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UNITED STATES SPACE COMMAND

OPERATIONS DESERT SHIELD AND DESERT STORM

ASSESSMENT

JANUARY 1992

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SECTION 1

PREFACE (U)

(U) This report details the contributions of space forces to Operations Desert Shield and Desert Storm. It deals with military space systems and selected civil and foreign systems that were used to support United States (U.S.) and Coalition forces. The time period covered by this study is 2 August 1990 to 9 March 1991. Where appropriate, references are made to activities outside these dates to complete or expand upon relevant information.

(U) Data for the study was compiled by United States Space Command (USSPACECOM), Army Space Command (USARSPACE), Naval Space Command (NAVSPACECOM), and Air Force Space Command (AFSPACECOM) personnel. Reviews of space operations and numerous interviews with personnel providing and receiving space support were conducted. To verify its validity and completeness, the briefing that contains the information, assessments, and recommendations that comprise the bulk of this assessment effort was reviewed with U.S. Central Command (USCENTCOM), U.S. Special Operations Command (USSOCOM), Joint Staff and personnel directly involved with Desert Shield/Storm operations.

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SECTION 2

INTRODUCTION (U)

(U) The war with Iraq was fought to free Kuwait of a brutal oppressor. It was fought by U.S. and Allied forces who were spread over vast territories, in a hostile environment, and against a well-entrenched enemy who had eight years of recent, large-scale combat experience to battle harden its forces.

(U) When U.S. forces deployed to Saudi Arabia, they had to bring much of the infrastructure that supports modern land, sea, and air operations with them. The standard support that military personnel require in the areas of communications, navigation, and weather was needed, but a new dimension of support was added--theater warning of tactical ballistic missile (TBM) attacks was a critical requirement.

(U) At the outset of the crisis, there was no established capability or infrastructure in the Persian Gulf to meet these needs. Much of the support U.S. forces needed was provided through the tailored exploitation of military and civil space systems. Operation Desert Storm was the Nation's first "space war" in that every aspect of military operations depended, to some degree, on the support provided by space systems and that all echelons, from commanders to individual soldiers, directly operated or interfaced with space systems.

(U) The United States entered the Persian Gulf War with satellite systems that had been used, but not highly stressed, in previous conflicts. During the successful military strike in Libya in 1986, space systems provided critical support to mission planning activities and dramatically enhanced air crew performance. When American forces were executing Operation Earnest Will in the Persian Gulf four years ago, U.S. and Allied commanders employed Global Positioning System (GPS) terminals on ships and helicopters during mine sweeping operations. During Operation Just Cause in Panama in 1989, military space systems provided extensive long-haul communication and critical weather support to U.S. forces. Each of these operations was limited in scope or duration, so only a portion of the U.S.'s military space capability was used. As a consequence, the vast military potential of space systems was not apparent.

(U) During Operations Desert Shield and Desert Storm, the U.S. military used space systems at an unprecedented level and solidly integrated space support into combat operations--their capabilities were exploited at Patriot batteries, in the foxhole, in the cockpit, and aboard almost every ship. Space systems supported every aspect of planning, control, and execution of the war with Iraq. Space support was immediately available for the Persian Gulf Crisis and will be first on the scene of future crises or campaigns.

SECTION 3

EXECUTIVE SUMMARY (U)

SPACE SUPPORT TO DESERT SHIELD AND DESERT STORM

(U) Space forces in Operations Desert Shield and Desert Storm and the people manning and maintaining them per-formed exceptionally well. Across the spectrum, they met the needs of U.S. land, sea, and air forces and, as is often the case, provided capabilities and support not envisioned when the systems were on the acquisition drawing boards, or during years of peacetime, unstressed operations.

(U) Space forces were there when required, but significant effort was needed to optimize their effectiveness. The alerting system that warned of SCUD attacks was essentially constructed from scratch after August 1990. The ground forces who initially deployed had only minimal access to the United States' most effective means of navigation, the Global Positioning System (GPS) and remained so until the U.S. Army used the delay in the war's start to procure and distribute thousands of commercial GPS receivers. Deployed forces received weather data broadcast by satellites and used maps produced from spaceborne platforms. These and other experiences indicate that, in the future, operations plans (OPLANs) and Joint Staff directives must carefully consider the handling and use of space-derived information and support. The benefits of space must become ingrained in joint planning and, more importantly, practiced in exercises at the national, theater, and unit levels.

[redacted] The integration of space-based warning and Patriot anti-tactical ballistic missile (ATBM) fire was one of the great success stories of the war. Space-based and ground-based sensors (Defense Support Program (DSP) satellites and Pirinclik radar) provided TBM warning. This capability was achieved through a reconfiguration of systems designed for strategic warning. DSP was not designed to meet the tactical mission and was operating at the limit of its detection capability.

[redacted] The theater of operations was nearly perfect for DSP detection of tactical ballistic missiles.

[redacted]

[redacted] To ensure that U.S. forces will always have the level of protection and warning provided [redacted]ith Iraq, the Follow-on Early Warning System (FEWS) is needed to remedy current DSP deficiencies for both strategic and tactical missile warning missions.

[redacted] In addition to warning, the elimination of mobile-SCUD launchers was a top priority and one of the most difficult tasks of the war. USSPACECOM provided launch locations identified by DSP, allowing U.S. Central Command (USCENTCOM) to vector strike aircraft to attack mobile-SCUD launchers.

(U) Use of space-based navigation and positioning was an unqualified success. The Global Positioning System (GPS) was widely used by U.S. and Allied land, sea, and air forces. From simple land navigation to aerial bombardment, GPS played a major role in achieving mission success. When Iraq invaded Kuwait, the U.S. military did not have enough GPS receivers to meet the needs of the forces that deployed to the Persian Gulf. This necessitated the purchase of thousands of commercial GPS receivers. Because of the dependence of U.S. and Coalition forces on these commercial receivers, the Selective Availability (SA) feature of GPS, which denies highly precise data to non-authorized users, remained off for all of Desert Shield and Desert Storm. Fortunately, our adversary was not able to exploit GPS; however, in future conflicts we will probably face enemies capable of exploiting this very critical system. Therefore, the Commander in Chief, United States Space Command (USCINCSPACE) and the other CINCs and services support the current national policy to preserve highly precise GPS data for authorized users (i.e., leave SA on).

(U) Satellite communication (SATCOM) was the backbone for long-haul and intra-theater connectivity for Desert Shield and Desert Storm. Over 90% of communication into and out of the theater went over communication satellites (COMSATs), with 24% of this traffic being carried by commercial satellites. There were over ten different military and commercial satellite communication systems supporting USCENTCOM operations--with almost as many managers. The system worked well, but experience highlights the need for stronger involvement by a central authority in allocating scarce space communication assets. The proposed Chairman Memorandum of Policy (CMOP) 37 now in staffing provides an opportunity to make needed improvements.

(U) The principal means of acquiring weather data over Iraq was through the Defense Meteorological Satellite Program (DMSP) and civil weather satellites. Weather data and imagery were broadcast directly to U.S. forces and used in all facets of military operations.

(U) The military utility of multi-spectral imagery (MSI) was clearly demonstrated during Desert Shield and Desert Storm. Many of the maps that U.S. forces carried with them of Kuwait City and the area of operations (AO) were made from MSI products. The planning and execution of strike operations were often dependent on MSI data provided by the U.S. commercial LANDSAT spacecraft and its French counterpart,

[redacted]

SPOT (Satellite Probatoire d'Observation de la Terre (Exploratory Satellite for Earth Observation)). Although MSI data proved to be invaluable, the continued existence of the U.S. LANDSAT system is in doubt since operations and maintenance costs are funded on an ad hoc basis and the availability of replacement satellites for the currently aging LANDSAT vehicles is questionable.

(U) The lack of a robust U.S. space launch capability was demonstrated during the war when a request for an early launch of a communications satellite could not be considered because of the lack of an intermediate booster--The U.S. has a launch-on-schedule, not launch-on-demand capability. Work on developing reactive launch systems must continue, and the U.S.'s expendable launch vehicle (ELV) capability must be improved.

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SECTION 4.1

SPACE SYSTEMS (U)

(U) USSPACECOM entered the Persian Gulf Crisis with the satellite systems identified in Figure 4-1 under its Combatant Command (COCOM). These space systems provided warning, communications, navigation and positioning, and weather support to U.S. and Allied forces.

(U) Warning data on SCUD TBM launches was provided by Defense Support Program (DSP) satellites. The DSP satellite identifies ballistic missile or space launches by detecting the infrared (IR) signature of a rocket in powered flight. These satellites are in geosynchronous (i.e., 24 hour orbit). 1

(U) Satellite communications support was provided by the Fleet Satellite (FLTSAT) Communications System (FLTSATCOM), Defense Satellite Communications System (DSCS), and the Air Force Satellite Communications System (AFSATCOM).

(U) FLTSATCOM is primarily a Navy system, but it provides critical tactical communications support to Army, Navy, Air Force, and other DOD agencies. It uses ultra-high frequency (UHF) and super-high frequency (SHF) uplinks and UHF downlink. 2

(S) The space segment of DSCS consists of satellites in geostationary orbits. Its payload is managed by the Defense Information Systems Agency (DISA). (Defense Communications Agency (DCA) became the Defense Information Systems Agency (DISA) on 1 September 1991.) It provides direct point-to-point, strategic, long-haul communications via SHF links. DSCS provides connectivity for command and control (C^2), b(1) ..., and diplomatic traffic. The DSCS constellation consists of DSCS II and DSCS III satellites.

b(1)

(S) DSCS network control for strategic and Ground Mobile Force (GMF) use is the responsibility of Army Space Command (USARSPACE). This mission is accomplished by five DSCS Operations Centers and three GMF Control Centers, located worldwide. USARSPACE also operates Regional Space Support Centers (RSSCs) in Europe, the Pacific, and CONUS that provide payload and network planning for GMF users in support of Unified and Specified CINCs.

(S) AFSAT provides strategic military communications. It consists of packages that are carried on other satellite programs b(1)

b(1)

b(1)

(U) Weather data was provided by the Defense Meteorological Satellite Program (DMSP) and civil meteorological satellites. DMSP satellites are in 833 kilometer (km),

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[redacted] DSCS network control for strategic and Ground Mobile Force (GMF) use is the responsibility of Army Space Command (USARSPACE). [redacted]

[redacted] AFSAT provides strategic military communications. [redacted] These satellites are in either geostationary, inclined, or highly elliptical orbits. [4]

(U) Weather data was provided by the Defense Meteorological Satellite Program (DMSP) and civil meteorological satellites. DMSP satellites are in 833 kilometer (km),

[redacted]

sun-synchronous orbits and provide direct readout of local weather data (visual and IR cloud cover imagery) to fixed and mobile terminals. It also provides recorded data playbacks of visual, IR, and other specialized meteorological data to the Air Force Global Weather Central and the Fleet-Numerical Oceanography Center. The U.S. National Oceanographic and Atmospheric Administration (NOAA) and TIROS, European METEOSAT, Soviet METEOR, and Japanese GMS civil satellites provide weather imagery (readouts from these satellites can be received by most DMSP fixed and mobile terminals or commercial weather receivers). [5]

(U) Navigation and positioning data was provided by the Global Positioning System (GPS) and the Navy Navigation Satellite System/TRANSIT.

(U) GPS is a radio-navigation system that provides highly precise, worldwide, three-dimensional position, velocity, and timing data. GPS satellites operate in inclined, semi-synchronous (i.e., 12 hour orbits). At the current time, GPS is still being deployed. When fully operational (1993), it will consist of a constellation of satellites that will provide continuous three dimensional, worldwide coverage. [6]

[redacted] TRANSIT provides two dimensional position information to surface ships and fleet ballistic missile submarines. It consists of satellites in polar orbits. [7] (Note. GPS will replace TRANSIT.)

[redacted] In addition to the satellites that USCINCSPACE has COCOM over, U.S. and Coalition forces used commercial communications and civil or foreign weather satellites, intelligence satellites, and the U.S. LANDSAT and French SPOT multi-spectral imagery satellites.

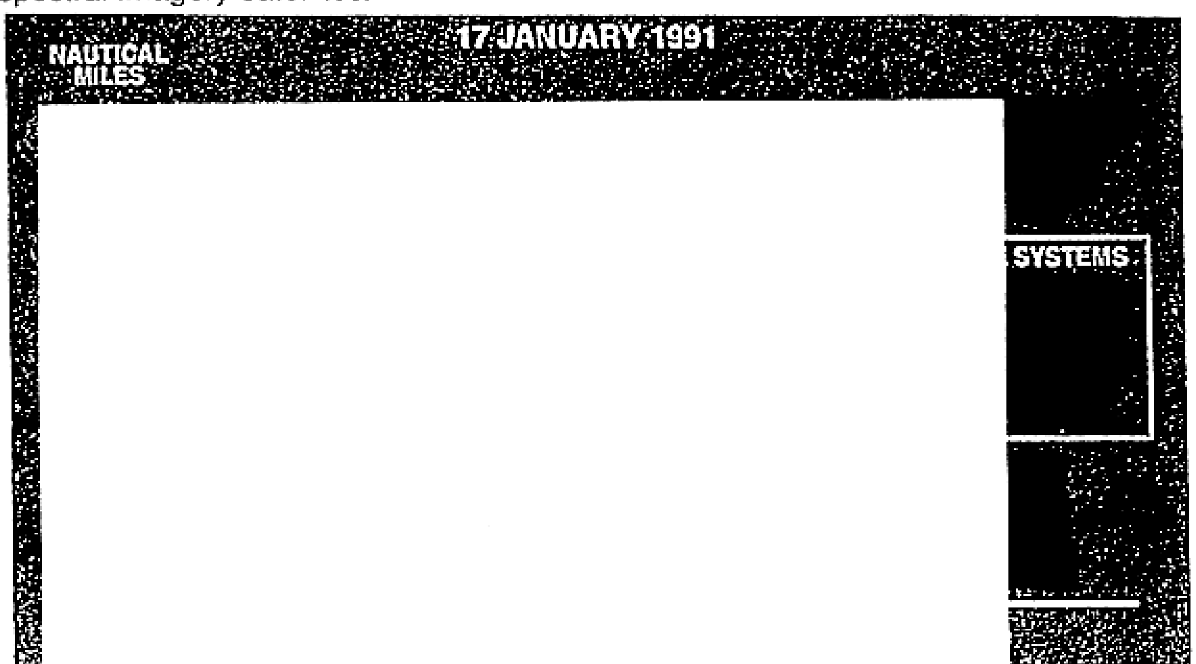

FIGURE CLASSIFIED [redacted]

Figure 4-1, USSPACECOM ORDER OF BATTLE (U)

[redacted]

SECTION 4.2

AREA OF OPERATIONS (U)

(U) Kuwait itself is rather small (see figure 4-2). Driving on a highway, you can cover the entire north-south distance of the country within two hours. But the entire area of operations is immense. An F117 taking off from Kamis Mushat in southern Saudi Arabia on a bombing run to Baghdad had to fly over one thousand miles, an equivalent distance from Colorado Springs to Chicago. U.S. and Coalition forces were stationed throughout Saudi Arabia and the surrounding countries, the Persian Gulf, Red Sea, and Indian Ocean. U.S. forces also operated from bases in Turkey, England, Diego Garcia, and thousands of soldiers, sailors, and airmen provided support throughout from continental United States (CONUS) and numerous overseas locations. [1]

(U) This was an immense theater of operations that was roughly equivalent in size to half the continental United States. Conducting military operations over this vast area demanded extraordinary efforts, and space systems played critical parts in every facet of Desert Shield and Desert Storm operations.

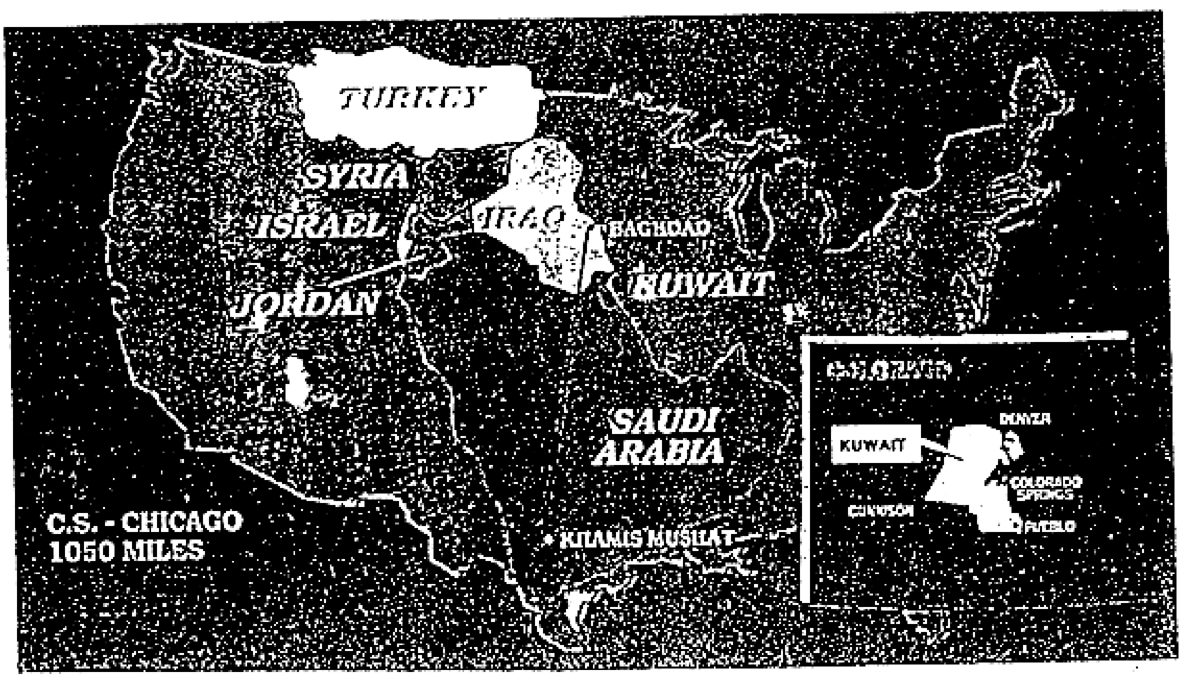

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Figure 4-2, AREA OF OPERATIONS (U)

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SECTION 5

SPACE SUPPORT (U)

[redacted] To assess the effectiveness of space support, specific areas of satellite operations were chosen that impacted U.S. operations during the Persian Gulf War. These areas were: tactical ballistic missile (TBM) warning, navigation and positioning, weather, multi-spectral imagery, satellite communications, and intelligence. Each of these areas was assessed by developing a timeline, identifying specific support elements, reporting strong and weak points, and finally drawing overall assessments of space support. In conducting these reviews, the primary emphasis was on USSPACECOM systems. Where appropriate, references are made to non-USSPACECOM systems (e.g., in the Weather Section, civil meteorological satellite support is addressed). The performance of U.S. intelligence satellites was not addressed in these reviews.

[redacted] Many of the review areas were interrelated (e.g., SCUD missile warning and the targeting of mobil-SCUD launchers are treated in both the TBM warning and intelligence review areas). Additionally, background material was included to present a complete picture of space operations.

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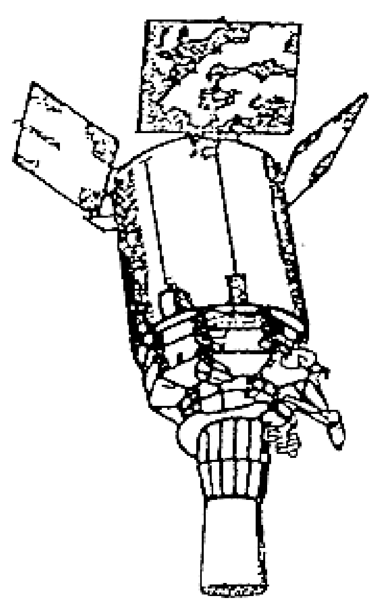
SECTION 5.1

TACTICAL BALLISTIC MISSILE WARNING (U)

DSP



[redacted]USSPACECOM used Defense Support Program (DSP) satellites and the Pirinclik space surveillance radar to alert U.S. and Coalition forces of Iraqi SCUD missile attacks. They provided an edge that allowed U.S. and Coalition forces to don chemical-protection suits and take defensive action. This also allowed USCINCCENT to alert Coalition members of attacks so that the civilian populace could take shelter. U.S. Space Command and Air Force Space Command operations crews, located half a world away, were uniquely close to the combatants. Daily on the television news, they heard the alert sirens sound and saw the Patriot missiles streaking into the skies to intercept attacking SCUDs. The Patriots used the warning provided by USSPACECOM to cue their batteries and make every shot count. The warning provided by Space Command crews was a critical factor in protecting American and Allied lives during the course of this conflict.

TIMELINE (U)

DATE	EVENT
2 August 1990	Iraq invades Kuwait. USCENTCOM has access to TBM warning
7 August	U.S. Forces deploy to Saudi Arabia
7 August	USCENTCOM voice-warning net (for SCUD alerts) proposed (this voice-warning net was known as the Commander in Chief United States Central Command (USCINCCENT) Execution Net)
9 August	Initiative begun by USSPACECOM and Component Commands to identify the location and potential distribution of terminals (i.e., Constant Source terminals) capable of receiving and processing TBM warning data--TERS
9 August	Pirinclik SPACETRACK radar was placed into a missile warning mode to detect and report Iraqi SCUD launches
10 August	USSPACECOM team sent to USCENTCOM (Rear), MacDill AFB, to coordinate space support for Desert Shield
13 August	USARSPACE conducts Constant Source terminal training in Europe and supervises the deployment of terminals to the AO [redacted]

14	August	Voice warning active--USSPACECOM Space Command Center (SPACC) implements voice warning procedures (USCINCCENT's Execution Net now connected to USSPACECOM)
27	August	Constant Source terminal is operational at the U.S. Air Forces, U.S Central Command (CENTAF) Control and Reporting Center (CRC), Dhahran, Saudi Arabia
8	September	DSP ground sites enhanced to provide better TBM warning
10	October	[redacted]
19	October	Offer to USCINCCENT to put computer TBM warning (TERS) over DSCS
13	November	USCINCCENT declined TERS-over-DSCS offer
13	November	[redacted]
27	November	
2	December	Iraq launches three SCUD missiles (test)
13	December	[redacted]
26	December	Iraq launches SCUD missile (test)
27	December	USSPACECOM team travels to Saudi Arabia to work problems in receipt of TBM-TERS warning data
28	December	Iraq launches SCUD missile (test)
15	January	SPACC warning displays updated
16	January	Desert Storm begins-[redacted]
17	January	USCENTCOM concurs with changes to voice alert warning messages
17	January	First SCUD attack
21	January	Pirinclik's search pattern modified
23	January	[redacted]
31	January	
1	February	Redundant communications initiated (contingency bent pipe) to guard against loss of access to [redacted] DSP satellite. [redacted]
24	February	Ground war begins
25	February	Last SCUD attack
27	February	Ground war is over
9	March	[redacted]

TIMELINE CLASSIFIED [redacted]

SEQUENCE OF EVENTS (U)

[redacted] On 2 August 1990, Iraq invaded Kuwait. Warning data of SCUD attacks was available to U.S. forces in the area of operations (AO) via the Tactical Event Reporting System (TERS). At that time USCENTCOM (Rear), MacDill AFB, Florida, and U.S.

naval units equipped with the Tactical Receive Equipment (TRE) on the TRE Related Applications (TRAP) system could receive TERS alerts. [1]

[redacted] U.S. force deployments to Saudi Arabia began on 7 August. In support of these forces, the Strategic Air Command (SAC) Liaison Officer at USCENTCOM (Rear) helped USCENTCOM personnel identify a method of disseminating warning of SCUD attacks by broadcasting voice alerts over an existing USCENTCOM communications network (USCINCCENT Execution Net). [2]

[redacted] On 9 August, USSPACECOM and Component Space Command personnel began an initiative to find computer terminals capable of receiving and displaying TERS messages (Constant Source-type terminals). This group also prepared a recommended distribution plan to optimize the effectiveness of these terminals. A USARSPACE representative deployed to Europe and worked with U.S. Army Europe (USAREUR) and U.S. Air Force Europe (USAFE) to orchestrate the training of operators and deployment of Constant Source terminals to the area of operations. By the end of August, six Constant Source terminals were distributed to the CRC and U.S. Air Force wings. [3]

[redacted] Between 2-9 August, negotiations were conducted between USSPACECOM and the Turkish General Staff to utilize the Pirinclik radar to cover and track potential missile launches from Iraq. [redacted] Intensive efforts were undertaken to develop operational procedures at Pirinclik to optimize the radar's missile detection capabilities. [redacted]

[redacted] On 10 August, a USSPACECOM team traveled to USCENTCOM (Rear) to explain the TBM warning process, the use of the Constant Source (TERS) computer warning system, and the enhancements Iraq had made to SCUD missiles to extend their range. The USSPACECOM team and USCENTCOM personnel prepared the TBM voice-warning broadcast format and completed the architecture for a tactical missile voice-warning net. These actions resulted in the connection of USCINCCENT's Execution Net to USSPACECOM and precipitated USCINCCENT's support of deploying Constant Source terminals. [2]

(U) Constant Source terminals began arriving in Saudi Arabia on 17 August. [4] Deployment and training needs for Constant Source-type terminals were addressed by both Air Force and Army Space Commands. Some of the terminals had to be retrofitted with software upgrades to enable the receipt and processing of TERS alerts. Training also had to be given to several units that were not familiar with these terminals or their functions. [5]

[redacted] By 8 September, DSP ground sites were enhanced to provide better SCUD warning [redacted] [Note. Negotiations were conducted between the Government of Australia (GOA) and USSPACECOM to support GOA requirements for notification to the Minister of Defense upon implementation of these procedures at Woomera, Australia. (The DSP large processing station at Woomera is jointly manned with Australians. Operation of the site is subject to United States and Australian agreement.) New procedures were established for the SPACC to notify the GOA when a specific SCUD warning operation was implemented.] [redacted]

[redacted] On 19 October, an offer was made to USCINCCENT to place the TERS alerts over DSCS, in addition to the existing FLTSATCOM net. This would get warning data to Saudi Arabia faster and provide greater security [redacted] On 13 November, USCENTCOM declined the TERS-on-DSCS offer [redacted]

[redacted] On 27 November, the DSP ground site software was enhanced [redacted]

[redacted] The Iraqis launched test SCUD missiles on 2, 26, and 28 December.

[redacted] On 27 December, a USSPACECOM team went to Saudi Arabia to assist USCENTCOM personnel in an investigation of problems with the Constant Source terminal located at the CRC. This terminal was receiving SCUD alerts ten minutes after other terminals. (Note. On 4 December, a USARSPACE representative in Dhahran reported that the CRC was receiving TERS alerts 10-15 minutes after launch. USARSPACE briefed USSPACECOM on this on 13 December.) Because of this, some USCENTCOM personnel questioned the reliability of the entire warning process. A problem with the software in this one terminal was found and fixed while the USSPACECOM team also worked with USCENTCOM personnel to refine the SCUD warning process. (Initial procedures called for launch and impact points to be reported in latitude and longitude. Deployed troops found the conversion of latitude and longitude to threat areas to be too time-consuming, and USSPACECOM subsequently passed launch point and azimuth from DSP and impact points in easily understood forms--for DSP: "Launch from southern Iraq, areas at risk are Dhahran and Bahrain;" for Pirinclik: "Launch from southern Iraq, area at risk is ten miles north of

[redacted]

King Khalid Military City."). [12,22] As a result of the review of existing procedures, a complete revision was made to USSPACECOM's SCUD warning process. This resulted in a simplified procedure (using general launch areas and areas at risk) that provided more timely and meaningful warning information. An end-to-end test of the warning system (from DSP Data Distribution Center to TRAP receivers) was also conducted during this visit. This test showed that the warning system worked effectively and identified areas where USCENTCOM could improve operations. [11]

(U) On the 15th of January 1991, SPACC Theater Display Terminal displays (originally for Europe only) were expanded to show the Middle East. [10]

[redacted]

[redacted] By the 17th, USCENTCOM had concurred with new warning procedures which identified cities as well as general areas which were coming under missile attack. [12] The first SCUD attack came later that day with Israel as the target.

[redacted] every available piece of equipment and operator, not performing strategic warning, was detailed to the tactical warning mission. [redacted] This procedure reduced the risk of a catastrophic equipment failure at DSP ground sites during a SCUD attack. [9]

[redacted] USCINCSPACE approved positioning the satellite in a location that would enhance USSPACECOM's ability to detect Iraqi SCUD launches. [redacted]

[redacted]

[redacted]

[redacted] The ground war began on the 24th of February, the last SCUD attack occurred on the 25th, and the ground war was over on the 27th. [redacted]

TACTICAL BALLISTIC MISSILE THREAT (U)

[redacted] Iraq possessed the SCUD TBM. The basic SCUD-B has a [redacted] warhead and a range of about [redacted] Iraq modified this missile and produced a variant called the "AL HUSSEIN" which had a [redacted] warhead and a range of [redacted]. (Note. Throughout the time this report was compiled, the identification of the Iraqi SCUD changed between "AL ABBAS" and "AL HUSSEIN.") [15]

[redacted] A comparison between an intercontinental ballistic missile (ICBM), the type of missile DSP was designed to detect, and a SCUD is shown on Figure 5-1. The infrared (IR) intensity of the rocket exhaust must be above a minimum level for DSP to detect the missile. [redacted]

[redacted] The basic SCUD is at the edge of the detection capability of DSP [redacted] However the Iraqis actually employed their modified version of the SCUD, the "AL HUSSEIN," [redacted]

[redacted]

[redacted] The space surveillance radar located at Pirinclik, Turkey, also provided SCUD warning. This radar provided a totally independent method of providing warning and unique data that was beyond the capability of DSP. While DSP provided launch coordinates and azimuth, predicted impact coordinates were provided by Pirinclik. These impact locations from Pirinclik were tailored, at USCENTCOM's request, to ensure only threatened ground forces donned chemical suits. [22]

[redacted] The reason this reaction time was so important was that the Patriot antitactical ballistic missiles (ATBMs) were dependant on cuing of SCUD launches identified by DSP or Pirinclik. [redacted]

[redacted]

FIGURE [redacted]

Figure 5-1 BALLISTIC MISSILE PROFILES (U)

[redacted] Additionally, this warning gave USCENTCOM personnel time to take protective measures and notify Coalition civil authorities that an attack was under way. 15

TACTICAL BALLISTIC MISSILE WARNING SYSTEM (U)

[redacted] TBM warning was provided to USCENTCOM via separate voice and computer networks (see Figures 5-2 and 5-3). Voice warning was broadcast to USCENTCOM Headquarters units and subsequently rebroadcast to subordinate units. The voice warning also went to Pirinclik and Incirlik Air Base in Turkey and to the Patriot units through their battalion and brigade headquarters. The computer or TERS alert was available to anyone who had one of the 57 Constant Source-type receiver (Army (Success Radio), Naval (TRE), and Air Force (Constant Source)) and had configured this receiver to display TERS alerts. These two networks provided redundant alerts that went to multiple agencies throughout the AO. They were mutually supportive and ensured TBM warning got through to the maximum number of U.S. personnel. 11

(U) USCENTCOM passed warning to Coalition forces, while the NCA provided warning to Israel, and U.S. European Command (EUCOM) provided warning to the Turkish Government and U.S. forces in Turkey. Finally, strategic warning was simultaneously performed for the North American Continent throughout the war. 10

[redacted] The following was the sequence of events for voice alerting of a SCUD attack (see Figure 5-2): DSP satellites detected the IR signature of a SCUD launch. The AFSPACECOM crew on duty at a DSP site sent an initial launch alert message to the USSPACECOM Space Command Center (SPACC) located at Peterson AFB, Colorado, and the Missile Warning Center (MWC) located at Cheyenne Mountain AFB, Colorado. [10] The SPACC crew immediately activated the USCINCCENT Execution Net and relayed a SCUD alert. Once DSP had gathered enough data and the MWC had validated the launch, a confirmation or denial message was sent to the SPACC. For actual SCUD attacks, the SPACC crew broadcast a SCUD launch confirmation message and identified the area under attack. If the initial alert was false, the SPACC promptly broadcast a cancellation message. When Pirinclik tracked the SCUD, the Pirinclik crew came up on the Execution Net and passed confirmation information and impact point predictions. As the SCUD alert was being completed, the USSPACECOM Consolidated Intelligence and Warning (CIW) Center contacted USCENTCOM intelligence personnel on a separate line to pass specific launch coordinates. (Note. Launch coordinate information was passed over a different communications line (see section 5.6) to free the SPACC's line for other SCUD launch alerts.) [12]

[redacted] Simultaneously with the voice confirmation message, the TERS launch report was formatted and dispatched over the TRAP System and the Joint Operation Tactical System (JOTS) (see Figure 5-3). The same information that was displayed on a missile launch confirmation message was converted into a TRAP or JOTS compatible format and transmitted. [17] [redacted]

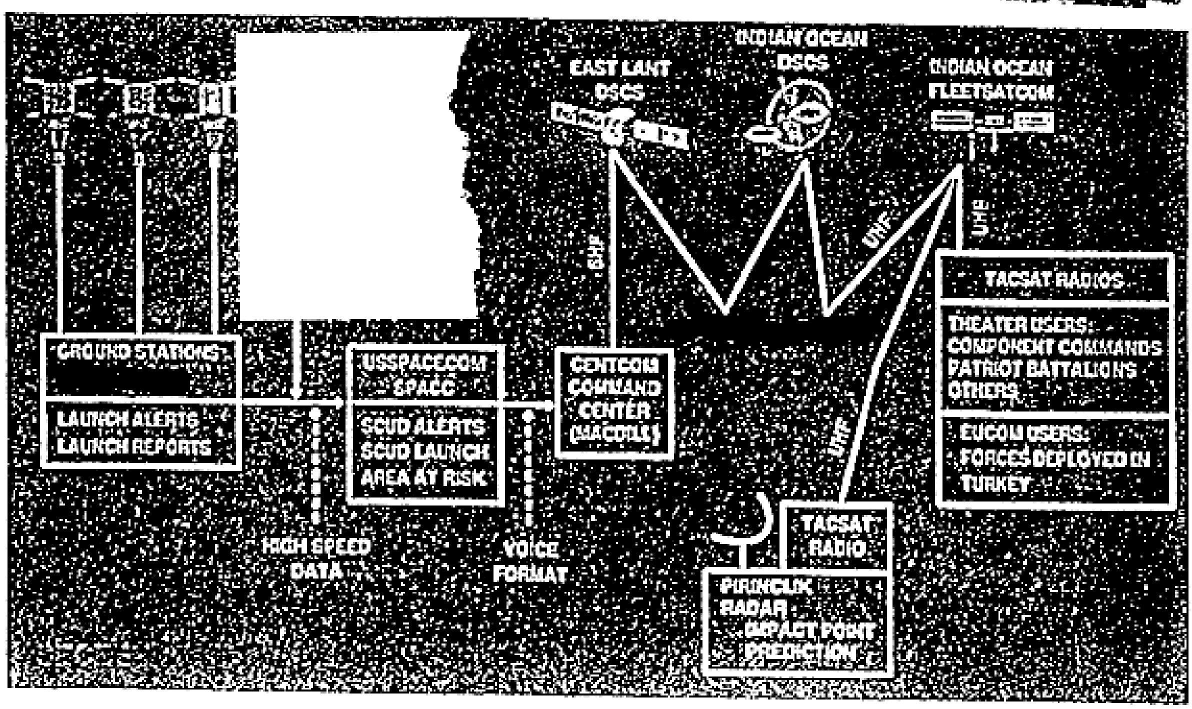


FIGURE [redacted]

Figure 5-2 TACTICAL MISSILE VOICE WARNING NET (U)

[redacted]

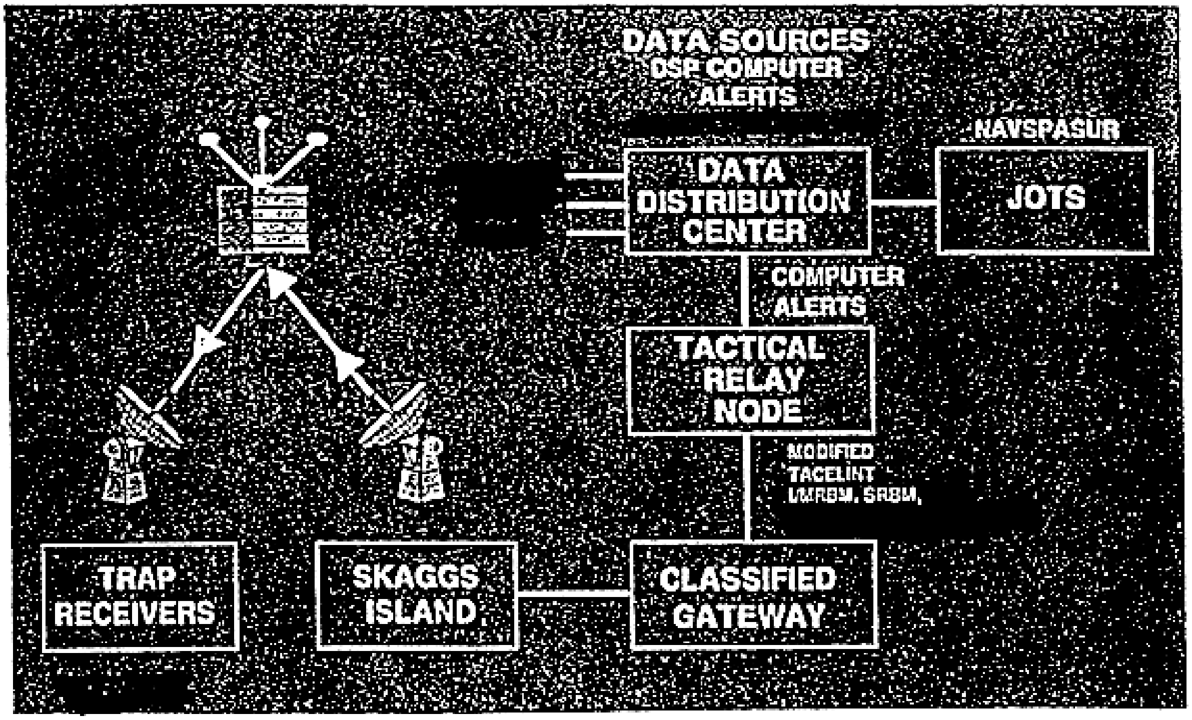


Figure 5-3 TERS ARCHITECTURE (U) [redacted]

[redacted]

LAUNCH - Zulu time the SCUD was launched.
VOICE - time the SCUD telephonic alert was initiated.
TERS - time that the TERS alert was received.
PIRINCLIK - time Pirinclik released a launch and impact message.
SPACECOM WARNING - time from lift off to receipt of voice warning.
CENTCOM REACTION - time available before SCUD impacts to initiate defensive measures.

Note. Test launches impacted in western Iraq. [redacted]

[redacted]

[redacted] The reason for this was the time DSP needed to confirm the launch and the transmission time for a TERS message. Additionally, TERS alerts are generated for each DSP site that detects a launch. Therefore, for a single SCUD launch, there could be multiple TERS launch messages.) [3]

TACTICAL BALLISTIC MISSILE WARNING PERFORMANCE (U)

[redacted] The TBM warning provided to USCENTCOM forces for the test SCUD launches in December 1990 is listed at Table 5-1. U.S. forces used this as a training exercise to identify those areas where warning was working well and where it could be improved. [redacted]

[redacted]

[redacted] USSPACECOM reviewed the lessons learned from the Iraqi test launches with USCENTCOM. USCENTCOM was adamant; they wanted warning, even if it meant that a false message would be periodically received. This required a modification of longstanding strategic procedures to allow USSPACECOM to specifically support a tactical commander. Although strategic procedures were not impacted, new procedures for SCUD launches from Iraq had to be developed, emphasizing speed as well as accuracy. Because of the short flight time of SCUD missiles [redacted] the absolute earliest warning was paramount. [redacted] USCINCCENT was willing to accept some false reports. For the strategic mission, however, false alerts are not acceptable, and absolute credibility was maintained for the strategic mission throughout the war.

[redacted] To meet this need, AFSPACECOM and USSPACECOM personnel modified procedures and trained to meet USCENTCOM's warning needs. [redacted] SPACC crews also stressed the importance of forwarding every possible launch to USCENTCOM. The tactical warning system was streamlined and improved on a near-daily basis. [redacted]

[redacted] All of these efforts paid off when Desert Storm began (see Table 5-2). [redacted] When U.S. forces were actually under attack, this was normally the minimum time available to take defensive actions. (See the appendix for a full list of SCUD attack timelines.) Due to the work on procedures and training by USSPACECOM, USCENTCOM, and AFSPACECOM, a good warning system was converted into a highly effective operation that met the needs of U.S. forces. The keys were developing straight-forward procedures with USCENTCOM and then taking advantage of opportunities to improve them. [10]

[redacted] During the war, USSPACECOM detected and reported [redacted] events (see Table 5-3), some of which were multiple [redacted] launches. [redacted]

[redacted]

[redacted] During the war, [redacted] "SCUD alerts" were called into theater. As the war progressed, DSP crews could tell when an alert was probably caused by something other than a SCUD. [redacted] Following the agreed-to procedure, every potential SCUD attack was called into theater. [redacted] Then, the SPACC would confirm an attack and pass probable target information or cancel the alert. [10]

[redacted] The tactical warning system employed during the Persian Gulf War was an outstanding success, but it had its risks. The time to make decisions for a SCUD alert

TABLE 5-2 SCUD ALERT TIMES, DESERT STORM (U)

DATE	TARGET	LAUNCH	VOICE	TERS	PIRINCLIK	SPACECOM WARNING	CENTCOM REACTION
[redacted]							

* Warning to Israel provided by the National Command Authority (NCA)

[redacted]

TABLE [redacted]

Table 5-3 OVERALL TACTICAL WARNING PERFORMANCE (U)

ACTIVITY	NUMBER	AVERAGE TIME
SCUD EVENTS	[redacted]	[redacted]
DSP ALERTS		
-- VOICE ALERTS		
-- CENTCOM REACTION		
DSP CONFIRMATIONS (TERS)*		
PIRINCLIK ALERTS*		
TOTAL VOICE ALERTS		--

Note. Only Alerts confirmed by DSP were transmitted by TERS.
Pirinclik recorded [redacted] detections and [redacted] of these were probably SCUDs.

TABLE [redacted]

was very limited [redacted] This action resulted in a tightening of procedures and updates to checklists that proved very effective when the war began.[1]

TACTICAL BALLISTIC MISSILE WARNING ASSESSMENT (U)

(U) The TBM warning process set up by USSPACECOM and USCENTCOM forces worked exceptionally well, but it took months to mature into the finely tuned system that exceeded all expectations during the war.

[redacted] New procedures were initiated or significantly modified to meet TBM warning requirements. [redacted] Additionally, the Pirinclik radar was effectively tracking [redacted] missiles; but before alerts from this USSPACECOM radar could be broadcast into theater, Pirinclik had to be added to the USCINCCENT's Execution Net. The use of DSP and Pirinclik in this mode also necessitated coordination with host foreign governments to enable warning data to be gathered and relayed.

(U) The SPACC was the center for issuing SCUD alerts. Prior to Desert Shield, the MWC (located in the North American Aerospace Defense Command (NORAD) Cheyenne Mountain Complex, Colorado) was the primary focus for all ballistic missile alerts. The decision to initiate warning from the SPACC, instead of the MWC, was made to preserve the MWC's strategic responsibility to provide warning of ICBM/SLBM attacks against North America. The MWC did, however, act as a backup to the SPACC and was fully capable of performing the same function, if necessary.[19]

(U) Warning was also being received by numerous organizations and relayed throughout Saudi Arabia. Both USSPACECOM and USCENTCOM personnel had to learn to work together and be exceptionally effective in relaying and acting on TBM alert data. All command centers went through a growth process where they adjusted procedures, checklists, and mission aids to meet the interrelated needs of supporting and supported CINCs.

[redacted] Constant Source-type terminals were employed to receive TBM alert data. These terminals were relatively new devices, and TERS was a system that had only been operational since late July 1990. These terminals and TERS were pressed into service. The Constant Source-type terminals had previously been used primarily for intelligence tasks. Now they were being used for operational TBM warning--a process that demanded unprecedented cooperation between operations and intelligence personnel and the possible relocation of these terminals to operations centers. Training for operating these terminals had to be provided to Army and Air Force personnel when they did not have experience with these terminals. Additionally, software problems had to be found and corrected.

[redacted] Patriot interceptor missiles became dependent on cuing data from missile warning sensors. This placed additional time constraints on warning data, and getting this data to the theater and distributing it in near-real-time was an absolute necessity. This stressed USSPACECOM and USCENTCOM forces and communications links. All had to work flawlessly.

(U) Provisions for reacting to SCUD attacks did not exist in August 1990. The space annex to USCENTCOM's Operations Plan (USCINCCENT OPLAN 1002-90, DRAFT) stated that "USSPACECOM will provide normal space support: warning, navigation and positioning, mapping, ...". This annex did not say the U.S. Space Command would provide warning in two modes, voice and computer. It didn't say that the warning would be used to cue Patriot batteries. Additionally, nowhere in the OPLAN did it say USCENTCOM would be able to receive, process, display, distribute and react to warning data. (Note. When USCENTCOM tested their portion of the SCUD alert system in Saudi Arabia in late December 1990 and early January 1991, they found that it took up to 40 minutes to get warning out to subordinate units. [18])

[redacted] In July 1991, USCENTCOM conducted a semi-annual exercise, Exercise Internal Look 90, during which USCENTCOM tested a new OPLAN for Southwest Asia and the Iraqi contingency. USSPACECOM supported this exercise by passing simulated voice ballistic missile warning messages from the SPACC to the USCENTCOM Command Center via STU III telephones. Additionally, a USSPACECOM Missile Warning Systems Staff Officer and a Plans Officer were at USCENTCOM during the exercise and briefed the TBM Warning/TERS cuing capabilities for Patriot operations (Note. This was briefed to USCINCCENT by ARCENT's ADA Brigade Commander later in the day). When Operation Desert Shield commenced, TERS was available to USCENTCOM, but could only be received at a few TRAP and JOTS receivers. Since the tactical receive equipment to display TERS data was service prototype systems, theater-specific concepts to provide further warning to subordinate elemants had not yet been developed. A joint USSPACECOM-USCENTCOM team developed the voice warning process from scratch to supplement the TERS on TRAP and JOTS systems. This voice warning system was improved and adjusted after the Iraqi test SCUD launches showed its strong and weak points. During Operation Desert Storm, SCUD warning information transmitted over the USCINCCENT Execution Net was tailored to maximize support provided to U.S. forces in the region.

[redacted] DSP's performance was clearly much better than expected. [redacted] Finally, there were sufficient ground site and command center crew personnel to man all the positions and meet both strategic and tactical warning needs. [redacted]

[redacted] Pirinclik also performed better than expected. [redacted] Everything worked for this effort--we weren't looking into hills, another radar, or base facilities--and Pirinclik was able to provide warning and impact predictions for the SCUD attacks. [redacted]

[redacted] Operational procedures were changed to meet USCENTCOM's alert requirements and the evolving needs to locate TBM mobile launchers. [redacted] and equipment was relocated to back up vulnerable DSP ground sites. All of these actions could have impacted USCINCSPACE's strategic mission and required approval before they were implemented. The centralized control that USCINCSPACE exercised over the warning systems allowed General Kutyna to rapidly assess recommendations and impacts and approve changes to meet the evolving SCUD threat.[20]

[redacted] USSPACECOM warning capabilities must be improved, or warning support could be limited in future conflicts [redacted]

(U) Future warning sensors must be able to better discriminate between multiple launches and provide more accurate information on impact points. The Follow-On Early Warning System (FEWS) is needed to overcome these limitations and assure U.S. forces the same level of warning support provided in the war with Iraq.

(U) Backups to vulnerable ground sites must be prepositioned. With all the stops pulled out and half of the equipment already in place, the backup-bentpipe at Ascension Island took 45 days to become operational.[14]

(U) A dedicated tactical warning capability is needed. USSPACECOM must be able to simultaneously meet its strategic and tactical warning requirements

(S/NF) Pirinclik also performed better than expected. First, it was an extraordinary set of circumstances that a radar, which was constructed to monitor the Soviet Kapustin Yar Launch Complex, would meet the needs of a war fought over 20 years after it was placed in operation (Note. The use of this radar to report SCUDs had to be approved by the Turkish Government). The SCUDs were also launched in the best possible location for this radar to track them. If they had been launched further north towards Turkey, they might have been within Pirinclik's minimum detection range (about 180 nautical miles). If the launches to Saudi Arabia had been with the standard SCUD-B, they would not have gotten high enough in altitude for Pirinclik to acquire them. When the first SCUDs were launched at Saudi Arabia (20 January 1991, see Table 5-2), they were not tracked by Pirinclik. The elevation, azimuth, and range parameters of the radar beam were changed, and the SCUDs were successfully tracked. Everything worked for this effort--we weren't looking into hills, another radar, or base facilities--and Pirinclik was able to provide warning and impact predictions for the SCUD attacks. In addition, early in the conflict, the Pirinclik radar was jammed by friendly electronic warfare (EW) aircraft in northern Iraq. The problem was quickly resolved, but the potential for missing a SCUD launch was great. [22]

(S) Operational procedures were changed to meet USCENTCOM's alert requirements and the evolving needs to locate TBM mobile launchers, one DSP satellite was moved, and equipment was relocated to back up vulnerable DSP ground sites. All of these actions could have impacted USCINCSPACE's strategic mission and required approval before they were implemented. The centralized control that USCINCSPACE exercised over the warning systems allowed General Kutyna to rapidly assess recommendations and impacts and approve changes to meet the evolving SCUD threat. [20]

(S) USSPACECOM warning capabilities must be improved, or warning support could be limited in future conflicts by the type of tactical missile employed or by solar, weather, or geographical limitations:

> (U) Future warning sensors must be able to better discriminate between multiple launches and provide more accurate information on impact points. The Follow-On Early Warning System (FEWS) is needed to overcome these limitations and assure U.S. forces the same level of warning support provided in the war with Iraq.
>
> (U) Backups to vulnerable ground sites must be prepositioned. With all the stops pulled out and half of the equipment already in place, the backup-bentpipe at Ascension Island took 45 days to become operational. [14]
>
> (U) A dedicated tactical warning capability is needed. USSPACECOM must be able to simultaneously meet its strategic and tactical warning requirements.

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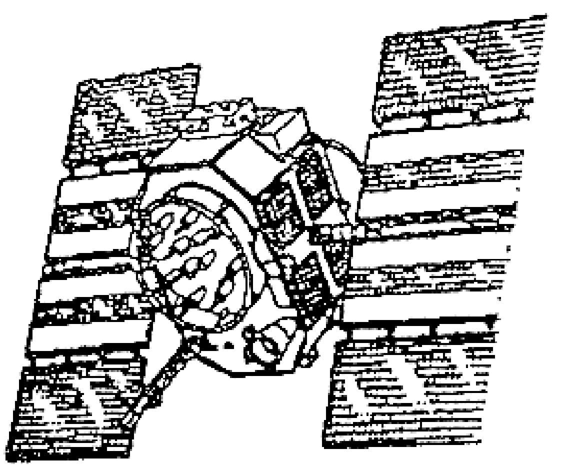
SECTION 5.2

NAVIGATION AND POSITIONING (U)

NAVSTAR-GPS



(U) As U.S. forces arrived in Saudi Arabia, they confirmed the fact that navigating in a featureless desert posed significant challenges. There were almost no man-made or natural features by which a soldier could determine his or her location. For this reason, it was no surprise that the space system that most directly supported individual U.S. military personnel was the Global Positioning System (GPS). GPS is comprised of a constellation of satellites that broadcasts precise navigation, positioning, and timing signals.

(U) The U.S. ground forces that initially deployed were trained and equipped with approximately 500 commercial, Small Lightweight GPS Receivers (SLGRs) supplied by Army Space Command (USARSPACE). The value of the SLGR was quickly realized, and thousands of additional GPS receivers were procured and distributed to meet the needs of U.S. forces.

TIMELINE (U)

DATE	EVENT
2 August* 1990	GPS satellite launch
10 August	GPS-Selective Availability (SA) was turned off
20 August	HQ U.S. Army Deputy Chief of Staff for Operations (DCSOPS) direction: "Get GPS receivers to the troops"
21 August	USARSPACE begins distribution of recalled SLGRs to AO
23 August	Assessment of Iraq's capability to exploit GPS with SA off--Iraq has some capability, but it would hurt U.S. more if SA were turned on
10 September	GPS Joint Program Office (JPO) issues contract for 1,000 commercial GPS receivers
2 October*	GPS satellite launch--constellation optimized for operations over Iraq
7 October	USARSPACE assesses suitability of SLGRs deployed to tactical Army units
26 November*	GPS satellite launch

TIMELINE IS UNCLASSIFIED

30 November		OSD approves purchase of 4,735 more commercial GPS receivers
10 December		GPS satellite (flight 6) failure
15 January	1991	Failed GPS satellite partially recovered and ready for limited operations
1 February		Failed GPS satellite activated for limited operations
7 March		Failed GPS satellite turned off

TIMELINE IS UNCLASSIFIED

* Scheduled before the start of Desert Shield

SEQUENCE OF EVENTS (U)

(U) USCINCSPACE provided Global Positioning System (GPS) service throughout Operations Desert Shield and Desert Storm. Three GPS satellites were launched during Desert Shield (asterisked items on timeline)--these operations were scheduled well in advance of the crisis. With these launches, the GPS constellation was brought to 16 satellites. [1]

b(1)

(U) As soon as U.S. forces began to deploy to the Persian Gulf, they immediately put the call out for GPS receivers--this was a direct result of an intense 18-month program by USARSPACE that demonstrated the use of and familiarized worldwide Army units with the SLGR--and led to the Army DCS for Operations on 20 August to direct the deployment of GPS receivers as quickly as possible. USARSPACE and AFSPACECOM combined their resources and identified 1,000 SLGRs that could be immediately deployed to Saudi Arabia (USARSPACE's supply of 500 SLGRs was immediately provided to deploying forces of the 82nd Airborne and 101st Air Assault Divisions). By 10 September, the GPS Joint Program Office contracted for the purchase of 1,000 more SLGRs, and by 30 November the Department of Defense approved the purchase of almost 5,000 commercial GPS receivers. Eventually, 10, 000 commercial GPS receivers were purchased for U.S. forces and almost 5,000 were sent to the Persian Gulf. [5,6]

(U) Prior to the start of Desert Storm, USARSPACE was providing a GPS visibility message to the commands that had SLGRs as part of the demonstrations program. When units began arriving in Saudi Arabia, there was a request to make the information operational. USARSPACE put the GPS satellite information into an operational format and sent it to all service combat users. (Note. The schedule was not always passed to lower echelons or to Coalition members.) [4]

(U) The October launch of a GPS satellite was replanned to place this spacecraft into the optimum orbit to support USCENTCOM forces by optimizing GPS coverage over Baghdad. By optimizing the orbit, more GPS satellites were visible to U.S. forces in the Persian Gulf than was originally planned. [7] The effects of this optimization are detailed in the NAVIGATION AND POSITIONING SUPPORT SUBSECTION.

(U) On 10 December, an older GPS satellite (flight 6) failed when one of its reaction wheels, which keeps it properly oriented, malfunctioned. AFSPACECOM did an excellent job of analyzing the malfunction and determined how to correct it. They "spun" the entire spacecraft up so that its antennas would point to the earth when it was over the AO. After verifying that the signal was usable, AFSPACECOM declared the satellite ready for operations on 15 January 1991. At the direction of the Joint Staff, the restoration of this satellite was precoordinated with USCENTCOM , SAC, and the Joint Staff. It took two weeks to complete this coordination, and GPS flight 6 was not providing navigation and positioning data until 1 February. [1]

NAVIGATION AND POSITIONING SUPPORT (U)

(U) GPS was perhaps the most visible example of space system support to U.S. troops in Operations Desert Shield and Desert Storm. GPS receivers were in demand throughout the theater and were used for everything from navigating warships and tank columns to "locating the mess tent." GPS provided the coordinates used to grid maps with highly accurate latitude and longitude markings. GPS can accurately be described as the compass U.S. forces used during the Persian Gulf War. [9] For example, the Air Force used GPS to guide fighters and bombers to targets. When a GPS-equipped fighter rolled onto a target and broke through the clouds, the target was right in front of the pilot. On the sea, GPS was used to clear mines and gave the precise launch coordinates which contributed to the accuracy of tomahawk cruise missiles. The Army used it to maneuver units, keep them out of each others fields of fire, and clear land mines. The Marines used it to set up artillery, while special operations utilized GPS widely for many applications. [1,4,7,8]

(U) After the war, Apache attack helicopter pilots informally voted GPS as the best addition that could be made to their aircraft. Many ground soldiers, who set up forward bases, used the term "SLGRed in" in honor of the device that enabled them to locate their bases, day or night, rain or shine. (Note. Air Force personnel who set up aircraft inertial navigation systems also used this term since they used GPS receivers.) [1,4,8]

(U) Since the GPS constellation was optimized to support U.S. forces, there was good two-dimensional coverage (latitude and longitude) in the Persian Gulf almost the entire day (three GPS satellites in view). Three-dimensional (3-D) (latitude, longitude, and altitude) coverage was available in the AO for about 18 hours a day (four GPS satellites in view). As a comparison, troops at Ft Bragg, North Carolina could only receive good 3-D coverage for about 15 hours a day. When the failed-GPS satellite (flight 6) was recovered and made operational, another hour of 3-D coverage was available to U.S. forces in the Gulf. [1]

COMMERCIAL GPS RECEIVER USE/IMPACT (U)

(U) Because of the immediate need for GPS receivers, U.S. and Coalition forces were forced to rely heavily on commercial GPS receivers. Almost 90% of the GPS receivers used by U.S. forces were commercial, non-crypto-capable receivers (see Table 5-4). These receivers were procured in the most expeditious manner possible. There were also numerous reports of personnel buying their own receivers or having them sent to them by family members. Additionally, there was no in-place distribution and maintenance plan to handle the commercial GPS receivers. As a result, commercial receivers were distributed on a first-come, first-serve basis. If one of these commercial GPS receivers broke, it had to be sent back to the CONUS for repairs. (Note. In January 1991, a repair capability was available in Saudi Arabia.) [4,5,10]

[redacted]

SELECTIVE AVAILABILITY POLICY QUESTION (U)

(U) A typical SLGR costs approximately $3,400. The military, portable GPS receiver with SA capability (AKA Man-Pack) costs $45,000. The SLGR weighs four pounds and can fit into the pocket of a soldier's battle dress uniform (BDU). By contrast, the

Man-Pack weighs 18 pounds and is designed to be carried on your back. No one carried a Rockwell Man-pack in the desert. They were strapped to trucks or helicopters. [1] (Note. JPO date for fielding the military version of the SLGR is 1994.) [15]

(U) Due to the widespread use of commercial, non-SA-capable GPS receivers, the basic GPS-SA policy is being questioned. Since U.S. forces were using available, low-cost commercial receivers so effectively, many GPS users began to doubt the reasonableness of maintaining the current GPS-SA policy (i.e., always keeping SA on). Because of these doubts, USSPACECOM and the other U&S CINCs addressed the question "why maintain the current SA policy and incur the costs of the more expensive, SA-capable receivers". [12]

Table 5-4, GPS RECEIVER DEPLOYMENT* (U)

SERVICE	COMMERCIAL	MILITARY
ARMY	3710	557
NAVY	130	85
MARINES	500	10
AIR FORCE	150	190
TOTAL	4490	842

* GPS Receiver Deployment, March 1991.

TABLE IS UNCLASSIFIED

(U) In addition to the questions raised on the need for SA because of the effective use of commercial GPS receivers, Selective Availability can be overcome by using a technique known as Differential-GPS. Differential-GPS involves setting up a GPS ground transmitter at a precisely known location and broadcasting a correction signal GPS receivers in the vicinity of the Differential-GPS transmitter will receive the correction signal and display very accurate position information. The U.S. Coast Guard is setting these types of stations along the United States border to provide highly accurate navigation signals for shipping, and survey companies use this technique to obtain very accurate survey data. [15] (Note. The ability to work around SA is not that simple. Differential-GPS involves setting up a transmitter that is located in a presurveyed site. This requires additional equipment and expertise. It is also vulnerable to attack.) [1]

(U) Finally, military users of GPS were concerned about managing receivers that contain crypto equipment. There were major concerns in controlling and accounting for thousands of encrypted receivers. With these receivers distributed at all levels of command and used in various environments, the error-free maintenance of crypto accounts could prove an almost impossible task. [5]

FIGURE [redacted]

Figure 5-4, SELECTIVE AVAILABILITY (SA) IMPACT (U) [redacted]

(U) In light of the above, the continuation of the SA-on policy required a review. Advanced weapons systems, which are GPS-equipped, are being sold today. [13] Contractors are also marketing GPS receivers that will only cost a few hundred dollars. In future conflicts, the United States may face adversaries that are capable of exploiting GPS or are supplied by armorers that provide weapons systems that employ GPS. Due to the war-fighting enhancements provided by GPS and the need to protect U.S. forces, USSPACECOM and the Unified and Specified (U&S) CINCs, along with the Services, agreed that the current national policy on GPS-SA should remain unchanged. [14]

(U) In developing his position, USCINCSPACE directed that the cost of SA and work-arounds to it be investigated. It was determined that the cost of SA was low ($54K annually for crypto material and $220 per receiver for auxiliary output chip). The basic cost increase in a military version of an SLGR (estimated to cost about $8,000) is due to the requirement to meet "MIL SPEC." [12]

(U) In addition to SA, another feature of the military GPS receiver is its Anti-Spoof (AS) capability. AS is a feature that enables the military version of the GPS receiver to avoid being spoofed or fooled. Commercial GPS receivers do not have the AS feature and are vulnerable to jamming and spoofing. This means that U.S. forces that depend on commercial GPS receivers are now vulnerable to being denied the advantage, and possibly the necessity, of having highly precise navigation and positioning data by an adversary jamming GPS signals. A more sophisticated enemy could actually introduce false signals and deceive U.S. forces as to their true location. The military, SA-AS capable receiver does not have this vulnerability. [1]

NAVIGATION AND POSITIONING ASSESSMENT (U)

(U) GPS was a great success. It was employed throughout the theater of operations and gave a common method of directing forces in a featureless, unforgiving desert. As stated by the Assistant Signal Officer, 11th Air Defense Brigade, when asked about GPS receivers: "If you mean those green position locators, they are lifesavers. Whenever we sent someone to another unit for coordination, we entered that unit's ten-digit coordinates and the SLGR directs them to the command post. Before, we had people getting lost in the desert, but since we got the three GPS receivers, nobody has got lost." [11]

(U) The need for GPS receivers in the quantities necessary for large scale maneuvers and to support "Desert Storm" type operations wasn't specifically called out in documentation or plans. [10] There weren't enough GPS receivers of the correct kind to meet needs of U.S. and Coalition forces. This necessitated the purchase of thousands of commercial, non-SA-capable GPS receivers. It took six months to get these receivers to U.S. forces in Saudi Arabia. Future conflicts may not allow the time to make up for procurement shortfalls. The procurement of receivers/terminals should be pursued very vigorously. Since these may be the responsibility of a Service, separate from the overarching space system, the need for and priority of these receivers must be acknowledged and pursued by the Services.

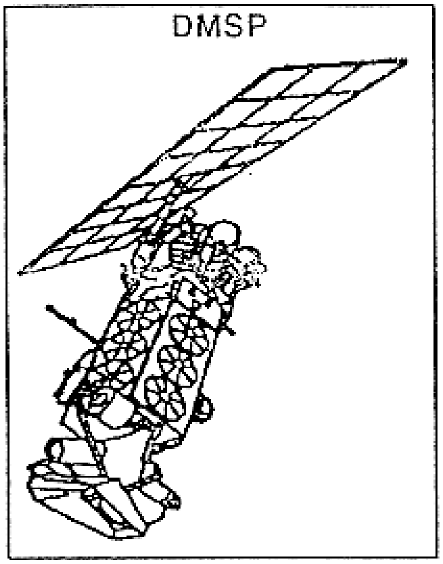
(U) Coordination on reactivating the failed GPS satellite delayed support to U.S. forces. It took almost two weeks to complete this coordination. Methods of more rapidly coordinating satellite support must be found.

[redacted]

(U) It is USCINCSPACE's position, and that of the other U&S CINCs and Services, that the current SA policy of denying highly accurate position data to non-authorized GPS users should be maintained. This position has also been affirmed by senior DOD policy makers.

SECTION 5.3

WEATHER (U)



(U) Weather satellites played a key role during the war. U.S. and Coalition forces used data from the Defense Meteorological Satellite Program (DMSP) spacecraft and civil weather satellites to predict rapidly changing weather patterns and monitor burning oil wells. Meteorological satellites (METSATs) were the most reliable source of information on weather in Iraq. The information they provided was used extensively to plan and execute attack missions, determine wind direction and potential spread of chemical agents, and to alert U.S. forces of sandstorms or other phenomena. This access to current weather data allowed U.S. forces to capitalize on night vision and infrared targeting capabilities.

TIMELINE (U)

DATE	EVENT
2 August 1990	Naval units utilize weather data from military and civil weather satellites
7 August	WRAASE commercial weather receive terminals deployed with Army units
20 August	MARK IV Weather Vans deployed with Marine forces.
2 September	MARK IV Weather Van active with CENTAF Headquarters Tactical Forecast Unit (TFU) activated and weather data distribution system initiated
15 November	Selected WRAASE terminals updated with WeatherTrac system
1 December	DMSP satellite launched *
10 December	WRAASE terminal software updated
15 December	DMSP interim terminal deployed to U.S. Army Forces, U.S. Central Command (ARCENT)
1 January 1991	USCENTCOM requested Joint Staff "prepare to selectively withhold meteorological data from Iraqi forces"
15 February	DMSP interim terminal deployed to U.S. Special Operations Command, U.S. Central Command (SOCCENT)

* Satellite was "on call" for launch before Desert Shield.

TIMELINE CLASSIFIED [redacted]

SEQUENCE OF EVENTS (U)

(U) On 2 August 1990, U.S. naval units were in the area of operations. Many of these units were equipped to receive and process satellite broadcasts of weather data from Defense Meteorological System Program (DMSP) or civil (National Oceanographic and Atmospheric Administration (NOAA)) and foreign METSATs. [1]

(U) On 7 August, Army units began deploying to Saudi Arabia. Generally, brigade and higher units with weather support deployed with WRAASE terminals (WRAASE is the name of the terminal), which were used to receive civil METSAT readouts only. [2] These commercial weather receivers were previously made available to U.S. Army divisions and separate brigades through the Army Space Demonstration Program and Forces Command (FORSCOM) effort. The commercial weather receivers made the civil weather satellite data available to the lowest practical operational level in the Army. (Note. Fifteen WRAASE terminals were deployed with Army units.) [3,9,11]

(U) On 20 August, the first MARK IV weather van arrived with Marine Amphibious Forces (MAF). An Air Force Mark IV Van was located at CENTAF HQ, Riyadh, where it provided valuable DMSP and civil imagery in support of the Tactical Forecast Unit (TFU), which disseminated forecasts to USCENTCOM forces throughout the theater. The Air Force Mark IV disseminated DMSP weather images via the Tactical Imagery Dissemination System (TIDS) to 25 Air Force bases in the area of operations. (Note. There were four Mark IV Vans in the area of operations. Three vans were with Marine units, and one Air Force van was at Riyadh. These vans could receive and process both DMSP and civil METSAT weather broadcasts.) [4]

(U) On 15 November, Army WRAASE terminals at the XVIII Airborne Corps and HQ ARCENT were updated by USARSPACE with additional computers and software to improve weather predictions. This enhancement involved the addition of a FORSCOM Automated Intelligence Support System (FAISS) computer and WeatherTrac software to help forecasters provide better prediction of coastal fog, heat stress, dust storms, etc. On 10 December, USARSPACE updated WRAASE software to provide better prediction of weather satellite passes. [5]

(U) A Defense Meteorological Satellite Program (DMSP) weather satellite was launched on 1 December 1990 and the on-orbit check-out of this spacecraft was accelerated to increase DMSP coverage. (Note. This DMSP satellite was launched into a slightly anomalous orbit. Nevertheless, it did provide useful mission data throughout the conflict.)

(U) On 15 December, a DMSP-capable receiver was provided to ARCENT HQ. (Note. This receiver was borrowed from a contractor by USSPACECOM TENCAP representatives to provide greater access to DMSP data by Army units.) This terminal provided direct access to realtime DMSP weather broadcasts. (Note. DMSP-capable terminals of similar size were procured and provided to SOCCENT and ARCENT prior to the start of the ground campaign.) [6]

[redacted] On 1 January 1991, USCENTCOM requested the Joint Staff prepare to selectively turn off TIROS (NOAA polar orbiter) direct transmissions to Iraqi forces and determine the feasibility of controlling foreign METSAT data. [7]

WEATHER SUPPORT (U)

[redacted] Weather satellites provided key support to U.S. forces in Saudi Arabia and surrounding areas in planning missions, preparing weapons systems, readying defenses, and moving troops--there were no weather observations routinely coming from Iraq prior to the ground war. Weather data became especially critical in the desert where heavy coastal fogs can hamper or seriously degrade all operations, sandstorms can cut visibility to zero, and rains can turn desert sands into bogs. In addition, weather data are crucial inputs in the process of target selection and in determining the best type of aircraft/munitions to use. Current weather updates are also used by cruise missiles just prior to launch. [8,9,10]

(U) In the Saudi desert, weather patterns changed within minutes--on 24 January 1991, one DMSP readout, for example, showed Baghdad as cloudy and Basra clear; 101 minutes later, a second DMSP image showed Baghdad clear and Basra overcast. The information provided by weather satellites was used for more than predicting the weather. On 21 January 1991, DMSP visual and infrared imagery showed thunderstorms west of Kuwait City. Analysis of microwave imagery from the same DMSP pass showed a moisture signature just west of the storms--the assessment was "standing water." The next day, newspapers showed U.S. Army vehicles stuck in the mud after a heavy desert rainstorm. (Note. Microwave imagery data was only available at Air Force Global Weather Central and other locations outside the theater and is programmed for Mark IV B and Small Tactical Terminal systems which are being procured for the future.) [13]

(U) DMSP direct broadcasts of weather data were received by major naval combatants (i.e., aircraft carriers) and Mark IV Vans (see Figure 5-5 and Table 5-5). The Air Force Tactical Forecast Unit (TFU) managed Mark IV operations at Riyadh and produced a standard textual weather report that was transmitted by high frequency (HF) radio to Army and Air Force users in theater. Weather images were faxed from the Air Force Mark IV Van to CENTAF units over land lines. Certain naval combatants received civil METSAT transmissions. [13]

(U) Access to DMSP information was limited due to the small number of DMSP receivers in the Persian Gulf. Additionally, Army units below theater level could not access DMSP imagery because the Mark IV Van did not meet Army mobility requirements. Army units used a commercial weather receiver (a WRAASE terminal), which was lightweight enough to travel everywhere Army units went--this terminal had not been available to the Army in significant numbers prior to the USARSPACE Demonstration Program. The WRAASE weather receiver was capable of obtaining weather imagery from civil weather satellites of four nations. WRAASE terminals were purchased by the Army

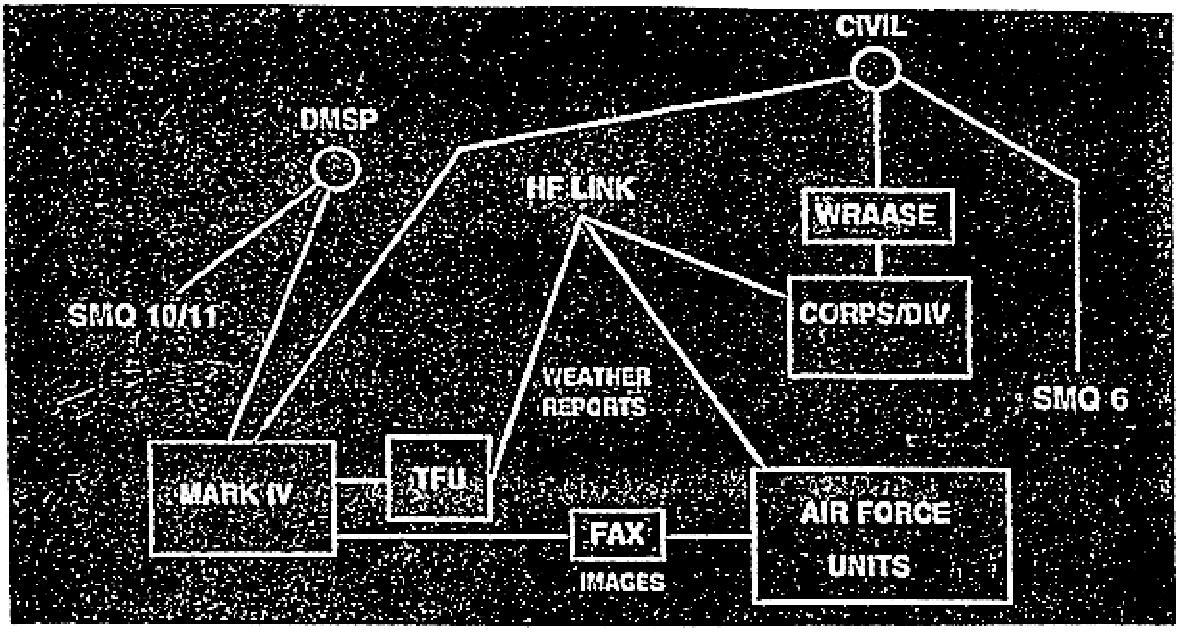


FIGURE IS UNCLASSIFIED

Figure 5-5, WEATHER SUPPORT (U)

Table 5-5, WEATHER SATELLITES (U)

SATELLITE	COUNTRY	ORBIT	COVERAGE*
DMSP	US	POLAR	Overhead 0610L and 1810L
DMSP	US	POLAR	Overhead 0735L and 1935L
DMSP	US	POLAR	Overhead 0930L and 2130L
TIROS (NOAA)	US	POLAR	Overhead 0723L and 1923L
TIROS (NOAA)	US	POLAR	Overhead 0206L and 1406L
GOES	US	GEOSTATIONARY	Western Hemisphere
GMS	JAPAN	GEOSTATIONARY	HEMISPHERE 140° E
METEOSAT	EUROPE	GEOSTATIONARY	HEMISPHERE 50° W
METEOSAT	EUROPE	GEOSTATIONARY	HEMISPHERE 0° W
METEOR	USSR	POLAR	twelve satellites available

* Coverage times are approximations, +/- one hour

TABLE IS UNCLASSIFIED

Space Institute and FORSCOM and supplied to active and reserve Army units to supplement weather forecasting equipment. [5,5]

WEATHER DENIAL (U)

[redacted]

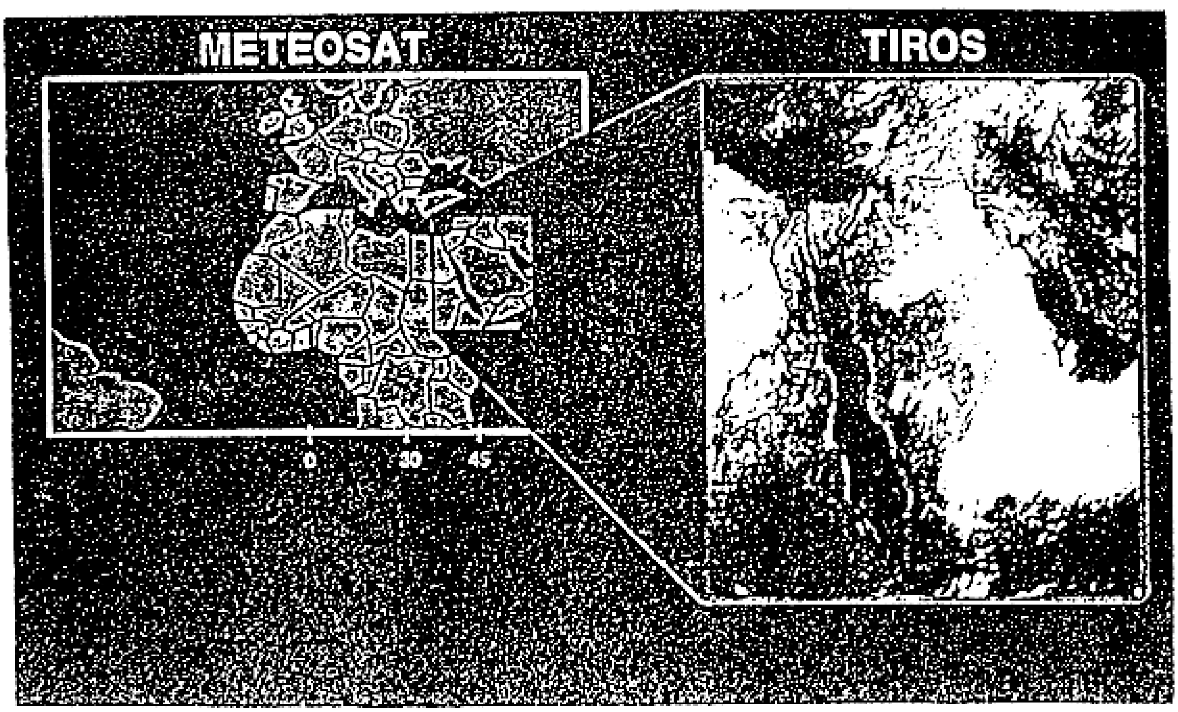


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Figure 5-6, CIVIL METSAT COVERAGE (U)

[redacted]

ASSESSMENT (U)

(U) Weather data was vital to military operations and was widely available to U.S. forces. METSATs, both DMSP and civil, played key roles in providing meteorological data on a timely basis. Both types of weather satellites were needed since each provided unique data or were providing time-critical weather data that was not accessible from another source. In particular, the TIROS transmissions at 1400 Local often provided some of the most useful information on the late afternoon jet stream that drove the desert's evening weather patterns. Information from the TIROS METSAT proved invaluable in forecasting desert weather conditions. [8]

(U) Even though there are numerous readouts of weather data, we still need more to meet the needs of U.S. warfighters. During the war, special operations forces had to terminate operations and lost aircraft and personnel due to the rapidly changing weather conditions in the desert. They need even more readouts than are currently available. [11, 12]

[redacted]

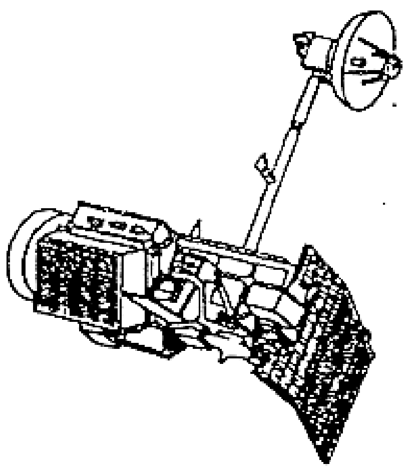
(U) Army units did not have direct access to DMSP readouts. This will be overcome when small tactical DMSP receive terminals are deployed in the next few years. Currently, approximately 270 of these small terminals are scheduled to be procured (60 of these terminals are being procured for the Army). [8]

[redacted]

SECTION 5.4

MULTI-SPECTRAL IMAGERY (U)

LANDSAT



(U) When American forces deployed to the Gulf, many of the maps of Kuwait, Iraq, and Saudi Arabia available to U.S. forces were old and out-of-date. To correct this deficiency, Multi-Spectral Imagery (MSI) satellite systems were used to image the AO; and up-to-date maps of the area of operations were prepared. There was also a need to plan amphibious and airborne operations, track the movement of Iraqi forces, and prepare for/practice strike operations. MSI figured prominently in all these activities.

TIMELINE (U)

DATE		EVENT
2 August	1990	LANDSAT intensifies imaging AO
7 August		USARSPACE technical liaison officer (LNO) deploys to Fort Bragg, North Carolina
14 August		1987 LANDSAT data processed by the U.S. Army
15 August		Initial MSI analysis/products for XVIII Airborne (ABN) Corps completed
21 August		1990 LANDSAT data to Army (nonrectified)
1 September		Defense Mapping Agency (DMA) rectified data to Army
3 January	1991	USARSPACE technical LNO deploys to AO
10 January		Army MSI work stations operational in AO

TIMELINE IS UNCLASSIFIED

SEQUENCE OF EVENTS (U)

(U) Prior to the crisis, USARSPACE conducted an aggressive Space Demonstration Program to acquaint Army tactical forces with the benefits of exploiting space systems, including MSI.

(U) The commercial contractor that manages LANDSAT (Earth Observation Satellite Company (EOSAT)) began imaging the AO on 2 August 1990. [1]

(U) By the 14th of August, older, 1987 LANDSAT data was being processed by the Army and provided to the XVIII ABN Corps (24 hour turnaround). By the 21st of August, 1990 data was being provided to Army users at Fort Bragg after coordination by USARSPACE. [1]

(U) By the 1st of September, DMA had started sending 1990 rectified data (i.e., MSI in digital format warped to the Universal Transverse Mercator Map Projection) to the Army. There were some problems with early products, as identified by USARSPACE technical support personnel, and DMA reprocessed the imagery. [1,2]

(U) By the 10th of January 1991, an Army MSI processing capability was operational with U.S. forces in Saudi Arabia. USARSPACE forward support personnel were deployed to the AO at the request of ARCENT and the 18th Airborne Corps to support this new capability. [3]

MULTI-SPECTRAL IMAGERY SUPPORT (U)

(U) MSI satellites (i.e., the U.S. LANDSAT and the French SPOT--Satellite Probatoire d'Observation de la Terre (Exploratory Satellite for Earth Observation)) image specific areas of the earth and transmit their images to ground stations. These images are much more than black and white pictures. They show features of the earth that are beyond human visual detection capability. By using these MSI images, for example, one can identify shallow areas near coastlines or where equipment has traveled over the earth. MSI can show what is hidden from normal view. In support of Coalition operations and to ensure the Iraqis didn't have access to spaceborne sources of data that could be used for intelligence purposes, LANDSAT and SPOT data were not sold to the Iraqis. [11,12]

(U) When Iraq invaded Kuwait, the available maps of Kuwait City and many areas of the AO were between 10 and 30 years old. USARSPACE LNOs and Army topographical units provided rapid response image maps using available LANDSAT and national imagery. The 82nd Airborne Division carried maps produced from LANDSAT data with them during their August 1990 deployment. [1,2]

(U) MSI images can show water depths up to 50 meters (under ideal conditions), but normally water depths are shown 20 or 30 meters depending on water clarity. The U.S. Navy used MSI data as an input to planning amphibious operations during the Persian Gulf War. Figure 5-7 gives a representation of this. The light blue areas and dark blue show how MSI can indicate where shallow and deep water areas are. [1,4, 11]

(U) The Kuwait City map, Figure 5-7, also showed clear, open areas that could be suitable for drop zones, helicopter landing areas, and forward fueling and rearming points. When the 82nd ABN saw this map, they asked for national imagery to check if there were traps or obstructions that would prevent an airborne landing. In addition, this map showed existing roads, trails, and an airfield. All of these items were key inputs to planning military operations. [1,4]

FIGURE IS UNCLASSIFIED

Figure 5-7, MSI Map--Kuwait City (U)

(U) U.S. forces used Saudi airfields, which often consisted only of runways in the sand. The U.S. military had to complete major construction on these airfields to meet the requirements of a modern Air Force. LANDSAT imagery of these airfields was converted into engineering drawings which were then used to plan and build some of the largest air bases in the world. [5]

(U) MSI shows the status of the ground. MSI image maps can be prepared to detect wet areas which could slow down an attack. The wet areas can be seen by manipulating the various spectral returns. One can also input directly into these maps defensive positions that national means have identified. Adding defenses to the trafficability data presents a clear picture for planning military operations. Training to support these applications was conducted by USARSPACE personnel deployed to the AO. [1]

[redacted]

(U) The LANDSAT image in Figure 5-8 depicts the east portion of the Kuwaiti-Saudi Arabian border. This image was made by comparing LANDSAT data taken in August 1990 and December 1990 and then emphasizing the differences between the two. The two LANDSAT data sets were compared digitally pixel by pixel. Data was displayed on a single image so that bright areas represent changes between the two LANDSAT images. Where the ground cover had been disturbed/changed/removed, resulting in changes to the reflective qualities of the ground, the LANDSAT image showed bright spots. Figure 5-8 is a computer enhanced image that accents the changes that took place along the border between August and December 1990. [1,4]

(U) Fan patterns stand out along the border. Analysis indicated that each fan was associated with an Iraqi brigade fighting front. The bright fan lines were resupply roads and oil lines which fed the oil-filled (i.e., fire) trenches that ran the length of the front. Gaps in the front include minefield areas. [1,4]

[redacted]

(U) Every time the ground is disturbed, which is unavoidable for a modern army, a spectral change occurs. This data is emphasized by comparing MSI computer images

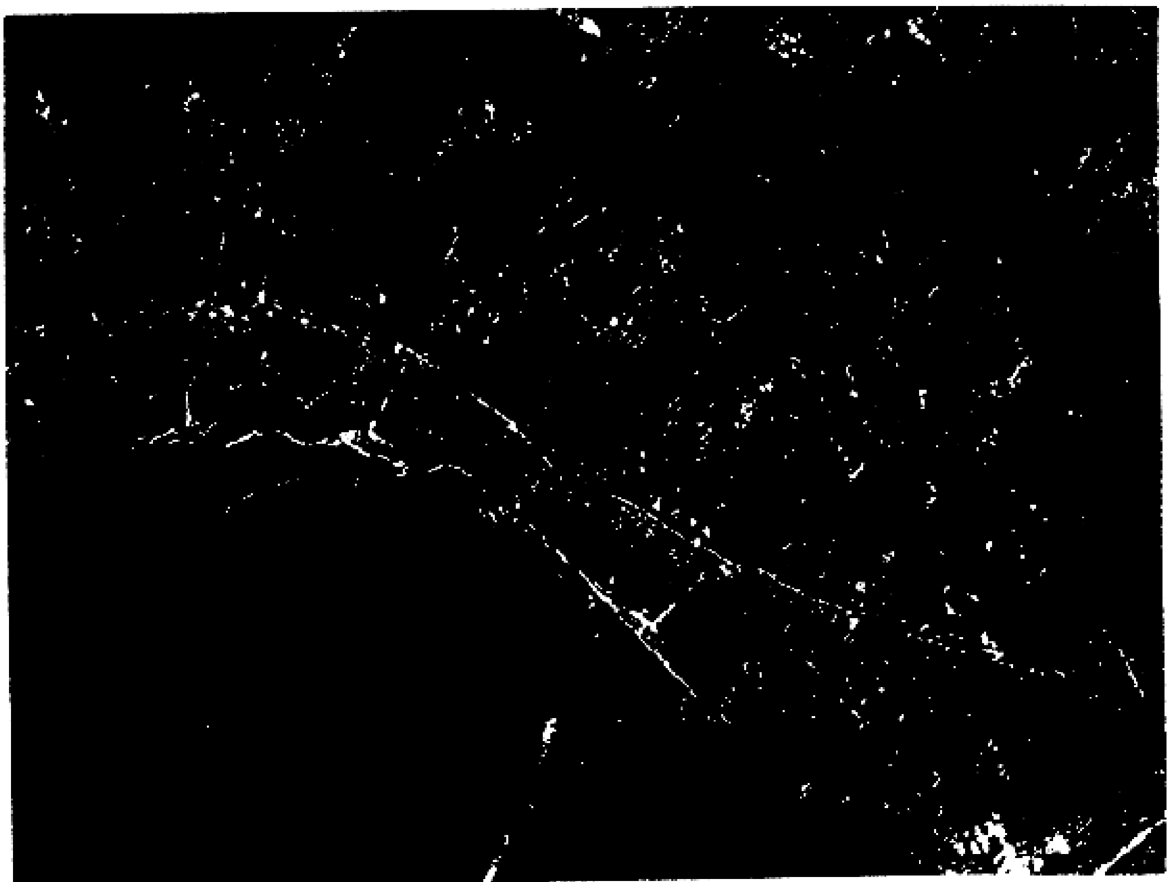


FIGURE UNCLASSIFIED

Figure 5-8, MSI IMAGE (KUWAITI - SAUDI ARABIAN BORDER) (U)

and instructing the computer to display changes. Figure 5-8 emphasizes the changes that have taken place over time. This type of information provided the U.S. warfighter with an insight into Iraqi operations and is almost impossible to hide. Whenever a vehicle travels over the ground, sand, or even grass, the ground cover is disturbed and stands out in an MSI image. Just prior to the ground war, DIA intervened at the last moment to prevent the release of LANDSAT data of the Kuwait-Iraq/Saudi border to the U.S. news media. If this data was released, it might have showed U.S. plans to use the "left hook" at the start of the ground war. The road building activities at that time were extensive and could have been divulged if LANDSAT imagery were displayed by the media. [11]

(U) The U.S. Air Force and U.S. Marine Corps used French SPOT data to plan and rehearse missions. (The black and white SPOT data was used because it had 10 meter resolution (LANDSAT has 30 meter resolution) see Figure 5-9). The MSI data was digitally merged with Digital Terrain Elevation Data (DTED), a DMA data base, and then used for a pilot to display attack routes and targets as they would appear at flight or attack altitudes.) A pilot could tell if a hill would be cleared in time for the

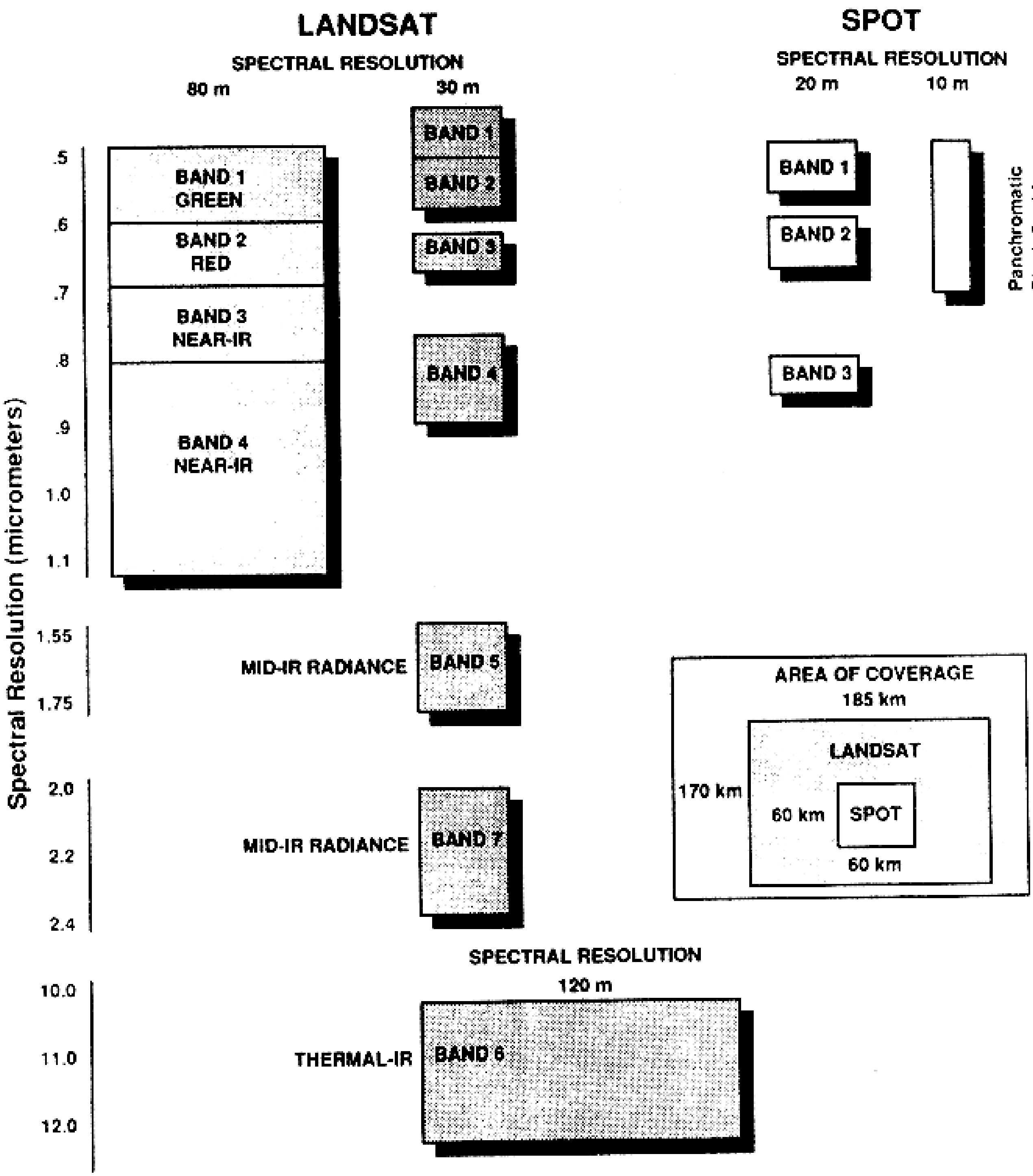


FIGURE IS UNCLASSIFIED

Figure 5-9, MSI IMAGE COMPARISON (U)

aircraft's weapons system to acquire a target before weapons release. F-111 pilots used this system in preparation for their mission to bomb the Iraqi well heads that were pumping oil into the Persian Gulf. After the mission was completed, the pilots commented that it seemed as if they had flown the mission before they ever climbed into the cockpit. [9,6]

MULTI-SPECTRAL IMAGERY DATA ACQUISITION (U)

(U) A CINC or Service requested MSI data. DMA processed the request and forwarded it to EOSAT. If EOSAT had the data in its data base, it took from two to three days to provide the data to DMA. If the data was not in EOSAT's data base, LANDSAT had to image the area. Since LANDSAT takes sixteen days to cover the earth and there are currently two LANDSAT satellites on orbit, it can take up to eight or sixteen days to obtain the data and another two to three days for EOSAT to provide the data to DMA. After DMA received the data, it only took a day to forward the image to the CINC and four to fourteen days for a map. The above represented the best the system could do. In many instances, MSI data was much more difficult to obtain or could not be obtained because of funding limitations. [1]

(U) The U.S. Air Force bought several million dollars worth of SPOT data (see above item under MSI support). The Navy participated in this effort. The Army was not adequately informed of the acquisition and did not participate. When Army units requested SPOT data, they could not use the data purchased by the other Services because of the proprietary nature of SPOT data. [4] Army users in the AO were unable to obtain their own supply of SPOT data because DMA representatives in USCENTCOM would not pass the requirement to DOD's acquisition agent, DMA. [1]

(U) MSI data was bought when specific needs were identified. As in the case of the Army's request for SPOT data, units could not always obtain MSI data in the quantity they desired. Army topographical (TOPO) units basically had the MSI data they deployed with. Finally, the Army units that were to produce MSI analysis for USCENTCOM forces found themselves occupied full time producing maps for troops that would be engaged in the ground war. [1]

MULTI-SPECTRAL IMAGERY ASSESSMENT (U)

(U) Multi-spectral imagery provided direct war-fighting support. The U.S. military spent millions of dollars on MSI data. MSI provided some unique capabilities to U.S. warfighters and enabled maps and intelligence assessments to be prepared that directly supported the war effort. (Note. USARSPACE continues to vigorously encourage the national intelligence community to build these enhancements into permanent capabilities to be used for future joint and combined actions.) Finally, unless intelligence data was inserted into the MSI product, it was "UNCLASSIFIED" (see Figures 5-5 and 5-8). This provided U.S. forces with a valuable tool that was easy to handle and transport.

(U) The current U.S. MSI system can be improved. The resolution of LANDSAT should be improved to meet military requirements (Air Combat Command (formally Tactical Air Command) has expressed a need for a five meter resolution MSI capability). [8] The French SPOT system currently gives ten meter resolution (black and white image); and the Soviets advertise five meter resolution (film, store and canister return system). Because of its seven bands of coverage and large scene size, LANDSAT is still competitive. But the next LANDSAT satellite is based on late 1950s and early 1960s technology and will have, at best, about 15 meter resolution. [4] If we don't take some action, we may find that MSI capability in foreign systems will be far superior to U.S. systems; and U.S. warfighters will be dependent on foreign sources for MSI data. (Note. A Mission Need Statement (MNS) for Remote Earth Sensing has been approved by the Joint Requirements Oversight Council (JROC). This MNS addresses MSI as well as other remote earth sensing requirements.) [10]

(U) The rectification, availability, and responsiveness in providing MSI data to U.S. military users should be improved. To a great degree, each purchase of MSI data was a new contracting effort. It normally required two government agencies to work together and impacted budgets in unplanned ways. Purchases were also made that could not be easily transferred between government agencies. (Since standardized military-MSI data bases areas were not maintained and MSI products were not always available in the quantity or over the time frames that were needed, U.S. MSI users did not have the access they needed to MSI data to meet full operational requirements.) Additionally, TOPO units found that they could not easily obtain additional MSI data and were overloaded with requests to perform higher priority, map making tasks. The military user should be able to obtain the type of data he or she needs, when it is needed, and in the quantity needed to meet mission requirements.

(U) Finally, the U.S. MSI capability can disappear. Operations and maintenance (O&M) has been funded by "passing the hat," in six month increments, between government agencies. There is no funding for a follow-on to LANDSAT VI which is currently scheduled for launch in 1992. [7] The current LANDSAT vehicles have exceeded their expected lifetimes--no one would be surprised if they died or were substantially degraded tomorrow. [1] Since it takes years after a satellite is funded before it is ready for launch and operations, the United States may find itself totally dependent on foreign sources for MSI support.

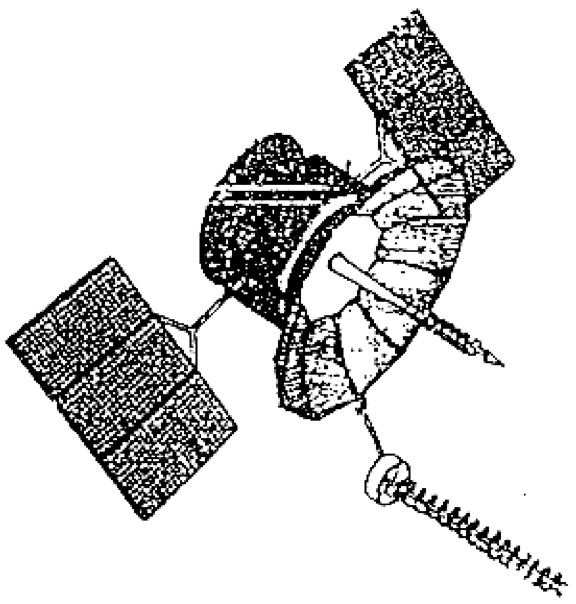
(U) The utility of MSI data in military operations was clearly demonstrated during the war with Iraq. To bring this into standard operations, a combined effort to assure the availability of MSI data, provide well understood and standardized products, and increase the understanding at all echelons of the strong and weak points of MSI use must be undertaken. The U.S. warfighter must integrate MSI into his or her normal operations, training, and exercises.

[redacted]

SECTION 5.5

SATELLITE COMMUNICATIONS (U)

FLTSAT



(U) It would be difficult to overstate the importance of communications satellite (COMSAT) support during the Gulf War. While the Saudis had an extensive communication system, it didn't go everywhere U.S. forces had to go; and it just couldn't provide the capacity to meet the needs of a half-million U.S. and Coalition personnel. COMSATs met this need. Supporting agencies repositioned satellites, brought ones that were on standby to full operation, and rented commercial COMSAT capability. Satellite circuits were reallocated from other military users to U.S. Central Command, thousands of terminals were transported to the area of operations, and commercial COMSAT support was procured to meet DOD needs.

TIMELINE (U)

DATE	EVENT
2 August 1990	USARSPACE Regional Space Support Center-CONUS (RSSC-CONUS) planning support to USCENTCOM
14 August	USARSPACE RSSC-CONUS representative to USCENTCOM--DSCS planning support
14 August	Commercial COMSAT circuits leased for USCENTCOM and XVIII ABN Corps
22 August	Multiple Access Communications Satellite (MACSAT) support to Marines begins
1 September	GAPFILLER activated
15 September	Defense Information Systems Agency (DISA) reconfigures eastern Atlantic (EASTLANT) DSCS III and Indian Ocean (IO) DSCS II satellites *
29 September	SKYNET support engineered by USARSPACE RSSC-Europe
23 November	DISA directs traveling wave tube switch on IO DSCS II
28 November	NAVSPACECOM--no additional UHF circuits available in AO

[redacted]

* (U) Defense Communications Agency (DCA) became DISA on 1 September 1991.

[redacted]

30 November		Missile-warning voice net maintenance control initiated
[redacted]		
19 December		Spare DSCS II activated in the IO
28 December		Second SKYNET support engineered by USARSPACE RSSC-Europe
21 January	1991	Lincoln Laboratory Satellite (LES-9) activated
21 January		NATO-3 support initiated
21 March		FLTSAT-8 extreme high frequency (EHF) support initiated

TIMELINE CLASSIFIED SECRET

SEQUENCE OF EVENTS (U)

(U) USARSPACE RSSC-CONUS began supporting USCENTCOM on 2 August. On 14 August, a representative from RSSC-CONUS was deployed to USCENTCOM-REAR to provide technical expertise and DSCS planning support. [1]

(U) On 22 August, MACSAT, a small Defense Advance Research Projects Agency (DARPA) experimental COMSAT, began providing limited support to theater Marines. This was an unclassified, store and forward, system used to transmit spare parts requirements and other administrative information to the 2nd Marine Aircraft Wing at Cherry Point, North Carolina. [2]

(U) GAPFILLER, a UHF satellite that supported the FLTSAT network, was providing support on the 1st of September. DISA directed the reconfiguration of the DSCS III EASTLAN and DSCS II IO satellite antenna patterns on 15 September to better support operations. [6] USARSPACE RSSC-Europe engineered SATCOM networks on SKYNET, a British COMSAT--support to U.S. forces began on 29 September. [3]

(U) On 23 November, DISA directs the switch of the traveling wave tubes on the spare DSCS II that was to be moved to the IO to ensure this critical satellite was ready to support any potential hostilities. [4]

(U) On 28 November, Naval Space Command (NAVSPACECOM), after inquiries by system users, stated that there was no additional FLTSATCOM UHF coverage available in the area of operations. This was not due to a lack of satellites; rather, the UHF spectrum that FLTSAT used had been completely filled in the AO. Additional users could not be supported without taking other users off. (Note. UHF access was improved with the addition of LES-9 coverage on 21 Dec 91.) [8]

[redacted] On the 30th of November, a maintenance control process for the voice warning net (the one that was used to call SCUD alerts) was initiated. Prior to this time, there was no overall maintenance control of this circuit. During October, when a SPACC crew member picked up the phone to complete a communications check, the circuit was dead. USSPACECOM personnel investigated and discovered that the circuit was down because standard preventive maintenance was being conducted on a portion of the circuit. After the maintenance control procedure was initiated, the circuit was automatically alt-routed if it failed, and maintenance had to be approved by the SPACC before this circuit was taken down. [5]

(U) On 19 December, the Atlantic FLTSAT (a degraded satellite that was supplying minimal UHF support) failed.

(U) On 19 December, DISA directed the activation of the western Pacific, spare DSCS II satellite as a backup to the existing DSCS II, and USARSPACE RSSC-Europe engineered SATCOM networks on a second SKYNET with access commencing on 28 December. [6]

(U) The Lincoln Laboratory COMSAT, LES-9, was providing UHF support by 21 January. LES-9 used a different portion of the UHF spectrum than FLTSAT and was able to provide additional UHF support to U.S. forces. Also on the 21st, the NATO-3 satellites were providing COMSAT support. [5,8]

(U) On the 1st of March, the EHF package on FLTSAT-8 was providing direct connectivity for USCINCCENT back to Washington, DC. [5]

COMSAT SUPPORT (U)

(U) Over 90% of U.S. communications into the area of operations were over satellite links (see Figure 5-10). DSCS, FLTSATCOM, commercial, NATO, and SKYNET systems were used to communicate with USCENTCOM forces. Approximately 24% of these communications were carried over commercial satellites. The U.S. military was absolutely dependent on COMSATs to communicate with its forces. [3]

(U) Not only were U.S. forces dependent on COMSATs for communications into theater, intra-theater command and control of U.S. forces was exercised extensively over military satellite communications (MILSATCOM) circuits. The Saudis had a modern communications system, but it did not always go where U.S. forces were and there wasn't enough of it to meet our needs. The U.S. military had to deploy its own communications systems, and the only practical method of doing this was to use COMSATs. In many instances when U.S. forces first deployed, units within the same city (e.g., Dhahran) communicated with each other over COMSAT links. With time, the Army installed standard terrestrial communications systems to support intra-city communications. [1,6]

(U) As shown in Table 5-6, USCENTCOM controlled the bulk of UHF COMSAT links available in the AO and a substantial level of support over SHF links, both military and commercial. These links were originally being used by other CINCs or Department of Defense (DOD) users. When USCINCCENT deployed, the Joint Staff orchestrated the allocation of circuits from other users to USCENTCOM. These circuits were transferred to USCENTCOM in an orderly fashion as forces deployed. This activity was orchestrated by the Joint Staff Command, Control, Communications Directorate. [6]

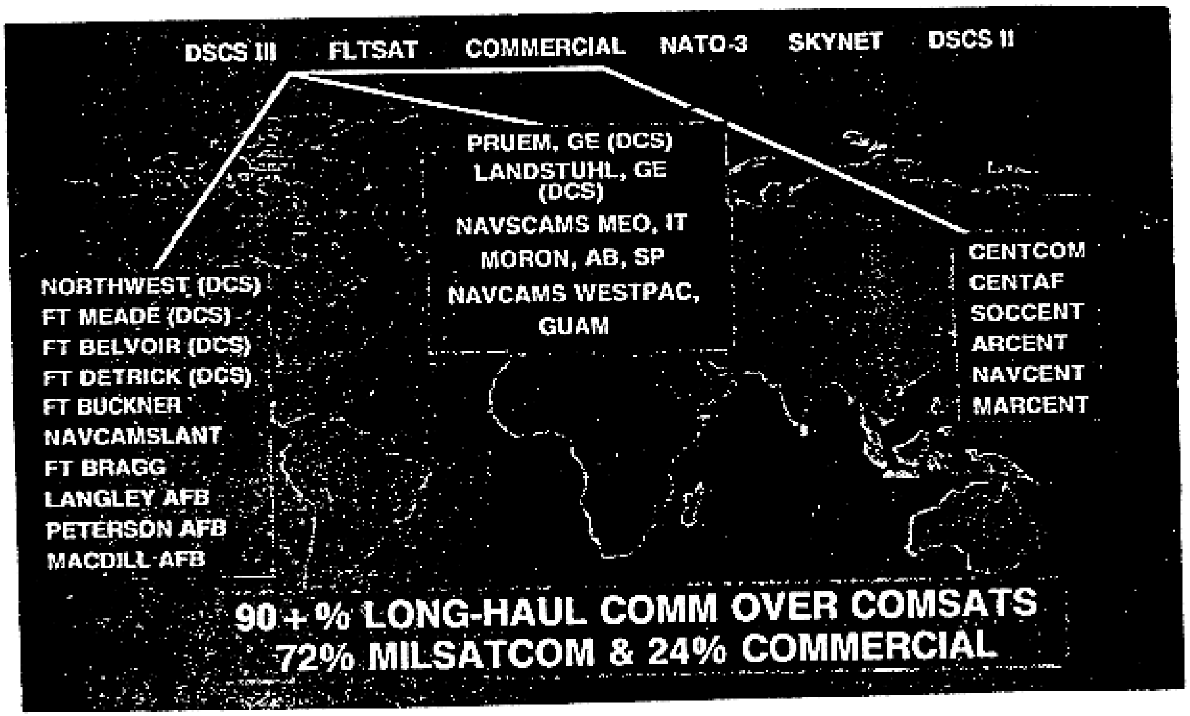


FIGURE IS UNCLASSIFIED

Figure 5-10, COMSAT INTER-THEATER SUPPORT (U)

Table 5-6, COMSAT SUPPORT (U)

SYSTEM	UHF	DSCS	SKYNET	NATO	COMMERCIAL
AVAILABLE SERVICE	6 SAT 125 CHAN	6 SAT	2 SAT	1 SAT	5 SAT
USCINCCENT USE *	98 CHAN	190 MBPS	5.4 MBPS	0.5 MBPS	33 MBPS
TERMINALS	THOUSANDS	8 GATEWAYS / 143 TER			14 TER

* Two MACSAT type satellites also provided support.
SAT = SATELLITES
CHAN = CHANNELS
MBPS = Mega Bits per Second
TER = TERMINALS
Data for Table 5-6 provided by Joint Staff/J6Z

TABLE IS UNCLASSIFIED

MILSATCOM CONTROL (U)

(U) COMSAT support provided to USCINCCENT during Operations Desert Shield and Desert Storm was extensive, involving over ten communications satellite systems (see Figure 5-11). This support required the coordination and integration of numerous agencies and was shaped over months as forces deployed and communications systems were brought on line or transferred from one DOD user to USCENTCOM. The following paragraphs detail how MILSATCOM support was supplied for validated requirements.

(U) When a theater CINC requested DSCS support, the request was processed by USARSPACE if it was tactical and DISA if it was strategic (see figure 5-11). DISA coordinated and approved the request if there were no conflicts. When there were conflicts, the Joint Chiefs of Staff (JCS) performed an adjudication process to provide USCENTCOM forces the support they needed. The DSCS network was planned by USARSPACE if it was tactical and DISA if it was strategic (Note. All DSCS networks were approved by DISA). Network and payload control was exercised by USARSPACE. The DSCS satellites were controlled by AFSPACECOM. Finally, anomaly resolution engineering support was provided by Space Systems Division (SSD) and the Defense Communications Engineering Command (DCEC). [5,7]

(U) For FLTSATCOM, the channels are normally assigned to the theater CINC. Requests for support would be processed and approved by the theater CINC. When there were conflicts, the JCS performed an adjudication process. The Commander Naval Computer and Telecommunications Command (COMNAVCOMTELCOM (CNCTC)) through the Naval Computer and Telecommunications Area Master Station (NCTAMS) assigned frequencies and monitored circuit status for the CINC. (Note. NCTAMS was previously designated as the Naval Communications Area Master Station (NAVCAMS).) The user of the circuit was responsible for planning and controlling the network. When appropriate, NCTAMS supported network planning. AFSPACECOM controlled the satellites, and the Commander Space Naval Warfare Systems Command (SPAWAR) performed engineering. [5,7,13,14]

(U) For AFSATCOM, the Strategic Air Command (SAC) processed, coordinated, and approved requests if there were no conflicts. The JCS did the adjudication process if there were conflicts. SAC planned the network, and Air Force Communications Command (AFCC) controlled the network. AFSPACECOM controlled the satellites, and SAC did the engineering. [5,7]

(U) Figure 5-11 shows the overall COMSAT community. MILSATCOM support for the war with Iraq involved interfaces and coordination with U.S. and foreign governments and commercial COMSAT agencies. Obtaining this level of support involved a significant effort by JCS organizations (primarily the Joint Staff/J6Z). This process required that a theater CINC's J6 (which USCINCCENT's did) know a great deal about COMSATs to ensure comprehensive COMSAT support--there was no one-stop

SYSTEM	REQUEST	PROCESS REQUEST	COORD	APPROVE CHANGE	NETWORK PLANNING	NETWORK CONTROL	TT&C	ENGINEERING
DSCS	CINC	ARSPACE (GMF) DISA(STRAT)	DISA/ * JCS	DISA/ * JCS	ARSPACE (GMF) DISA(STRAT)	ARSPACE	AFSPACE	SSD/DCEC
FLTSAT	CINC	CINC	CINC/ * JCS	CINC/ * JCS	USER NCTAMS	USER	AFSPACE	SPAWAR
AFSAT	CINC		[illegible] JCS	SAC JCS			AFSPACE	[illegible]
COMMERCIAL	CINC	DCA/ DECCO	N/A	N/A	COMMERCIAL	COMMERCIAL	COMMERCIAL	COMMERCIAL
LEASAT/ GAPFILLER	CINC	CINC	CINC/ ** JCS	CINC/ * JCS	USER NCTAMS	USER	COMMERCIAL	COMMERCIAL
MACSAT	COMMAND	DARPA	N/A	DARPA	COMMERCIAL	COMMERCIAL	COMMERCIAL	COMMERCIAL
SKYNET	CINC	ARSPACE	JCS	ARSPACE	BRITISH	BRITISH	BRITISH AFSPACE	BRITISH
NATO-3	CINC EUCOM	NATO	NATO JCS	JCS	NATO	NATO	AFSPACE	SSD

CINC ARSPACE SSD/DCEC NCTAMS SPAWAR AFCC DECO BRITISH

DISA JCS AFSPACE USER SAC COMMERCIAL

* NO CONFLICT ** CONFLICTS NATO EUCOM

FIGURE IS UNCLASSIFIED

Figure 5-11, MILSATCOM CONTROL (U)

shopping for COMSAT support. It also required time and the ability to transfer communications support between DOD users. The level of MILSATCOM support for the Persian Gulf War might have been much more difficult or impossible due to the limited number of MILSATCOM assets if there had been a second crisis or conflict that absorbed limited communications assets. [5,7]

(U) Figure 5-11 highlights that this is an involved process, but it worked. During Desert Storm, U.S. forces got the communications support they needed. This doesn't say that they got every circuit they requested and that there weren't some significant problems. But, by and large, this process worked well--however, it is involved. (Note. USSPACECOM is not on the chart. As stated in the Unified Command Plan and the Forces for U&S Commands, USSPACECOM has combatant command (COCOM) over the military satellites listed here, but does not control the communications support provided the U&S CINCs or the JCS--USCINCSPACE only impacts the communications packages aboard these satellites in a coordination role.) [5,7]

ELECTRONIC WARFARE (U)

[redacted]

[redacted]

TABLE 5-7, COMSAT VULNERABILITY (U)

TARGET	TYPE	POWER	NUMBER
[redacted]			

VULNERABLE U.S. TARGETS:

[redacted]

[redacted]

(U) U.S. forces were absolutely dependent on COMSATs. Desert Shield and Desert Storm again highlighted the necessity for reliable, robust, and jam-resistant communications (both data and voice) to worldwide tactical users. COMSATs were the backbone for long-haul and intra-theater connectivity for the Persian Gulf War. The time to build up forces and the lack of a second contingency or conflict allowed MILSATCOM to be adjusted and enhanced to meet the needs of USCINCCENT. Although the U.S. military dependence on MILSATCOM support will continue, the same set of circumstances may, and will probably, not exist in future contingencies. To ensure the U.S. warfighter has the communications support he or she needs, communications systems such as Milstar and UHF Follow-On, that are capable of providing reliable, worldwide support, must remain a top priority. [12]

(U) Because the build-up lasted for a prolonged period, there was time to reconfigure MILSATCOM systems and to lease commercial satellite communications systems to augment the DOD capability. USSPACECOM, DISA, and the Joint Staff made use of the interval to coordinate with MILSATCOM system managers and USCENTCOM to ensure responsive communications support.

(U) Commercial COMSATs also provided vital support to U.S. military operations. Prior to the conflict, commercial satellite support was recognized as a vital part of military operations and identified as a requirement in USCENTCOM's Operations Plan. [11]

[redacted]

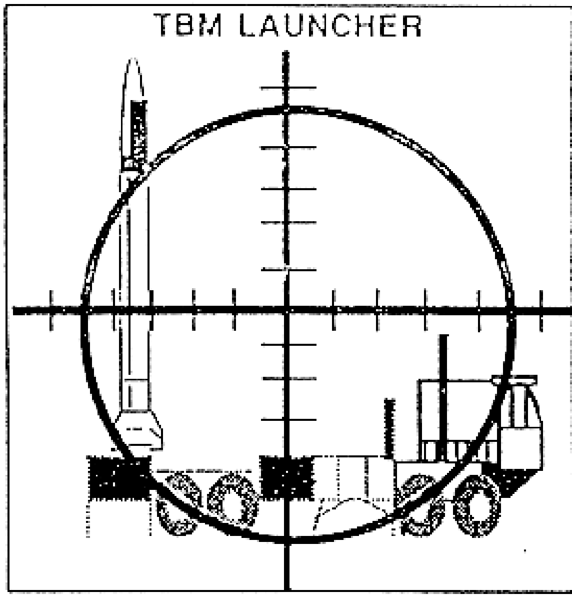
(U) There is no "one-stop shopping" for obtaining COMSAT support, and USCINCSPACE currently impacts the communications support primarily in a coordination role. There were over ten different military and commercial satellite communications systems supporting USCENTCOM operations--with as many managers. The system worked well, but USSPACECOM's experience highlights the need for stronger involvement by a central authority in allocating scarce space assets.

[redacted]

[redacted]

SECTION 5.6

INTELLIGENCE (U)



[redacted] In addition to warning, the elimination of mobile-SCUD launchers was a top priority and one of the most difficult tasks of the war. USSPACECOM called in launch locations, identified by DSP, to USCENTCOM, allowing strike aircraft to be vectored to attack mobile-SCUD launchers. [redacted]

TIMELINE (U)

DATE		EVENT
19-29 July	1990	Iraq force buildup
1 August		Iraq units at Kuwait border
2 August		Invasion
[redacted]		
16 November		USSPACECOM/J2C visit to USCENTCOM (Rear)
[redacted]		

[redacted]

[redacted]

SEQUENCE OF EVENTS (U)

[redacted]

[redacted]

(U) On 1 November, USARSPACE contacted the intelligence community staff to downgrade national imagery for wider distribution. CIA approved a USARSPACE-DIA downgrading technique on 5 January 1991.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

b(1)

FIGURE 5-12, SCUD LAUNCH LOCATION REPORTING (U)

[redacted]

b(1)

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INTELLIGENCE ASSESSMENT (U)

(S) Intelligence activities at USSPACECOM contributed to finding mobile-SCUD launchers and provided an input to the battle damage assessment (BDA) process. Mobile-SCUD launchers were very difficult to find.

b(1)

Combining these efforts would likely provide better support in finding mobile TBM launchers.

b(1)

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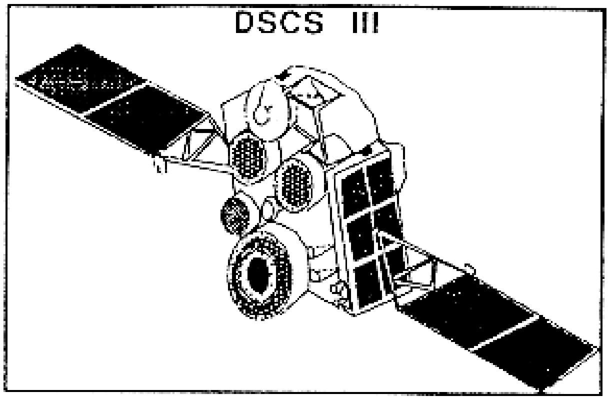
SECTION 6

UNFULFILLED REQUESTS (U)



(U) In accordance with USCINCSPACE direction, unfulfilled requests from Desert Shield/Storm were to be identified and investigated. The bulk of all space requests met deployment/operational requirements. There were some items that could have been done more quickly or completely (e.g., GPS receiver deployment, COMSAT support, etc.). But there was one exception to this, a request for the accelerated launch of a DSCS III.

DSCS III LAUNCH (U)

(U) During November 1990, CENTAF requested that a DSCS III satellite be launched early to ensure that communications supporting Desert Shield were not interrupted. [1]

(S) USSPACECOM and AFSPACECOM reviewed this request and determined that the Eastern Atlantic (EASTLANT) DSCS III satellite was not in imminent danger of failing.

b(1)

(U) During this investigation, USSPACECOM and AFSPACECOM personnel determined that the replacement DSCS III satellite could not be launched before its scheduled time frame of mid 1991. The DSCS III launch was originally scheduled for November 1986 on the Space Shuttle. Following the Challenger disaster, the DSCS III satellite was moved to an Atlas expendable launch vehicle (ELV). This required that a new upper stage be developed. This development was started but was not scheduled to be completed until early 1991. The satellite could not be launched any earlier than July 1991. [3]

U.S SPACE LAUNCH CAPABILITY (U)

(U) Between 2 August 1990 and the start of Desert Storm, six military payloads were launched (see Table 6-1). All of these launches involved satellites that would be crucial to Desert Storm operations (GPS, DSP, DMSP, and a classified payload). [4]

TABLE 6-1, U.S. MILITARY SPACE LAUNCHES (U)

DATE	BOOSTER	PAYLOAD
2 AUG	DELTA II	GPS
1 OCT	DELTA II	GPS
13 NOV	TITAN IV	DSP
15 NOV	STS	CLASSIFIED
26 NOV	DELTA II	GPS
1 DEC	ATLAS E	DMSP

TABLE IS UNCLASSIFIED

(U) The military satellites on this list have a well understood build-up and check-out timeline (see Figure 6-1). The acceleration of any of these launches is constrained by numerous factors that include launch pad availability, booster/payload availability, and range schedule constraints. The variations in booster types and complexity of U.S. launch operations adds to the launch timelines. Just before Desert Storm began, there were 11 military and civilian satellites scheduled to be launched from U.S. launch sites through May 1991 (see Table 6-2). This table shows that the same launch pads are used for military and civilian payloads, and several different boosters are used. The U.S. space launch system was not built to be reactive and support short notice launch operations. In contrast, the Soviet-demonstrated launch capabilities are shown in Figure 6-2. The Soviets achieved this launch capability by designing their space program to be able to rapidly launch or replenish satellites.

TABLE 6-2, U.S. LAUNCH SCHEDULE(U) *

DATE	BOOSTER	PAYLOAD	SITE
7 JAN	DELTA II	NATO IV A	LC-17B
30 JAN	DELTA II	GPS	LC-17A
12 FEB	TITAN IV	SM 1V**	SLC-4E
15 FEB	DELTA II (C)	INMARST	LC-17B
13 MAR	DELTA II	GPS	LC-17A
10 APR	DELTA II (C)	ASC/CONTEL	LC-17B
18 APR	ATLAS I (C)	BS-3H	LC-36B
2 MAY	DELTA II (C)	AURORA II	LC-17A
14 MAY	ATLAS E	NOAA	SLC-3W
29 MAY	DELTA II	GPS	LC-17B
31 MAY	ATLAS II	DSCS III	LC-36A

* - Schedule as it existed on 17 DEC 90.
** - Classified payload
C - Commercial payload
SLC - Space launch complex
LC - Launch complex

TABLE IS UNCLASSIFIED

b(1)

FIGURE 6-2, SOVIET SPACE LAUNCH TIMELINES (U)

LAUNCH ASSESSMENT (U)

(U) The DSCS III launch situation highlights the need for a responsive space launch capability. The United States continues to be overly constrained by existing launch systems which cannot respond quickly to short notice requirements.

(U) USSPACECOM and the U&S CINCs have long been aware that the United States' current launch posture is a weakness. The recent experience with DSCS III reinforces the need to continue upgrading existing launch systems and to pursue alternate launch vehicles. The fielding of a reactive U.S. launch capability will not be cheap. The current launch systems were developed to meet research and development (R&D) requirements. The infrastructure for the ELVs fell into decay when the United States decided to launch all satellites on the Space Transportation System (STS, Space Shuttle). Commonality between payloads and boosters is by exception rather than by design. Additionally, the building and check-out of launch vehicles and payloads on the launch pad puts choke points in the space launch process. AFSPACECOM has a master plan to overcome much of the above, but it will take time and money to rebuild and "operationalize" the U.S. space launch capability.

SECTION 7

RECOMMENDATIONS (U)

(U) Preplanning is essential for effective support from space. Space forces were there when required, but significant effort was needed to optimize their effectiveness. The United States may not have the luxury of a six-month build-up to develop procedures or procure equipment in a future conflict. The alerting system that warned of SCUD attacks was essentially constructed from scratch after August 1990 by USCENTCOM and USSPACECOM personnel. The U.S. troops which initially deployed had limited access to the U.S.'s most effective means of navigation, the Global Positioning System (GPS), and remained so until the Services used the delay in the war's start to procure thousands of commercial GPS receivers. These and other experiences indicate that, in the future, OPLANs and JCS directives must consider the handling and use of space-derived information and support. The benefits of space must become ingrained in our joint planning and, more importantly, practiced in exercises at the national, theater, and unit levels. [1]

NORMALIZE TACTICAL WARNING (ALL SPACE) SUPPORT (U)

(U) The first recommendation is to "normalize" tactical warning support. This is a joint Theater CINC-USCINCSPACE action.

(U) The theater forces must have the receive equipment and expertise so they can receive, process, act on, and disseminate warning data. OPLANs must address both USSPACECOM and theater CINC requirements. They must specify what warning is to be provided and how. They should also specify how warning is received, processed, and acted on by theater forces. If warning is needed by a Patriot battery, this must be stated in the OPLAN.

(U) Dedicated and reliable communications are needed to guarantee warning will get through. These communications must be preplanned and identified in OPLANs. Additionally, exercises must include tactical warning to train Space Command and theater CINC personnel. These exercises should include the entire warning system, i.e., from DSP site to Patriot battery. As a minimum, the exercise should stress the same timelines and message dissemination that were encountered in Desert Storm. In many instances, timelines for warning will have to be tightened to meet theater needs.

[redacted] Feedback networks are needed to identify problem areas. The Constant Source receiver that was displaying warning data ten minutes after the SCUD impacted (see Section 5-1) is the type of device that must be quickly identified and fixed. USSPACECOM and USCENTCOM personnel had to cooperate in testing this equipment and isolating the problem. Future problems such as these must be identified before an adversary launches missiles. [redacted]

(U) USCINCSPACE should tailor warning to theater CINC needs. What worked for USCENTCOM may not meet the needs of United States Pacific Command (USPACOM). USSPACECOM should also develop a dedicated tactical warning capability to ensure both strategic and tactical warning requirements can be met simultaneously.

(U) Each of the above items must be addressed by both USCINCSPACE and the theater CINCs. U.S. Space Command can develop inputs to OPLANs, but these will be useless unless the supported CINC incorporates them into the OPLAN, which is written and published by the U&S command, and updates the other annexes to deal with how warning data is processed and acted upon. For all the above items, USSPACECOM and theater CINC personnel must act together to ensure warning support is effectively provided to U.S. forces.

(U) What was said about warning is true for all space systems. All space support should be normalized. It should be put into procedures, checklists, plans, training, and exercises. Space support should be institutionalized in the same manner as we have institutionalized transportation support with standard interfaces and known/understood mechanisms to give and receive space support.

ACQUISITION OF USER TERMINALS (U)

(U) During the intervening months between the declaration of Operation Desert Shield and the start of Operation Desert Storm, GPS terminals, Constant Source terminals, prototype DMSP-weather receivers, and MSI workstations were acquired and sent to Saudi Arabia to support U.S. forces. It took months to procure and ship these terminals and train personnel in their use. Along with the very glamorous and expensive space system, the terminals that receive, process, and display space data should be procured. This is a Service responsibility. USCINCSPACE and the theater CINCs must lead the services into positions that ensure receive terminals are procured in a timely fashion and are available to meet the needs of American fighting men and women.

MAINTAIN CURRENT GPS SA POLICY (U)

(S) The ability to reserve highly-precise GPS data for U.S. war-fighters or to deny it to an adversary depends on being able to activate the GPS-SA feature.

b(1)

SUPPORT CHANGES TO MILSATCOM ROLES (U)

(U) While USCINCSPACE is given COCOM by the JCS of designated MILSATCOM systems, no formal relationship exists between USCINCSPACE and MILSATCOM system managers. The operational control of MILSATCOM systems remains fragmented among various agencies, services, and commands. USSPACECOM strongly believes that operational forces would be better served by a streamlined chain of command and well defined responsibilities to serve contingency/wartime C^2. The Desert Shield/Storm experience highlights the need for a centralized SATCOM structure that operates as well in wartime as it does in peacetime, and emphasizes support to CINCs. Proposed changes to CMOP 37 address the needs identified in the above paragraph. These changes will reaffirm USCINCSPACE's advocacy role for MILSATCOM.

MAINTAIN U.S. MSI CAPABILITY (U)

(U) The United States must maintain its MSI capability and give the user the type of support he or she needs to use MSI data. Unless action is initiated quickly, the U.S. MSI capability will "go away" (see Section 5.4). If this happens, the U.S. war-fighter will be dependent on foreign sources for MSI data. Additionally, the supply of MSI data should be improved so that U.S. military personnel receive the type and quantity of MSI data they need.

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SECTION 8.1

METHODOLOGY (U)

(U) On 28 October 1990, General Donald J. Kutyna, Commander in Chief United States Space Command (USCINCSPACE), directed that a lessons learned effort be conducted on USSPACECOM support to operation Desert Shield. This effort was to measure the impact of space systems and determine their strengths and weaknesses. It would highlight unfulfilled requests; explore USSPACECOM-Component Command staff functions, supporting-to-supported CINC relationships, and policy issues; and finally, prepare for congressional testimony.[1]

(U) This lessons learned effort was completed and presented to General Kutyna in the form of a briefing on 23 January 1991. Following this briefing, General Kutyna directed that the recommendations provided in the briefing be fleshed out for review and action. To implement General Kutyna's tasking, Vice Admiral William A. Dougherty, Jr., Deputy USCINCSPACE, directed that the recommendations provided in the Desert Shield briefing be expanded and offices of primary responsibility and offices of corollary responsibility be identified.[2]

(U) On 11 February 1991, VADM Dougherty directed the lessons learned effort be continued to include Operation Desert Storm.[3] Where the previous Desert Shield effort focused on all space support, the Desert Storm effort would focus on direct support provided by USSPACECOM and its components (USARSPACE, NAVSPACECOM, and AFSPACECOM). This effort was completed, and General Kutyna was presented the results on 29 April 1991.[4]

(U) Between May and August 1991, the results of the USSPACECOM Desert Shield/Desert Storm Lessons Learned Effort were briefed to senior and working level personnel in the Office of the Secretary of Defense, Joint Staff, Unified Commands, Strategic Defense Initiative Organization (SDIO), and space/strategy-related contractor or study groups.[5]

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[redacted]

SECTION 8.2

TACTICAL WARNING SUPPORT (U)

(U) USSPACECOM employed systems that were designed for strategic warning or space surveillance to meet the tactical ballistic missile (TBM) warning needs of USCENTCOM forces during Operations Desert Shield and Desert Storm. The space-based system, the Defense Support Program (DSP), was deployed over twenty years ago and updated continuously to meet strategic warning requirements. The ground-based system, the Pirinclik SPACETRACK radar, was deployed in the late 1960s and updated continuously to meet space surveillance requirements.

DEFENSE SUPPORT PROGRAM (U)

[redacted] The DSP system consists of satellites at geosynchronous orbit that monitor the earth for infrared (IR) events (see Figure 8-1). If the IR event is bright enough, DSP can detect it. [redacted]

[redacted]

Figure 8-1, DSP SYSTEM DESCRIPTION (U)

[redacted]

[redacted]

[redacted] The ground stations that monitor DSP data are at Buckley Air National Guard Base, Colorado (CGS); [redacted] and Woomera, Australia (OGS). These ground stations prepare launch alert and launch report messages. [redacted]

These messages are transmitted over high speed data lines to the NORAD Cheyenne Mountain Complex and the USSPACECOM Space Command Center. These reports are evaluated for strategic and tactical threats and forwarded to national or tactical users. In the case of Desert Storm, SCUD alerts were passed over voice and computer links to USCENTCOM forces. Section 5.1 details how this system operated.

[redacted]

Figure 8-2, DSP DEPLOYMENT FOR DESERT STORM (U)

GROUND-BASED RADARS (U)

[redacted] The missile warning sites that support USCINCSPACE's warning mission are shown on Figure 8-3. These sites consist of phased array and mechanical radars. [redacted] The site at Pirinclik, Turkey, is a mechanical tracker [redacted]

[redacted]

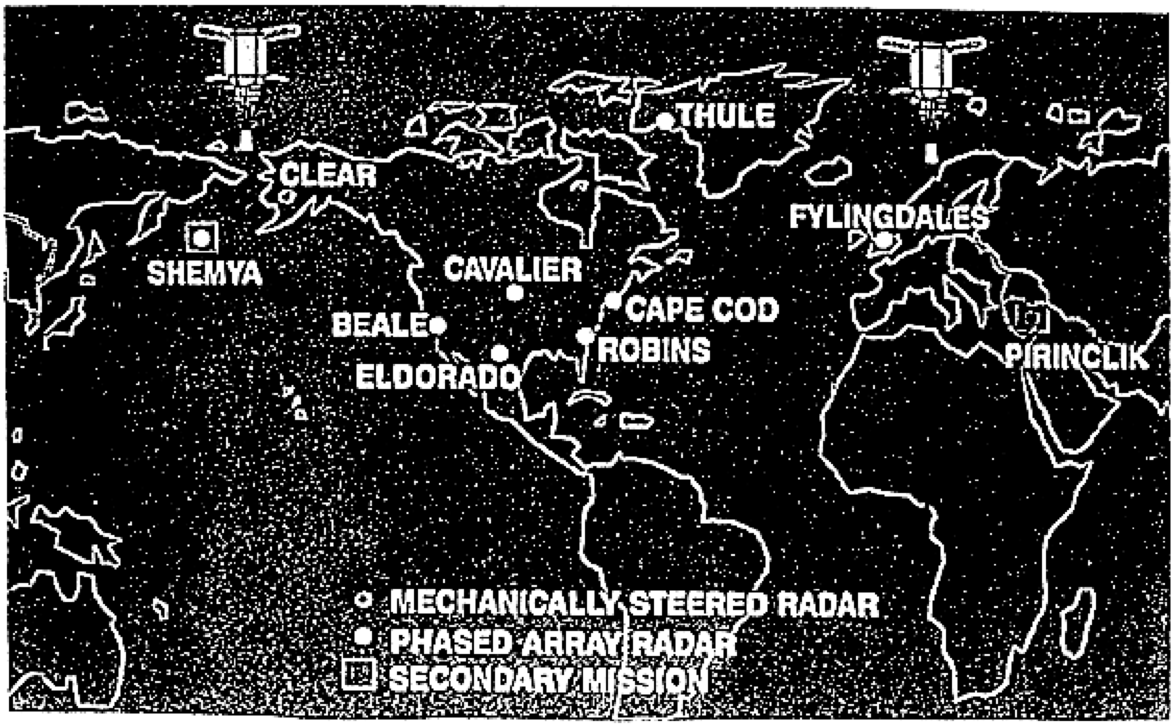

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Figure 8-3, Missile Warning Sites (U)

[redacted] Pirinclik was on the voice warning network that provided SCUD alerts to USCENTCOM forces. When a SCUD was detected by Pirinclik, the crew passed the SCUD alert on the voice network and provided target (i.e., impact) information. Pirinclik also passed assessment information over a separate voice line to the USSPACECOM Missile Warning Center (MWC). The MWC alerted Pirinclik to potential SCUD activity by cuing the radar site based on DSP alerts.

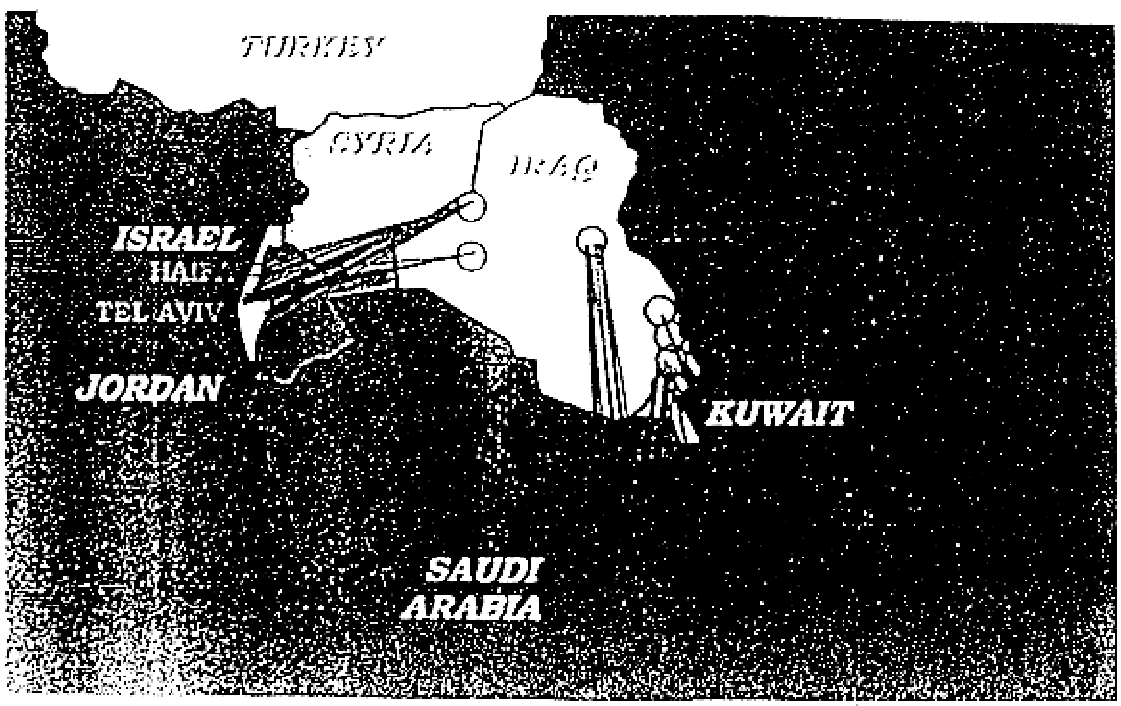
[redacted]

Figure 6-4, PIRINCLIK COVERAGE (U)

SECTION 8.3

SCUD ATTACK STATISTICS (U)

(U) FIGURE 8-5 and Table 8-1 detail SCUD attacks. Data for the figure and table are contained in the DESERT STORM WARNING DATA ANALYSIS Report (Draft), 24 SEP 1991. For additional information, contact USSPACECOM/AN. Data displayed in the table was available to SPACC personnel or was received in "after-action reports" from supporting agencies (e.g. FTD). Specific information on data sources and uses is contained at the end of the table.



[redacted]

Figure 8-5, IRAQ SCUD ATTACKS (U)

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TABLE 8-1 SCUD STATISTICS

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SECTION 9

ACRONYMS

ABN	Airborne
AFSATCOM	Air Force Satellite Communications System
AFSPACECOM	Air Force Space Command
ARCENT	U.S. Army Forces, U.S. Central Command
AO	Area of Operations
ATBM	Anti-tactical ballistic missile
BDA	Battle damage assessment
BDU	Battle dress uniform
CSG	Cryptologic Support Group
CENTAF	U.S. Air Forces, U.S Central Command
CIA	Central Intelligence Agency
CINC	Commander in Chief
CIW	Combined Intelligence Watch
CMOP	Chairman Memorandum of Policy
CNCTC	COMNAVCOMTELCOM (Commander Naval Computer and Telecommunications Command)
COCOM	Combatant Command
COMSAT	Communications satellite
CONUS	Continental United States
CRC	Control and Reporting Center
CRITIC	Critical Information System
C^2	Command and control
DARPA	Defense Advance Research Projects Agency
DCA	Defense Communications Agency
DCEC	Defense Communications Engineering Command
DCI	Director Central Intelligence
DCSOP	Deputy Chief of Staff for Operations
DEFSMAC	Defense Special Missile & Aeronautics Center
DIA	Defense Intelligence Agency
DISA	Defense Information Systems Agency
DMA	Defense Mapping Agency
DMSP	Defense Meteorological Satellite Program
DOD	Department of Defense
DSCS	Defense Satellite Communications System
DSP	Defense Support Program
DTED	Digital Terrain Elevation Data
EASTLANT	Eastern Atlantic
EHF	Extremely high frequency

ELV	Expendable launch vehicle
EOSAT	Earth Observation Satellite Company
EUCOM	European Command
EW	Electronic Warfare
FAISS	FORSCOM Automated Intelligence Support System
FEWS	Follow-on Early Warning System
FLTSAT	Fleet Satellite
FLTSATCOM	Fleet Satellite Communications
FORSCOM	Forces Command
GMF	Ground Mobile Force
GOA	Government of Australia
GPS	Global Positioning System
HF	High frequency
ICBM	Intercontinental Ballistic Missile
IO	Indian Ocean
IR	Infrared
JCS	Joint Chiefs of Staff
JEWC	Joint Electronic Warfare Center
JPO	Joint Program Office
JOC	Joint Operations Center
JOTS	Joint Operation Tactical System
JS	Joint Staff
JROC	Joint Requirements Oversight Council
Km	Kilometer
KW	Kilowatt
LC	Launch complex
LES	Lincoln Laboratory Experimental Satellites
LNO	Technical Liaison Officer
MACSAT	Multiple Access Communications Satellite
MAF	Marine Amphibious Forces
METSAT	Meteorological (Weather) satellites
MILSATCOM	Military satellite communications
MNS	Mission Need Statement
MSI	Multi-spectral imagery
MWC	Missile Warning Center
NAVSPACECOM	Naval Space Command
NCA	National Command Authority

NCTAMS	Naval Computer and Telecommunications Area Master Station
NMIST	National Military Intelligence Support Team
NOAA	National Oceanographic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NSA	National Security Agency
OPLAN	Operations plan
O&M	Operations and maintenance
RSSC	Regional Space Support Center
R&D	Research and development
SA	Selective Availability
SAC	Strategic Air Command
SATCOM	Satellite communication
SDIO	Strategic Defense Initiative Organization
SSD	Space Systems Division
SEP	Spherical error probable
SHF	Super-high frequency
SLBM	Sea Launched Ballistic Missile
SLC	Space launch complex
SLGR	Small lightweight GPS receiver
SOCCENT	U.S. Special Operations Command, U.S. Central Command
SPACC	Space Command Center
SPAWAR	Commander Space Naval Warfare Systems Command
SPOT	Satellite Probatoire d'Observation de la Terre (Exploratory Satellite for Earth Observation)
STS	Space Transportation System
TACC	Tactical Air Control Center
TBM	Tactical ballistic missile
TERS	Tactical Event Reporting System
TFU	Tactical Forecast Unit
TIDS	Tactical Imagery Dissemination System
TLAM	Tomahawk Land Attack Missile
TOPO	Topographical
TRE	Tactical Receive Equipment
TRAP	TRE Related Applications
TUDE	Tactical User Display Equipment
TWT	Traveling wave tube
UHF	Ultra-high frequency
U.S.	United States
USARSPACE	Army Space Command
USCENTCOM	U.S. Central Command
USCINCCENT	Commander in Chief United States Central Command

USCINCSPACE	Commander in Chief United States Space Command
USPACOM	United States Pacific Command
USSOCOM	U.S. Special Operations Command
USSPACECOM	United States Space Command
U&S	Unified and Specified

SECTION 10.0

REFERENCES

SECTION 4.1 SPACE SYSTEMS

1. Space Systems Summaries, Annex C, 4 Apr 88, Page C-42.
2. Space Systems Summaries, Annex C, 4 Apr 88, Page C-11.
3. Space Systems Summaries, Annex C, 4 Apr 88, Page C-9-10.
4. Space Systems Summaries, Annex C, 4 Apr 88, Page C-8.
5. Space Systems Summaries, Annex C, 4 Apr 88, Page C-36.
6. Space Systems Summaries, Annex C, 4 Apr 88, Page C-33.
7. Space Systems Summaries, Annex C, 4 Apr 88, Page C-34.

SECTION 4.2 AREA OF OPERATIONS

1. Interview with CDR Sharrett, USSPACECOM/J3O on 1 Dec 90

SECTION 5.1 WARNING

1. Interview with LCDR McFadden, USSPACECOM/J3MM on 1 Nov 90
2. Interview with Capt Kordell, USSPACECOM/J3MM on 15 Oct 90
3. Interview with LTC Groskopf, USSPACECOM/J3OT on 10 Jan 91
4. Interview with CPT Lobdell, USARSPACE/MOSC-OI on 20 Nov 90
5. Interview with Lt Col Hale, AFSPACECOM/DOXW on 7 Nov 90
6. Briefing by Maj Knight, AFSPACECOM/DOM to VADM Dougherty on 26 Sep 90
7. USSPACECOM/J3 MSG, 171705Z OCT 90
8. USSPACECOM/J3 MSG, 192240Z OCT 90 and USCINCCENT/J3 MSG, 130930Z NOV 90
9. AFSPACECOM/DOX Lessons Learned Input, 1 Mar 91
10. Interview with Lt Col Briscoe, USSPACECOM/J3MM on 28 Apr 91
11. Interview with MAJ Mortensen, USSPACECOM/J3MM on 20 Nov 91
12. Interview with LCDR Taggart, USSPACECOM/J3CP on 22 Mar 91
13. Meeting between Gen Kutyna, USCINCSPACE and Lt Gen Moorman, AFSPACECOM/CC on 20 Jan 91
14. Interview with Mr O'Neill, AFSPACECOM/LKW, on 15 Mar 91
15. Interview with LT COL Lichtenberger, USSPACECOM/J2RP on 20 Mar 91
16. Interview with CPT Hyman on 24 May 91, Joint Staff/J5 (assigned with 11 ADA during Desert Storm)
17. Briefing by LCDR McFadden, USSPACECOM/J3MM on 27 Sep 90
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