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ANALYSIS OF ELECTRONIC INTELLIGENCE SAFEGUARDS DURING THE GULF WAR

by

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ABSTRACT During the Gulf War at the beginning of 1991, the most lethal and precious weapon was not missiles, fighters, tanks, or warships. It was, however, the electronic intelligence system which multinational units, led by the U.S., deployed in the Gulf region. This intelligence system was large scale, technologically advanced, well organized, and had high operational efficiency. For the command structures at various levels of multinational units, it supplied complete, accurate, timely, and continuous information on relevent Iraqi forces, guaranteeing needs associated with the drawing up of operational plans and the implementation of commands. It played a key role in securing victory in the war. The Gulf War displayed in a concentrated way the characteristics of the modern digitized battlefield. U.S. forces recognized that the Gulf War proclaimed the end of an era in warfare, marking the advent of the C3I era. As a result, analysis of electronic intelligence assurance systems has very great significance with regard to dealing with battlefields under future high technology conditions.

KEY TERMS Electronic intelligence, Intelligence services, Intelligence analysis

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During the Gulf War, widespread utilization was made of air raids, electronic countermeasures, precision guided weapons, as well as other advanced weapons, very greatly increasing the need for counterintelligence safeguards. The multinational units, led by the U.S., made use of various types of outer space, airborne, seaborne, and ground electronic reconnaissance systems, composing a grand electronic intelligence safeguard system. This intelligence assurance system was large in scale, technologically advanced, well organized, highly efficient operationally, and played a huge role in guaranteeing the operational victory of multinational units.

1 MISSIONS AND REQUIREMENTS ASSOCIATED WITH ELECTRONIC INTELLIGENCE SAFEGUARDS

Intelligence is the foundation for drawing up operational plans. It is also an indispensible element in operational safeguards.

1.1 Missions of Electronic Intelligence Safeguards

The missions associated with Gulf War electronic intelligence safeguards are primarily included in 5 areas.

(1) Bombing Target Selection. Due to multinational units taking air raids and using them as primary operational forms of strength to destroy the Iraqi forces, bombing target selection, therefore, is a primary mission associated with electronic intelligence safeguards. Multinational unit bombing targets included: ((1)) the Iraqi force command, communications, control, and intelligence system; ((2)) the Iraqi force radar and missile system; ((3)) plants, depots, and experimental bases serving Iraqi forces--in particular, biological and chemical weapons and nuclear experimental installations; ((4)) airfields, harbors, highways, and bridges; ((5)) Iraqi combat units--in particular, the Republican Guard. During the selection of bombing targets, there is a requirement that electronic intelligence safeguard systems be able to supply such information as the attributes, value, external form characteristics, and precise locations of targets.

(2) Real Time Monitoring of Battlefield Status. Included are tracking and monitoring against mobile "fleet footed runner" missile launchers in all Iraqi territory; monitoring against Iraqi force unit activities; and, monitoring against Iraqi force radar and communications hub activities.

(3) Supplying Target Data. As far as supplying the data required to execute electronic countermeasures is concerned, jamming parameters are provided for electronic counter jamming. Targets are also indicated for fire power strikes. /29

(4) Intelligence support is provided for friendly unit combat activities, ensuring unit coordination, command, and control.

(5) Checking Out Bomb Damage Results. It is possible to determine bombing results in a timely and accurate manner. It is

then possible to save large amounts of troop strength and munitions. Multinational bombing targets for each day were numerous and very strong. Checking out bombing results is a very important task.

1.2 Requirements with Regard to Electronic Intelligence Safeguards

During localized wars associated with conditions of high technology, the requirements on intelligence safeguards are quite high. These requirements can be mainly summarized in the few points set out below.

(1) Comprehensiveness. Comprehensiveness includes two areas. One is complete coverage of space. The second is ensuring comprehensive content. Although the scope of main Iraqi force deployments was limited, due to Iraqi forces possessing mobile "fleet footed runner" [Chinese translation of Iraqi arabic designation for modified Iraqi SCUD] missile launchers, there were certain biological and chemical weapon combat capabilities. Therefore, there was a need to carry out reconnaissance and monitoring against the whole of Iraqi territory, supplying intelligence associated with all important strategic targets and military targets, including their attributes, value, degree of hardening, and location, in order to facilitate determining whether or not to regard them as bombing targets and, during bombing, what type of weapons to opt for the use of. With regard to the content of intelligence requirements, they are even more numerous and varied--including, radar signals, communications signals, technical parameters, terrain, imagery, the content of intercepts, and so on.

(2) Accuracy. Multinational units opted for the use of precision guided weapons in large numbers for the sake of being able to precisely hit targets and, at the same time, reduce to the greatest extent possible civilian losses and damage. As a result, it was necessary to provide precise target location information. For example, with regard to Tomahawk cruise missiles, option was made for the use of terrain matching navigation and a number of other navigational means. It was necessary to have precise terrain data on the missile flight paths.

(3) Continuity. Due to the fact that, during the Gulf War, combat was intense, and the battlefield status changed very rapidly, electronic intelligence safeguard systems needed to be able to continuously provide various types of intelligence required for operations.

(4) Timeliness. During the Gulf War, use was made of large numbers of such weapons as missiles and aircraft. Weapon warhead movement speeds are very fast. There is a requirement to be able to provide nearly real time intelligence. During the interception of "fleet footed runner" missiles, the requirements for timeliness were exceptionally high. During air raids and the countering of air raids there was also a need to ensure close to real time intelligence.

2 COMPOSITION OF ELECTRONIC INTELLIGENCE SAFEGUARD SYSTEMS

In order to complete the tasks associated with electronic intelligence assurance, multinational units made use of large numbers of reconnaissance, communications, and command and control equipment, composing a huge electronic intellignece safeguard system.

2.1 Space Reconnaissance Satellites

(1) Photo Reconnaisance Satellites. Photographic satellites were primarily KH-11's and KH-12's. The resolutions of these two types of satellites reach 0.1m. Their digitized imagery went through data relay satellite communications, and the entire process from orbital launch to ground processing only required 1.5 hours. Photographic satellite resolutions are very high. However, they are greatly influenced by weather conditions. Moreover, they are not able to continuously provide imagery on the same spot.

(2) Composite Aperture Radar Reconnaissance Satellites. These possess all weather capabilities and are able to detect underground targets below a certain thickness of vegetable matter and several tens of meters deep under the soil. They can distinguish between camoflage and concealed targets. However, they are also not capable of providing continuous intelligence.

(3) Electronic Reconnaissance Satellites. Among these, "the big wine bottle", "the little room", and ADP-658 are geostationary orbit satellites. There are also two low orbit satellites and special model intelligence satellites. Electronic reconnaissance satellites are used on reconnaissance radar and communications signals. Reconnaissance intercept frequency ranges against radars are 100MHz-20GHz. Stationary orbit electronic reconnaissance satellites are capable of carrying out continuous reconnaissance against Iraqi forces. However, due to orbital altitudes, signals they are capable of intercepting are limited by radar or communications power and beam direction. Low orbit electronic satellites have low orbits and are capable of intercepting more signals. However, due to their short movement periods, points under the satellites shift. They are not able to supply continuous intelligence on the same spot.

(4) Missile Early Warning Satellites. These are used to monitor "fleet footed runner" missile launches. They opt for the use of infrared detection. Infrared telescopes scan once in each interval of 10-12s. One image is transmited to the ground in each interval of 30s. Due to opting for the use of multiple early warning satellites, it is possible to maintain continuous monitoring.

(5) Oceanic Monitoring Satellites. Their code name is "white cloud". Infrared surveying received through antennas can monitor continuously, detecting surface ships and submarines. /30

(6) Military Weather Satellites. These opt for the use of such means as visible light, infrared, as well as microwave imagery, and so on, to provide weather intelligence.

2.2 Airborne Electronic Reconnaissance Systems

Multinational units, from beginning to end, put to use over 100 strategic reconnaissance planes and tactical reconnaissance planes. They also made use of multiple types of pilotless reconnaissance planes. The main reconnaissance equipment which was utilized included composite aperture radar, infrared detectors, and cameras. Besides this, in intelligence reconnaissance, E-3A/B and E-8A early warning aircraft also played an important role. Below, we introduce the characteristics of a few types of reconnaissance aircraft.

(1) SR-71 Strategic Reconnaissance Aircraft. Reconnaissance altitude 24km. Cruising speed (when altitude is 21km) 3M. Maximum level flight speed (altitude 24km) 3.2M. Practical ceiling 26.6km. Range (altitude 24km, 3.0M cruising, no aerial refueling) 4800km. Main reconnaissance equipment includes battlefield reconnaissance systems, cameras, infrared and electronic indicator devices, AN/APG-73 composite aperture radars, and strategic reconnaissance systems, as well as battlefield reconnaissance systems. The strategic reconnaissance systems scout areas of 155 thousand km2 each hour.

(2) TR-1 Reconnaissance Aircraft. It is one type of high altitude tactical reconnaissance aircraft. It is capable of continuous day and night, all weather oberservations of targets deep within enemy territory in order to support ground and air operations. The main reconnaissance equipment is AN/UPD-X observation radar.

(3) Pilotless Aircraft. Pilotless aircraft are low cost, and there are no problems with personnel casualties. They are capable of carrying out reconnaissance deep into enemy occupied areas. During the Gulf War, there were 3 types of pilotless aircraft used--the U.S. "short haired hunting dog", the French "mate (phonetic)", and the Israeli "vanguard". The reconnaissance equipment utilized by pilotless planes includes such systems as television cameras, infrared imagery devices, electronic counter reconnaissance equipment, and so on.

The capabilities of modern pilotless aircraft reconnaissance are very strong. In battlefield surveillance and target acquisition, they play a huge role. For example, the British "phoenix" pilotless aircraft is capable of completing battlefield monitoring, target search, identification, and positioning missions and is able to provide in real time precise battlefield target locations for medium and long range (approximately 50km) guns. This system possesses the following characteristics. ((1)) It is capable of day or night 24 hour all weather operations. ((2)) It gives continuously and in real time high resolution target imagery as well as the precise locations. ((3)) Continuous cruising time is greater than 6 hours. ((4)) It possesses stealth capabilities. ((5)) It possesses secure air/ground communications capabilities and is not easily detected and discovered.

(4) E-8A Reconnaissance and Early Warning Aircraft. They are equiped with side looking radar with detection ranges of 250km. They are capable of detecting activities of ground and

low altitude targets in deep enemy areas. In conjunction with this, they take target location information and, at specified times, transmit it to ground commanders and airborne attack aircraft, directing guided air and ground fire attacks.

2.3 Seaborne Electronic Reconnaissance Systems

All large U.S. surface ships are equiped with electronic reconnaissance equipment. They are capable of monitoring the activities of the Iraqi navy.

2.4 Ground Electronic Reconnaissance Systems

Ground electronic reconnaissance systems are primarily communications intelligence stations. In such nations as Turkey, Saudi Arabia, Oman, as well as the United Arab Emirates, and so on, multinational units set up several score of communications intelligence stations used to intercept Iraqi communications as well as other electronic signals.

Various types of multinational unit outer space, airborne, seaborne, as well as ground electronic reconnaissance systems make use of communications systems to form an integrated whole. It is capable of realizing real time information transmission and sharing. From the brief introduction above, it is possible to see that multinational unit electronic reconnaissance systems have a few striking characteristics. ((1)) Reconnaissance system completeness, forming outer space, airborne, ground, and seaborne reconnaissance systems into a whole, creating a multilayered, all around, three dimensional reconnaissance system. ((2)) The advanced characteristics of reconnaissance systems. In reconnaissance systems, option is made for the use of various types of advanced electronic reconnaissance means such as radar imagery, electronic counter reconnaissance, electronic intercept, visible light photography, infrared photography, television cameras, and so on. Thus, it is possible to acquire target information in many fields in order to offer adequate sources of information for integrated intelligence processing. ((3)) Reconnaissance system flexibility. In peacetime, U.S. electronic reconnaissance satellites are capable of carrying out strategic reconnaissance. In wartime, it is possible to make use of orbital maneuvers to carry out reconnaissance and monitoring against relevent nations and areas.

3 INTEGRATED ANALYSIS OF ELECTRONIC RECONNAISSANCE INTELLIGENCE

The amounts of intelligence information acquired by multinational unit electronic reconnaissance systems are very large. However, most of this intelligence information is only intelligence source material. It is necessary to make /31 use of integrated intelligence analysis systems to carry out integrated analysis of this intelligence source material. Only then is it possible to form intelligence which can be provided for the use of command personnel at various levels. As a result, integrated intelligence analysis is the core of intelligence assurance systems.

3.1 Types and Characteristics of Electronic Reconnaissance

Intelligence

The types of reconnaissance intelligence which various kinds of electronic reconnaissance systems acquire are very numerous. It is possible to divide them into the three classes set out below.

(1) Imagery Intelligence. This includes visible light photographs, radar imagery, infrared imagery, and television signals. Various types of imagery intelligence possess different characteristics.

Optical photograph resolutions are the highest. They are capable of clearly showing terrain and land forms as well as various types of military targets such as tanks, transport vehicles, missile launchers, and so on. However, fields of view of high resolution photographs are limited. Information cannot be provided in real time, and photograph quality is limited by weather conditions.

Using composite aperture radars to acquire radar imagery, it is possible to display land forms as well as imagery several tens of meters deep beneath dry soil. It is possible to distinguish such moving targets as tanks, transport vehicles, missile launchers, and so on. It is also possible to distinguish the location and attributes of sand and earth works. Radar imagery is capable of being presented in real time. It is not limited by weather conditions. However, resolution is not as good as optical photographs.

Infrared imagery signals can realize night vision. They can carry out early warning against missiles. It is possible to use them to search for tanks buried in the sand. Infrared imagery possesses relatively strong capabilities for distinguishing camoflage.

(2) Communications Intelligence. Through intercept, it is possible to grasp and follow the communications of various levels of Iraqi force command personnel. Up as far as the highest Iraqi force command organizations and down as far as the communications of squad and platoon command personnel--the contents, in all cases, can be intercepted by multinational units.

(3) Electronic Intelligence. Making use of electronic counter reconnaissance equipment, it is possible to acquire in real time various types of technical parameters associated with Iraqi force radar and communications signals. In conjunction with this, positioning is carried out against radar and communications equipment in order to provide data for the implementation of electronic jamming and destruction by fire. Multinational unit acquisition of electronic intelligence is divided into two parts. One is prior reconnaissance before battle. Basically, it is finding out technical data associated with Iraqi force radar and communications signals. The second is direct wartime reconnaissance. During the process of combat operations, real time monitoring and reconnaissance is carried out against Iraqi force radar and communications signals--checking old signals and discovering new signals.

3.2 Data Fusion Associated with Electronic Reconnaissance

Intelligence

Reconnaissance systems utilized by multinational units arevery numerous. Quantities of intelligence information are extremely large. It is necessary to opt for the use of computers to carry out automatic processing. U.S. forces make use of data fusion techniques to carry out integration, correlation, and synthesis on data acquired by multiple platforms and multiple sensors.

Data fusion possesses a number of the advantages that follow. (1) It is possible to expand the spacial coverage range of systems. (2) It is possible to expand the time range coverage of systems. (3) It is possible to increase utilization rates of systems. (4) It is possible to raise the reliability and precision of information. (5) It is possible to lower system investment.

The concept of data fusion appeared in the 1970's. Since the 1980's, it has achieved an enormous development. Due to its possessing the important advantages discussed above, it has already, as a result, rapidly entered into a good number of military realms. According to reports, U.S. forces already have a few score data fusion systems. Among these, there were a good number which saw use during the Gulf War. In conjunction with this, their efficiency was empirically proven to be very good.

Data fusion--in accordance with a layering of reconnaissance data integration and processing--can be divided into three types. (1) Image Element Level Fusion. Fusion carried out directly against original data signals--for example, carrying out selection and identification in counter radar equipment directly against radar signals. (2) Characteristic Level Fusion. Carrying out fusion against signal characteristics, that is, first carrying out the selection of characteristics and then carrying out fusion on the characteristics--for example, using target signal characteristics acquired by electronic counter reconnaissance and the external form characteristics of targets acquired by optical photographs to carry out fusion and integrated determinations of target characteristics. (3) Strategic Decision Level Fusion. Carrying out fusion on results associated with various independent channels of strategic decision--for example, carrying out fusion using results scouted and identified by various electronic reconnaissance systems, integrating determinations of target natures and various types of technical parameters. In a single integrated reconnaissance and intelligence processing system, the three levels of data fusion discussed above are often coordinated in their use.

At the present time, detailed reports relating to U.S. force data fusion systems are still very scarce. Here, we take as an example the all source analysis system/enemy situation correlation elements (ASAS/Ensce) in order to explain the functions of data fusion systems at the present time.

ASAS/Ensce is capable of taking intelligence data coming from various types of sensors and intelligence sources and carrying out data fusion, providing for military command /32

personnel accurate and real time intelligence and also providing needed intelligence for electronic countermeasures units to control electronic warfare assets.

Linked up with ASAS/Ensce systems are airborne and ground based sensors as well as electronic warfare assets. The systems in question are capable of the integrated handling of communications intelligence, electronic intelligence, imagery intelligence, and personnel strength intelligence. The results of integrated processing are capable of being superimposed on three dimensional terrain maps and used for instantaneous identification of the direction and belts of separation associated with units, obstacles, zones of concentration, and aerial targets approaching in the advance.

3.3 Electronic Intelligence Safeguard Capabilities

During the Gulf War, the electronic safeguard capabilities of multinational units reached a very high level. The U.S. Department of Defense recognizes that intelligence assurance capabilites during the Gulf War were the first time in several hundred years that command personnel were allowed to see clearly at a glance the battlefield situation. Iraqi forces would develop a battalion troop strength. Immediately, it would then be shown on display screens of multinational units. Seen as a whole, multinational unit electronic intelligence safeguard capabilities primarily manifested themselves in the several areas set out below.

(1) There was one structurally complete, technologically advanced, electronic intelligence assurance system with flexible deployment. This electronic intelligence safeguard system is the most advanced in the world at the present time.

(2) It was capable of comprehensive reconnaissance and continuous monitoring against strategic targets and military activities within a large range. Moreover, it possessed very high capabilities to distinguish true and false targets. This clearly shows that modern, large scale military activities are hard to conceal.

(3) Night vision capabilities were greatly strengthened. Night operations have already become a superiority of U.S. forces. At the same time, it also reflects that, in modern limited wars, units lacking night vision systems and all weather electronic reconnaissance systems will have a hard time seizing the initiative in battle.

(4) Electronic counter reconnaissance capabilities are very strong. They are capable in real time of reconnoitering the signal parameters and locations associated with all Iraqi force radars and most communications networks. Due to the widespread use of precision guided weapons, being discovered usually means being destroyed. As a result, at the present time, the wartime survival capabilities of electronic equipment which does not have counter reconnaissance capabilities have already greatly dropped.

(5) Real time intelligence reconnaissance and safeguard

capabilities associated with airborne electronic reconnaissance equipment are very strong. In particular, E-3A/B, E-8A, pilotless reconnaissance aircraft, as well as various types of electronic countermeasure reconnaissance aircraft play key roles in real time intelligence safeguards. E-3A/B and E-8A have already become the focal points of electronic countermeasures.

4. DRAWBACKS OF ELECTRONIC INTELLIGENCE SAFEGUARD SYSTEMS

Despite the fact that--in electronic intelligence safeguard systems--U.S. forces and multinational units made use of almost all reconnaissance systems and advanced technologies which can be employed, the intelligence assurance capabilities, however, were still not perfect. During the processes of actual combat, it was clearly shown that there were still a number of important problems existing in the intelligence safeguard systems.

(1) Capabilities for the investigation of bomb damage results are inadequate. This type of situation was often given rise to. There was no way--with regard to targets which had been hit--to determine whether targets had been thoroughly destroyed, partially destroyed, or had been lightly damaged. In this way, there was then no way to accurately determine which targets needed continued bombing. At times, there was nothing else to do but carry out bombing of a target again, thus wasting personnel strength and munitions. As far as inadequacies of the capabilities to check on bombing damage results are concerned, they are explained by U.S. forces currently having various types of reconnaissance systems with powers of resolution which are still limited. In particular, this is the case in battlefield environments associated with bad weather conditions and full of dust.

(2) Real time intelligence capabilities are not adequate. During intense warfare, command personnel often cannot get real time intelligence. This is particularly the case in situations where the weather is comparatively bad--for example, 22-23 January. Because--in the Gulf War area--there were a lot of clouds and rain, there was a lack of real time intelligence support. The air raid activities of multinational units were blocked. A good number of fighters and bombers carried bombs or missiles back to base. From this, it can be seen that real time intelligence is an important constituent part of combat power. Losing real time intelligence is also losing combat power to a certain extent.

(3) Capabilities to identify camoflage are not adequate. Iraqi forces grabbed onto the weak points of reconnaissance satellites, making use of camoflage methods in order to disrupt multinational unit satellite reconnaissance and monitoring. It also made it difficult for multinational unit air forces to identify bombing targets as true or false. The camoflaged targets included dummy aircraft, dummy tanks, dummy missile launchers, dummy air force bases, and so on.

(4) Identification friend or foe capabilities were

inadequate. During the Gulf War, air combat and the ground war both presented problems of inadequacies in identification /33 friend or foe capabilities. Due to errors in identification friend or foe, there were large numbers of casualties created. This type of casualty was comparable in number to personnel who died from enemy fire. The problems were then even more striking. For example, the British First Armoured Division had a total of 17 casualties and 8 vehicles destroyed. However, among these, only 1 person died from enemy fire. All the other losses were created by friendly fire. Among the total number of U.S. force casualties, friendly fire created 35 killed and 72 wounded.

5 CONCLUDING REMARKS

Since the Second World War, over 160 local wars have already occurred in the world. With regard to a good number of nations including China, the possibilities of the outbreak of future local wars are very great and are the most direct threat. Electronic intelligence safeguard technologies and means during the Gulf War will achieve widespread utilization and development in local wars of the future. As a result, development of future electronic counter measure means should adequately study electronic intelligence assurance technologies and means during the Gulf War, using this level of electronic reconnaissance technology to act as the target for countermeasures, strengthening the establishment of electronic countermeasure units in Chinese forces.

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