic warfare will achieve the initiative in the war. Speaking with regard to an air defense system, electronic countermeasure capabilities are already key characterisitcs associated with air defense systems.

What is meant by electronic warfare system countermeasures? At present, opinions vary. There is still no one unified understanding and clear definition. Our science and technology committee acting head Chen Huaijin suggested: "New ideas should be introduced overall. Setting out from the angle of systems and systems countermeasures, gradually break through the concept of individual weapons systems fighting alone--not capable of exchanging information in real time between various individual elements--to form distributed type systems composed of various types of detection devices, launching platforms, tactical missiles, and command, control, and communications systems. In combat, they can divide up and come together in order to improve the overall combat effects, reliability, and survivability of weapons systems, improving counter jamming and capabilities against radiation resistant missiles and antistealth targets. The concept of unified, three dimensional, air-ground air-sea warfare must be established. At the same time, in combat and weapon development, electronic countermeasure capabilities are given key, prominent positions." From the view point described above, it is possible to see the basic general picture for electronic warfare systems, that is, combining the efficiencies of various types of detectors, various types of launching platforms, as well as various types of tactical missiles and systems for exercising control, exerting the integrated combat effects of weapons systems, and, in conjunction with that, making weapons systems possess maximum strength electronic countermeasure capabilities.

The author believes that electronic warfare system

countermeasures should make use of various types of electronic warfare means. In conjunction with that, they should make them exert maximum integrated efficiencies, as a result, guaranteeing that the various types of weapons systems are able to project maximum combat functions so as to achieve electronic warfare actions to seize control of the electromagnetic spectrum.

Electronic warfare systems not only depend on how high the technological levels of various electronic warfare means are. They also depend on the proficiency level of command personnel with regard to the employment of electronic warfare countermeasure strategies and command levels.

2 BASIC PRINCIPLES OF ELECTRONIC WARFARE SYSTEM COUNTERMEASURE EMPLOYMENT

2.1 Exerting the Combined Integration Advantages Associated with Various Types of Electronic Warfare Means

(1) In the realm of reconnaissance, it is necessary to adequately bring into play the roles of various types of reconnaissance means--for instance, reconnaissance satellites, early warning aircraft, reconnaissance aircraft, various types of ground radar stations, and so on, which will--through C3I systems--form the reconnaisance means discussed above in a multilayered, all-around reconnaissance system. /2

(2) In the realm of antireconnaissance, it is necessary to make adequate use of camoflage technologies, making it difficult for reconnaissance to distinguish between the real and the fake, to make use of deception techniques, to transmit on false fequencies, to put out false information and false orders, to make use of feigned attacks to achieve concealment of real combat maneuvers, and to make use of stealth technologies to make make it difficult for reconnaissance means to discover targets. That is, taking camoflage, deception, feigned attacks, as well as such antireconnaissance measures as stealth, and so on, to form an antireconnaisance system.

(3) In the realm of jamming, there must be close coordination between active jamming and passive jamming. Radar jamming, infrared jamming, and laser jamming must be closely coordinated. Radar jamming must be closely coordinated with communications jamming. Jamming can not only be used in the offense and breakthrough. It can also be used in the defense. There must also be close coordination between the many kinds of sea, land, and air jamming platforms, forming a jamming system.

(4) In the realm of counterjamming, the "one missile multiple warheads" principle must be thoroughly implemented or, in a weapons system, the combining together of various counterjamming measures with external jamming in a timely manner by automatic counterjamming management systems.

(5) In the realm of destroying targets, use must not only be made of antiradiation missiles attacking targets. Use must also be made of tactical laser weapons to attack targets.

(6) In the realm of antidestruction, use must not only be made of radar deflection techniques. Use must also be made of concentrated antiaircraft artillery to carry out antidestruction.

(7) In the realm of stealth, radar stealth, infrared stealth, and laser stealth must be closely coordinated. Of

course, stealth must be combined together with the use of antireconnaissance measures.

(8) In the realm of antistealth, it is necessary to develop multiple types of detection devices in order to reach antistealth objectives.

2.2 Bringing into Play the Combined Integration Advantages Associated with Multiple Types of Electronic Warfare Means

(1) Reconnaissance and jamming are inseparable. For instance, airborne and shipborne reconnaissance and jamming systems go through early warning and command aircraft, taking information gathered by multiple types of reconnaissance equipment and pooling it. After that, real time command of various types of sea, land, and air jamming achieve the objective of paralyzing enemy radar systems.

(2) Going through aerial early warning craft, take reconnaissance, jamming, hard kill and damage, as well as stealth to form one large system.

(3) Take reconnaissance, antireconnaissance, jamming and antijamming, destruction and anitdestruction and form one system. For example, one aircraft or warship must give overall consideration to various types of electronic warfare means. One weapons system must make overall coordination of various types of jamming, counterjamming, as well as other electronic warfare means in order to bring into play the integration efficiencies associated with system countermeasures.

In summary, employment of electronic warfare system countermeasures must fit with the ideas of "concentrating advantages and troop strength to defeat the enemy" and "doing the unexpected and attacking where they are not prepared".

2.3 Analysis of the Employment of Electronic Warfare System Countermeasures During the Gulf War

Seen from a macroscopic viewpoint, multinational units adequately brought into play the advantages of such multiple types of combat means as electronic reconnaissance, electronic jamming, electronic stealth, and electronic destruction. In applications, adequate considerations were given to raising integrated combat efficiencies associated with electronic warfare; moreover, these combat means were fused in time domains, space domains, and frequency domains. Here is a concise summary as follows:

2.3.1 Reconnaissance and Antireconnaissance Electronic Warfare Strategies

2.3.1.1 In the reconnaissance area, multinational units set up

multilayered, all around three dimensional reconnaissance systems synthesized from various types of space, aerial, sea, and land reconnaissance means.

(1) In space: The U.S. urgently coordinated the use of and launched more than 50 military satellites belonging to over 10 types for "Desert Shield" and "Desert Storm" service. The U.K. military communications satellite "Sky Net 4" and the French SPOT remote sensing satellite were both also thrown into service.

These satellites played a huge role in the areas of determining the precise locations of strategic targets, monitoring Iraqi radio communications, as well as collecting various types of radar parameters. In particular, infrared telescopes on early warning satellites played a key role with regard to the U.S. side monitoring the launch of Iraqi "Feimaotui (phonetic)" missiles. U.S. defense experts said that when Iraq launched missiles toward Tel Aviv, they required 5 minutes to fly to Tel Aviv. However, multinational units received raid warnings in less than 4 minutes. Satellites were also able to monitor large scale Iraqi military maneuvers. For instance, three weeks before the ground war broke out, Iraq launched an offensive which was particpated in by a number of divisions in the vicinity of Wofula (phonetic). This offensive was observed by space satellites. Multinational units immediately adopted an aerial counterattack. In conjunction with this, it was defeated.

(2) In the air:

Multinational units transfered for use 36 early warning aircraft.

The E-8A, equiped with "combined monitoring and target attack radar systems", is capable of monitoring ground targets. Once rough location information for Feimaotui (phonetic) launchers was received from satellites, it was then able to follow maneuvering launchers. In conjunction with this, through "combined tactical information distribution systems", it was sent to U.S. forces ground commanders, directing the interception of ground missiles. /3

Early warning aircraft such as E-3A, E-2C, E-8A, and so on, then completed monitoring, identification, and tracking of aerial targets, in conjunction with this, commanded and directed multinational unit aircraft in executing attacks. Besides this, these early warning aircarft also coordinated the combined maneuvers of aerial and ground units.

Multinational units also put to use such reconnaissance aircraft as U-2, TR-1A, as well as various models of pilotless reconnaissance craft to carry out missions like target reconnaissance, as well as bombing result evaluation, and so on.

Such aircraft as F-15, F-111, etc., made use of on board infrared sensing devices to be capable of detecting the scattered amounts of heat from tanks hidden inside trenches. Under these deeply dug in tank locations, amounts of heat were absorbed from the sun during the day. Their speed of heat dissipation will be lower than that of the surrounding sand. As a result, highly sensitive infrared sensors will then be capable of detecting these tanks hidden under the ground.

JS radar systems installed on Boeing 707's are capable of standing far off combat positions and reconnoitering enemy activities in depth. They can observe moving targets. In conjunction with this, they are capable of precisely measuring their position. During fighting in the attack on Haifu,i (phonetic), Iraq sent large tank units to carry out reinforcement. It was precisely these aircraft equiped with JS radar systems which discovered the movements of these tanks. In conjunction with this, they sent back relevent imagery, marking the route of march of the Iraqi armored units just beginning to advance. When the Iraqi military had been beaten by multinational units, and, in conjunction with that, were fleeing away from Kuwait City, it was also JS radar systems which first discovered their trail.

(3) On land: U.S. forces ground combat commanders made use of "stable intelligence source systems" to directly receive imagery sent back from satellites. In conjunction with this, through "tactical digital fax machines" imagery was sent to such combat units as fighter wings, the Marine Corps, and so on. Multinational units deployed large numbers of ground electronic intelligence reconnaissance stations along the border between the Kuwaiti desert and the Iraqi desert.

(4) On the sea: On aircraft carriers, the U.S. installed AN/SSC-2 model terminals capable of receiving information transmited by satellites.

(5) Information was obtained going through diplomatic channels and intelligence agencies.

U.S. military figures said that the Soviet Union supplied very valuable information to the U.S., helping multinational units lower projected loss rates in aerial combat with Iraq. This information which the Soviet Union supplied (including weapons and air defense systems) was capable of letting coalition fighter aircraft pilots--through adjusting electronic jamming systems on aircraft--effectively jam Iraqi air defense systems.

U.S intelligence agencies, by contrast, collected intelligence from scientists who had recently visited Baghdad, contractors who had undertaken construction projects in Iraq, as

well as various types of personnel who understood Iraqi military production facilities and nuclear production facilities.
2.3.1.2 In the area of antireconnaissance, Iraqi units did a great deal of work in order to thoroughly implement Saddam's guidance to "avoid the spearhead, conserve strength, play for time, and watch for an chance to counterattack".

(1) Electronic Deception Tactics

Iraq made use of aluminum plates and plastic to build a good number of fake missile launchers. On fluorescent airborne radar screens, they showed radar target echos extremely similar to real launchers. They lured multinational unit bombers to carry out large amounts of ineffective bombing. Moreover, real launchers then executed maneuvers in a timely manner, arriving at the deception target. Iraq also possesses Italian made metal wire reinforced plastic tanks. On fluorescent radar screens, they also form true to life echos, making it difficult for multinational units to distinguish true from false.

(2) Optical Camoflage Techniques

Iraq carried out optical camoflage with regard to various types of strategic targets, military installations, and weapons systems, eliminating target revealing indicators. Measures were carried out on special target exterior form characteristics. As a result, it made them difficult for multinational unit reconnaissance to discover. Iraq was aided by satellite photos purchased from the U.S. in carrying out camoflage on its military targets--for example, on aircraft runways, they built a number of fake shell craters, leading U.S. pilots to mistakenly believe that the runway had already been blown up and not to carry out bombing again.

(3) Smoke Laying Tactics

Iraqi military forces blew up a good number of oil wells inside the Kuwait border, making a lot of constant smoke in the air over Kuwait. Oil smoke not only influences pilots carrying out bombing missions. Moreover, it also influences U.S. reconnaissance satellite reconnaissance of blown up military targets.

(4) Covering Techniques Associated with Important Military Targets and Equipment

Iraqi military units--in order to avoid the reconnaissance and attacks of multinational units--took such military equipment as their missile launchers, aircraft, tanks, and so on, and hid them inside various types of emplacements. Saddam's headquarters went into an underground combat control emplacement. After the surface communications facilities of Baghdad and other important

cities had met with destruction, Saddam made use of precisely buried underground fiber optic electrical cables in order to direct combat.

Consequently, in the area of antireconnaissance, Iraq also adopted multiple types of tactics. Moreover, these tactics were coordinated with each other in their use. For example, after /4 taking real missile launchers or tanks, aircraft, and so on, and hiding them in underground emplacements, on the surface, they also built a good number of fake aircraft, tanks, and missile launchers, so as to confuse the pilots of multinational units.

2.3.2 Jamming and Anitjamming Electronic Warfare Strategies

In the area of jamming tactics, multinational units made full use of their advantage in this area, laying down high power, wide frequency band saturation type suppression jamming. They not only made use of active radio jamming. They also laid down passive foil strip jamming. At the same time, they also laid down photoelectric jamming. During the 24 hours before execution of the "Desert Storm" combat, electronic warfare was then launched on a large scale. Multinational units brought into play many electronic warfare aircarft such as EA-6B, EF-111A, EC-130H, and so on. On the basis of C3I systems and various types of radar frequencies reconnoitered before the war, they laid down directed, very strong, narrow band, aimed type jamming. Besides this, U.S. forces also used "smart" electronic jamming deployment systems to lay inside the Iraqi border in the vicinity of weapons and carry out automatic jamming.

When multinational units laid down jamming, they opted for the use of the tactics below:

(1) In the breakthrough phase, use EA-6B aircraft to lay down high power, full frequency band, long range support jamming.

(2) EF-111A aircraft and fighter bombers form units together in the breakthrough, laying down unit following support jamming, covering the combat maneuvers of attacking aircraft.

(3) Such aircraft as EA-6B's, and so on, throw out large amounts of foil strips to form jamming corridors, covering the incoming direction of attacking aircraft.

(4) During aerial combat, multinational unit fighter planes use radar jamming and infrared jamming (or decoys) to deal with Iraqi air to air missile attacks and the interception attacks of ground to air missiles.

The jamming tactics of multinational units discussed above appear almost simultaneously. Moreover, coordination by tacit agreement causes the whole jamming system to bring to bear maximum efficiencies.

In the fields of jamming and counter jamming, Iraq was placed in a position of complete inferiority. The command level lacked active defense concepts. Military units did not have a decent active defense operational plan--much less adopt active defense measures. The majority of Iraq's C3I systems and various types of air defense missiles were bought from the Soviet Union and western countries. The counter jamming capabilities of these weapons systems were basically very bad. In addition, the Iraqi military leadership did not adopt any effective counter jamming measures, and, what is more, lacked electronic warfare training.

2.3.3 Stealth and Antistealth

During the Gulf War, multinational units made full use of the advantages associated with their own stealth technology--playing an enormous role in the area of breaking through the Iraqi air defense network. At 2:00 in the morning on the first day of "Desert Storm", F-117A stealth aircraft of multinational units penetrated the Iraqi air defense radar monitoring net. They broke through to the skies over Baghdad, accurately dropping the first BLU-109/B laser guided bomb on the roof of Baghdad's telegraph and telephone building. Following that, they also bombed the National Defense Ministry building, and so on. The U.S. not only had F-117A stealth aircraft with RCS reaching 0.02 square meters (It was said that some could reach 0.01 square meters.). Moreover, AGM-109C Tomahawk cruise missiles and AGM-88A Hamu (phonetic) antiradiation missiles also went through modifications to possess certain types of stealth characteristics. In the area of antistealth, Iraq was at its wits end, and was powerless. This was due to Iraq's limited technological level. Even more important was Iraqi leaders being unable to see the important role which high technology played in the realm of electronic warfare. Taking antistealth as an example, the back portions of stealth aircraft have more irregular bulging sections (for example, cockpits, engine compartments, weapons firing sections, and so on) compared to low sections. Their RCS values are thus relatively large. Besides this, engine jet ports are also all installed on the upper part of the fuselage. As a result, making use of such airborne radars as early warning aircraft, it is possible to detect the existence of stealth aircraft. Despite Iraq's also having 2 early warning aircraft, the detection equipment on the aircraft was obsolete and could not play a role in detecting stealth aircraft.

2.3.4 Destruction and Antidestruction

In this realm, Iraq was also placed at an absolute disadvantage. It is possible to say that various types of radars associated with Iraqi antiaircarft systems all did not possess counter antiradiation missile capabilities. Tactically, there was also no adoption of even more numerous counter antiradiation missile measures. They just closed down the radars, and that was it.

The Gulf War clearly showed that multinational units closely coordinated various types of electronic warfare means--such as reconnaissance, jamming, stealth, as well as destruction, and so on. In conjunction with this, they were organized into one large jamming system, producing, on Iraqi air defense systems, a crushing absolute jamming advantage. This caused Iraqi air defense system C3I networks as well as various types of radars to be rapidly placed into a paralyzed condition, creating safe routes for the large scale air raids of multinational units. /5

3 DISCUSSION OF ELECTRONIC WARFARE COUNTERMEASURE MODALITIES IN THE ATTACK AND DEFENSE

Even if one does not go beyond the limited wars of the future, they are carried out in such forms as land war, air war, and sea war. Electronic warfare system countermeasures must also be employed in the forms of warfare described above. The strategic concepts of "integrated air and ground war" and "integrated air and sea war" as well as " three dimensional warfare in great depth", set down by such nations as the U.S. and the Soviets, require that, in each campaign, there must be a rapid seizing of "air superiority" and "sea superiority". Moreover, electronic warfare system countermeasures run through them from beginning to end. Firmly seizing "electromagnetic frequency spectrum supremacy" is, then, a prerequisite condition of obtaining "air supremacy" and "sea supremacy".

Below, there are respective discussions of the basic offensive and defensive modes associated with electronic warfare system countermeasures for different forms of war.

3.1 Offensive Electronic Warfare System Countermeasure Modalities

3.1.1 Air Raid Actions Aimed at Destroying Important Enemy Strategic Targets

(1) Reconnaissance Before Combat

Employing all reconnaissance and detection means, including reconnaissance satellites, various types of reconnaissance aircraft, various types of ground reconnaissance equipment, and special types of reconnaissance detachments, get a clear understanding of the locations of such strategic targets as enemy headquarters, missile positions, antiaircraft gun positions, air fields, fuel depots, and so on, communications frequencies, radar frequencies, etc.

(2) Some short time before combat, begin to lay down various types of jamming, paralyzing various types of radar and command communications systems. In conjunction with this, use antiradiation missiles to carry out destructive strikes. Open up safe channels for air raid aircraft and long range missiles.

(3) After beginning combat, various types of jamming equipment continue working right up to the conclusion of fighting, and, only then, does the jamming stop. Various types of reconnaissance means also continue operating, providing the dynamic enemy situation as necessary and supplying references to commanders.

(4) Fighter groups carry out aerial combat missions,

opening up safe aerial corridors for bomber groups.

(5) Bomber groups carry out bombing against enemy strategic targets.

As far as the electronic warfare system countermeasure strategies which should be adopted among the combat elements discussed above are concerned, they are:

(1) Adopting reconnaissance and antireconnaissance actions before and during combat.

Among these are included aerial reconnaissance satellites, various types of reconnaissance aircraft--in particular, unmanned aircraft associated with deception and collection of radar external parameters--and various types of ground radar stations. They also include peacetime reconnaissance data, as well as all intelligence data acquired during diplomatic and external affairs activities, and so on, along with antireconnaissance countermeasures such as ground camoflage, radar silence, transmiting false frequency signals, as well as false targets possessing radar and photoelectric signatures (below, an analysis will be carried out combining hypothetical concrete battles) adopted by the opposition being faced. At the same time as this, one's own side will launch antireconnaissance activities against the enemy.

(2) Various types of jamming measures adopted during the entire battle, including the few hours immediately before combat.

Seen from the point of view of jamming platforms: there are electronic warfare aircarft, various types of airborne jamming equipment, and surface and vehicle borne jamming equipment, etc.

Seen from the point of view of jamming frequency domains: there are ground communications frequency bands, meter wave bands, microwave frequency bands, as well as infrared wave bands, and so on.

Seen from the point of view of jamming subjects: there are radio communications equipment, various types of ground radars (including missile acquisition, tracking radars, air defense artillery fire control radars, and so on), airborne radars, ground air field command guidance radars, missile borne equipment, and so on.

Seen from the point of view of jamming methods, there is jamming coming from satellites, long range support jamming, and unit following escort jamming.

Seen from the point of view of types of jamming: there is radar suppression type jamming and deception jamming, one time use jamming, passive metal foil jamming, infrared decoy jamming, smokescreen jamming, infrared metal foil jamming, infrared jamming devices, laser jamming devices, and so on.

Of course, jamming systems will face various types of antijamming countermeasures.

Jamming system employment must aim at achieving the objective of paralyzing and blinding various types of enemy radars. Following that, it assists the use of antiradiation missiles to do hard kills and damage so as to facilitate a rapid achieving of "electromagnetic frequency spectrum supremacy".

(3) Adopting electronic warfare system air countermeasures during aerial combat

((1)) Make use of early warning aircraft to carry out early warning, command and guidance, in order to make the aircraft of one's own side be placed in an advantagous position for active attacks.

((2)) On the basis of intelligence acquired before the war, during combat, carry out high power jamming against air field control tower guidance command radars, to make enemy fighters lose ground control after they take off.

((3)) Adopt missiles possessing high counter jamming performance as well as being able to be launched at ranges beyond visual to attack enemy aircraft.

((4)) Make use of airborne alarm jamming to jam missiles launched by the other side. /6

In the combat elements discussed above, the friendly side electronic warfare capabilities must exceed those of the other side. Only then is it possible to guarantee with certainty victory in this air battle.

3.1.2 Make use of ground to ground tactical missiles and cruise missiles important enemy strategic targets.

(1) When ground to ground tactical missiles and cruise missiles penetrate defenses, electronic warfare system countermeasures adopted are:

((1)) Make use of radar stealth materials in order to lower the radar reflective surface area, lowering the detection probability form the other side's long range warning radars.

((2)) Adopt smokeless propellants in order to lower the infrared radiation strength, causing detection by

((4)) Make missile heads and bodies separate in order to lower the RCS value.

((5)) Make missiles carry small model low power jamming devices (capable of making fuse receivers overload). Jam the proximity fuses of incoming missiles or destroy the combat guidance coordination, guaranteeing that ground to ground tactical missiles will be able to smoothly penetrate defenses.

((6)) Make missiles carry passive jamming equipment, creating certain false targets (Formed from foil strip cloud clusters, the foil strip cloud cluster RCS values will be more than twice as large as missile RCS values.).

((7)) Strengthen counter radar and photoelectric jamming capabilities associated with radars on missles and guidance systems related to terrain matching.

3.2 Defensive Type Electronic Warfare System Countermeasure Modalities

In limited wars of the future, offensive operational systems will be an orgainc whole. They will include reconnaissance satellites, various types of aircraft (fighter aircraft, bombers, electronic warfare aircraft), air to air missiles, air to ground missiles, ground to ground tactical missiles, and so on. Under the unified command of C3I systems, each fulfils its responsibilities, forming offensive systems with extremely high operational efficiencies. As a result, defensive systems will also take various types of operational elements and unify a coordinated command, bringing into play integrated maximum efficiencies.

In defensive systems, various types of reconnaissance communications satellites, various types of reconnaissance aircraft, operational aircraft, early warning aircarft, electronic warfare aircraft, ground to air missiles, antiaircraft artillery, ground to air jamming systems, and so on, should be included. They should also be coordinated under the command of C3I systems, each fulfiling its responsibilities, to form defensive systems with extremely high operational efficiencies.

Defensive systems will also go through (1) precombat reconnaissance; (2) the laying down of various types of jamming after the battle begins; (3) fighters taking off to meet

incoming aircraft and incoming ground to ground tactical missiles as well as cruise missiles; (5) defensive systems must also carry out active defense guidance as well as actively attacking the strategic targets of the other side, and so on. During the various combat elements described above, the electronic warfare actions carried out by the friendly side must certainly "be very skillfully planned" in order to achieve "electromagnetic spectrum supremacy" for the entire campaign.

Because electronic system countermeasures are roughly the same as those types adopted in the offense, we will, therefore, not waste time discussing them.

4 TENTATIVE IDEAS FOR ELECTRONIC WARFARE CAPABILITIES WHICH NEW GENERATIONS OF AIR DEFENSE SYSTEMS SHOULD BE PROVIDED WITH

New generations of air defense systems are based on high technology. For this reason, air defense systems should carry out the guidance of "integration of attack and defense and active defense".

4.1 Operational Modalities and Tactics of Future Limited Wars

As far as limited wars of the future are concerned, operational modalities adopted by the enemy are roughly as follows.

4.1.1 Ground Warfare Mode

-Tactical ground to ground missiles possessing certain stealth characteristics and launched from land attack important strategic targets;

-A certain number of attack aircraft are launched to carry out bombing of strategic targets;

-A certain number of ground units are sent out to launch an offensive on land.

-Air mobile units are sent out and coordinate actions with ground units.

4.1.2 Sea Warfare

-Large numbers of warships are sent along coastal areas. In conjunction with this, cruise missiles are launched from warships to carry out strikes on strategic targets;

-A certain number of aircraft are sent out to bomb important strategic targets along the ocean;

-Such ground units as the marines are sent out.

Speaking in terms of air defense systems, operational missions are to intercept various types of attacking aircraft, that is, aircraft and missiles. The key point is, then, to intercept enemy craft coming to attack.

4.1.3 Air Raid Tactics Capable of Adoption

-Air Raid Tactics Under Radio Silence;

Making use of stealth aircraft as well as airborne lasers, infrared detection systems, photoelectric guided missiles and bombs to attack targets. /7

-Ultra Low Altitude Defense Penetration Tactics;

Defense penetration tactics adopted making use of guidance radar low altitude blind spots.

-Long Range Missile Launching Tactics;

The Gulf War demonstrated that this is an important form of air raid to be adopted from now on. For instance, during the Gulf War, the U.S. used "Harpoon" missile bodies and fitted them with "Youchu (young livestock)" infrared imaging guidance heads as well as other systems to form AGM-84E "Silamu (phonetic)" missiles capable of being launched from outside 110 kilometers.

-Night Air Raid Tactics

This is successful experience from the Gulf War. The first air strikes and the first ground battles launched by multinational units were all carried out at night. The reason was that, in the area of night vision systems, multinational units held an extreme advantage--for instance, the LANTIRN systems installed on F-15E aircraft are capable of detecting targets with temperature differentials of 0.1°C. and are capable of acquiring targets in the dark, smoke, and dust.

4.2 Types of Air Defense Systems and Fire Power Deployment

According to classifications of defended areas, there are three types of air defense--air defense of national territory, zonal air defense, and air defense of key point targets. Due to differences in the protected areas, the fire power deployments in air defense systems are also different. Completion of operational missions is also different.

Zonal air defense systems are composed of a certain number of key point target air defense systems. On the basis of air defense missions and concrete utilization environments, they take air defense systems for unequal numbers of important point targets and organize them, in accordance with a certain form, into a screen type peripheral air defense system or group military region air defense systems.

The Gulf War as well as all previous world and limited wars clearly show that key point target air defense systems should be composed of 4 parts, that is, detection and tracking systems, self-defense type electronic warfare systems, C3I systems, and fire power intercept systems.

4.2.1 Detection and Tracking Systems (Also Capable of Merging with C3I Systems)

-Making use of aerial early warning aircraft and ground radar networks, detection radii are 300km for various types of intruding aircraft targets from ultra low altitudes to heights of 10km. This detection and tracking system is composed of various

types of sensing devices. Among them are included various types of detection devices such as radars, lasers, infrared, and so on.

-Making use of passive detection equipment to precisely fix aerial targets.

4.2.2 Self-Defense Type Electronic Jamming Systems

They are composed of two parts, that is, active ground to air jamming systems and ground photoelectric integrated countermeasure systems.

Active jamming systems are composed of a guidance command station and a certain number of jamming stations. Target indication is completed by fire control system radars. It is not necessary to set up other units.

-Identification and tracking systems should be able to distinguish friend and foe; identify threat radars and threat levels; be able to distribute jamming targets, and, in conjunction with that, coordinate the operations of various jamming stations.

Ground photoelectric integrated jamming systems should possess laser, infrared, ultraviolet, and millimeter wave band countermeasure capabilities. Key point protection is for army groups, division command posts, communication nexses, air fields, as well as other strategic targets. They are capable of jamming the attacks of laser guided bombs, laser guided missiles, infrared guided missiles, as well as millimeter wave guided weapons. The systems in question are composed of multiple types of sensing devices such as laser reconnaissance alarms, infrared reconnaissance alarms, millimeter wave reconnaissance alarms, and so on. Multiple types of jamming equipment carry out effective integrated jamming by central control computer processing and, in conjunction with that, guidance by lasers, infrared, millimeter waves, and so on.

4.2.3 C3I Systems

C3I systems complete various types of functions, such as command, control, communications, information gathering and processing, as well as timely analysis and management of the battlefield, and so on. They are centers of the air defense systems.

They are composed of three parts:

(1) Reconnaissance and detection systems--they are responsible for collecting various types of intelligence. The information and intelligence systems primarily depend on:

-intelligence provided by national C3I systems

-information and intelligence obtained from various types of reconnaissance equipment in air defense systems (including aerial reconnaissance aircraft, early warning aircraft, ground radar stations, and so on).

They are capable of integrating detection and tracking systems.

(2) Command and control systems--they are responsible for collecting, processing, and displaying various types of intelligence on both friendly and enemy sides, situations, analysis of threat forces, analysis of battlefield electromagnetic jamming environments, and supplying information for command personnel to make policy decisions.

(3) Communications systems--they are responsible for transmiting intelligence and orders. Communications channels are: linear carrier waves, microwave communications, and optical fiber communications. /8

Tactical C3I systems should possess six types of functions:

-information collection function---gathering troop strength deployments for both the friendly and enemy sides, combat maneuvers, battlefield environments, weather data, electromagnetic jamming parameters, and so on.

-information transmission function---fast, accurate, secure, and uninterrupted transmission of various types of information, and, in conjunction with that, the ability to automatically carry out exchange, classification, declassification, and so on.

-information processing function---the ability, for various types of formated information inputed into computers, to automatically synthesize, store, update, and so on, and, in conjunction with this, to carry out military operations, putting forward operation plans.

-information display function---the ability to present graphical, audiovisual, clear postures and actual on the ground situations for command personnel using multiple types of forms such as text, symbols, tables, as well as charts, figures, and so on.

-strategy determination monitoring and control function--- the ability to present target flight paths to command and control friendly side offensive interception weapons, and so on.

-execution inspection function---evaluation of results associated with the status of execution of orders to completed as well as weapon hits on targets, and so on.

4.2.4 Fire Power Interception Kill and Damage Systems

They are composed of four part fire power systems, that is,

-air defense missiles

-antiaircraft artillery

-ground to ground tactical missiles

-airborne fire power (missiles, bombs, and so on).

4.3 Electronic Warfare Functions which Air Defense Systems Should Possess

C3I systems are the centers of air defense systems. They are also one of the key targets the enemy hits. Just as a former U.S. Secretary of Defense said: "Jamming one radar only destroys one weapon. However, jamming out a C3I system is just equivalent to destroying a weapons depot--even to the point of causing the entire defensive system to be placed into a completely paralyzed condition. The Gulf War fully demonstrates this point. In this connection, C3I systems should possess relatively strong counter jamming characterisitcs, that is, counter destruction, counter jamming, counter deception, counter utilization, and so on.

As far as antidestruction is concerned, it is possible tc adopt the increasing of C3I system mobility or adopt dispersed type structures as well as resorting to electromagnetic and photoelectric camoflage measures, and so on. With regard to counterjamming measures, it is possible to adopt the use of low intercept probability radars, dual base operating radars, the emplacement of various types of decoys, resorting to passive receiving systems, and so on. In the case of antideception measures, there are communications classification, the emplacement of decoys, and so on. Computers in C3I systems must have counter computer virus jamming measures.

4.3.2 Electronic Warfare Capabilities of Ground to Air Jamming Equipment

Active jamming equipment should be able to jam enemy airborne acquisition radars, navigation radars, bomb aiming radars, as well as air to ground terminal guidance radars. Speaking in terms of radar systems, the jamming equipment discussed above should be capable of jamming continuous wave radars, pulse Doppler radars, rapid frequency change radars, pulse compression radars, and so on. Besides this, they should also have capabilities to counter antiradiation missile hard kill and damage and to jam missiles associated with various types of radar guidance systems.

Ground to air photoelectric jamming equipment should be able to jam infrared point source seeking missiles, infrared imagery guided missiles, as well as laser guided missiles and laser guided bombs, etc.

4.3.3 Electronic Warfare Capabilities of Various Types of Intercept Kill and Damage Systems

(1) Electronic Warfare Capabilities which Various Types of Air Defense Missiles Should Possess

((1)) Antireconnaissance Capabilities

As far as opting for the use of low intercept probability

radar systems is concerned, they should possess low secondary lobe antennas, low peak value transmission powers, and random radar parameter changes. With regard to opting for the use of passive detection systems, missile systems opt for the use of photoelectric stealth measures and radar stealth measures, increasing the mobility capabilties of missile systems, and so on.

((2)) Counter Jamming Capabilities

-opt for the use of measures to track noise to counter wide band obstruction jamming.

-opt for the use of fast frequency change systems to counter narrow band obstruction jamming.

-opt for the use of fast frequency change or skip frequency technology to counter sweep frequency jamming.

-opt for MTI or MTD technology to counter foil strip cloud cluster or foil strip jamming corridors.

((3)) Counter ARM Capabilities

Antiradiation missiles constitute a severe threat to various types of radars. Various types of radars in air defense systems all should possess counter antiradiation missile capabilities. Countermeasures are simply described as follows:

-opt for the use of dual base radars;

-opt for the use of low intercept probability radars;

-opt for the use of deception and diversion measures;

-opt for the use of radar networking measures;

-opt for radar stealth measures;

-increase radar mobility capabilities; /9

-opt for densely packed positions of small antiaircraft artillery to carry out fire power destruction;

-opt for the use of tactical laser weapons to carry out hard kill and damage on antiradiation missiles;

-opt for the use of interceptor missiles to carry out hard kill and damage.

((4)) Antistealth Capabilities

Due to the break neck development of stealth aircraft and other stealth flying objects, new antiaircraft system radars should all possess counter stealthed flying object functions.

Countermeasures opted for are roughly:

-increasing power aperture areas;

-increasing transmited wave form time period band width area;

-opt for the use of dual frequency band and dual color guidance technology;

-opt for the use of passive detection and tracking technology;

-opt for the use of satellite borne or vertical view detection using early warning aircraft against stealth targets.

As far as fire control radars in air defense systems are concerned, the counter jamming capabilities and the requirements discussed above are the same.

(2) Electronic Warfare Capabilities which Tactical Ground to Ground Missiles Should Possess

Electronic warfare capabilities of ground to ground tactical missiles include two areas. One is antidetection capabilities. The second is terminal guidance system counter jamming capabilities.

Antidetection area:

-lower missile RCS values;

-raise missile terminal velocities;

-launch fake missiles and real missiles at the same time to make it difficult for detection systems to distinguish between real and false.

Counterjamming capability area:

-in missiles, carry active jamming equipment and jam the terminal guidance systems of enemy interceptor missiles;

-jamming missiles and real missiles accompany one another in flight. The jamming missiles, on the one hand, jam the various radio elements of enemy interceptor missiles. On the other hand, it is also possible to jam various types of radars in the vicinity of enemy targets;

-guidance systems in ground to ground tactical missiles should possess counter noise jamming, deception jamming, and sweep frequency jamming capabilities.

(Reference materials omited.)

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