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PROJECT CHECO SOUTHEAST ASIA REPORT

IGLOO WHITE

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PROJECT
Contemporary
Historical
Examination of
Current
Operations
REPORT

IGLOO WHITE

JANUARY 1970 - SEPTEMBER 1971

1 NOVEMBER 1971

HQ PACAF
Directorate of Operations Analysis
CHECO/CORONA HARVEST DIVISION

Prepared by:

CAPT HENRY S. SHIELDS
Project CHECO 7th AF, DOAC

[redacted]

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS PACIFIC AIR FORCES
APO SAN FRANCISCO 96553

OFFICE OF THE CHIEF OF STAFF

PROJECT CHECO REPORTS

The counterinsurgency and unconventional warfare environment of Southeast Asia has resulted in the employment of USAF airpower to meet a multitude of requirements. The varied applications of airpower have involved the full spectrum of USAF aerospace vehicles, support equipment, and manpower. As a result, there has been an accumulation of operational data and experiences that, as a priority, must be collected, documented, and analyzed as to current and future impact upon USAF policies, concepts, and doctrine.

Fortunately, the value of collecting and documenting our SEA experiences was recognized at an early date. In 1962, Hq USAF directed CINCPACAF to establish an activity that would be primarily responsive to Air Staff requirements and direction, and would provide timely and analytical studies of USAF combat operations in SEA.

Project CHECO, an acronym for Contemporary Historical Examination of Current Operations, was established to meet this Air Staff requirement. Managed by Hq PACAF, with elements at Hq 7AF and 7AF/13AF, Project CHECO provides a scholarly, "on-going" historical examination, documentation, and reporting on USAF policies, concepts, and doctrine in PACOM. This CHECO report is part of the overall documentation and examination which is being accomplished. It is an authentic source for an assessment of the effectiveness of USAF airpower in PACOM when used in proper context. The reader must view the study in relation to the events and circumstances at the time of its preparation--recognizing that it was prepared on a contemporary basis which restricted perspective and that the author's research was limited to records available within his local headquarters area.

ERNEST C. HARDIN, JR., Major General, USAF
Chief of Staff

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ABOUT THE AUTHOR

Captain Shields received his commission in the USAF upon graduation from Franklin and Marshall College, Lancaster, Pennsylvania, in June 1965. He began his active duty in October 1967 after completing a Master's Degree in Russian and East European History at Indiana University. Since that time he has served as a personnel officer and has graduated from the Defense Intelligence School, Anacosta Naval Annex, Washington, D.C. Immediately before becoming a CHECO writer, Captain Shields worked for a year in the Laos Branch of DCS/Intelligence, at Headquarters Seventh Air Force, Tan Son Nhut Airfield, Republic of Vietnam, starting in July 1970.

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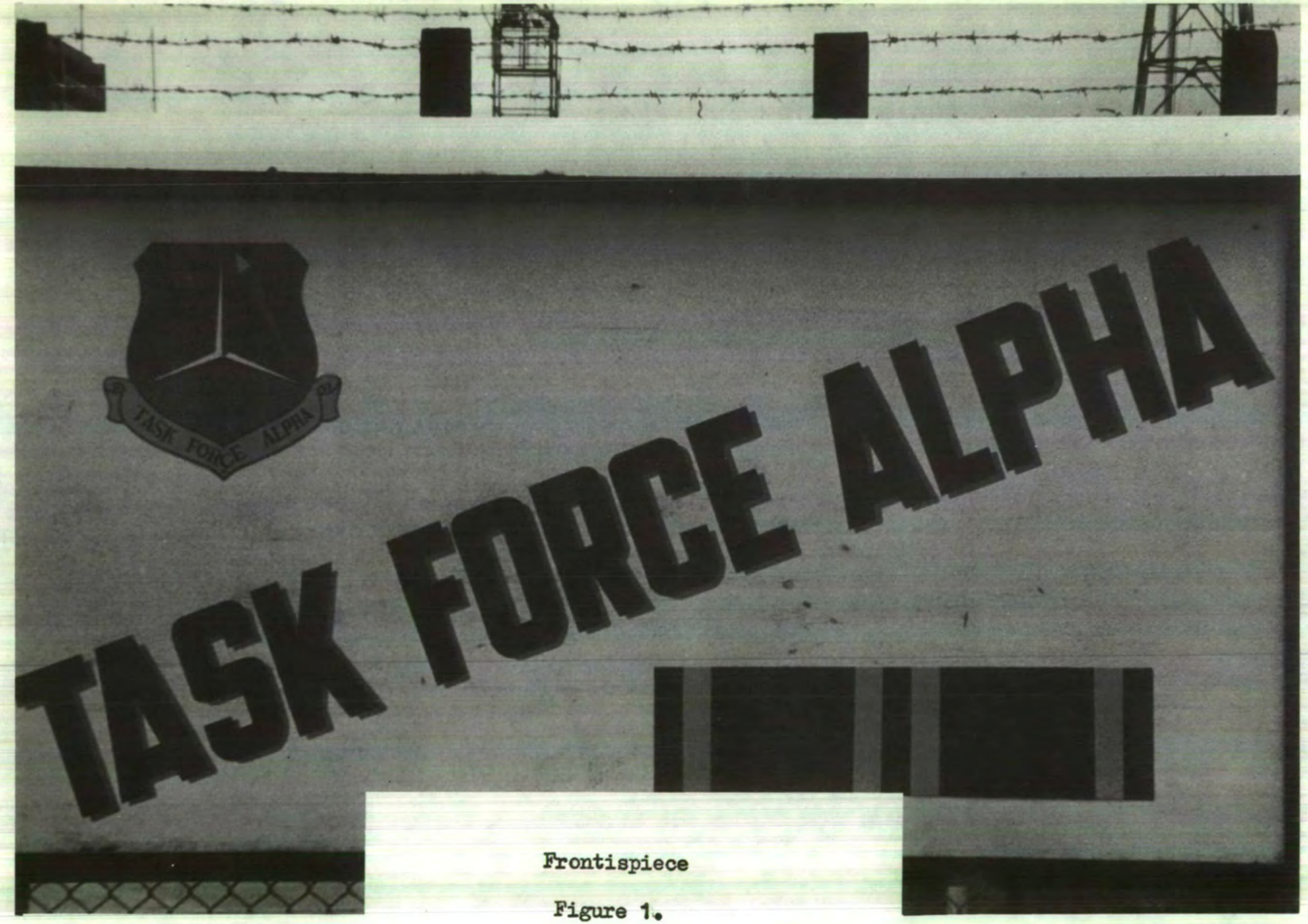

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Figure 1.

CHAPTER I

INTRODUCTION

Origins of IGLOO WHITE

IGLOO WHITE originated as part of a September 1966 plan of Secretary of Defense Robert S. McNamara to interdict North Vietnamese infiltration into the Republic of Vietnam (RVN). Originally called PRACTICE NINE, the plan was renamed ILLINOIS CITY, DYE MARKER, and MUSCLE SHOALS before it was finally designated IGLOO WHITE in June 1968. The initial PRACTICE NINE program included two major, closely related subsystems: (1) A Strong Point Obstacle sub-System (SPOS) (later redesignated DUEL BLADE) stretching across the RVN just below the Demilitarized Zone (DMZ) from the coast to the Laotian border; and (2) An air-supported anti-infiltration subsystem stretching westward from the SPOS into Laos to interdict the Ho Chi Minh Trail through central and eastern Laos, by which the enemy supplied his forces in South Vietnam. The Laotian part of the plan envisioned the emplacement of both sensor devises and special munitions to detect and impede this traffic. By July 1968, however, the munitions part of the program had proved to be relatively ineffective, and the use of air-delivered electronic ground sensors for reconnaissance purposes became the primary feature of the system.[1/] A special joint task force designated the Defense Communications Planning Group (DCPG) was established by Mr. McNamara to plan and develop this system.[2/]

DCPG's original concepts concerning the role and functioning of the new anti-infiltration system differed significantly from those of Seventh Air Force, the operational command responsible for operating MUSCLE SHOALS/IGLOO WHITE and using its data. The DCPG program plan of 25 October 1967 included a strike component consisting of "such elements as Forward Air Controller (FAC) aircraft, strike aircraft, and the Southeast Asia (SEA) Integrated Air Control System."[3/] When discussing MUSCLE SHOALS'/IGLOO WHITE's and the SPOS's objectives, this plan referred to the performance of a "large scale selective interdiction" of the enemy's resupply and support effort and implied that a relatively high priority was attached to the assignment of strike resources to areas covered by MUSCLE SHOALS/IGLOO WHITE.[4/]

The 7AF Operations Plan 481-68 of 10 August 1967, however, viewed MUSCLE SHOALS/IGLOO WHITE as an augmentation of the overall interdiction program, rather than a "substitute for it."[5/] Seventh Air Force regarded the system as functioning basically as an intelligence gathering device, rather than a control center for directing aircraft strikes on specific targets. Actual control of FAC and strike aircraft would be vested in the Seventh Air Force Command Center at Tan Son Nhut Air Base, Republic of Vietnam, and the Airborne Command and Control Center (ABCCC) C-130Es operating over the southern Laos interdiction area (Steel Tiger).[6/] As a result of this arrangement, aircraft frequently were unavailable to investigate and strike MUSCLE SHOALS/IGLOO WHITE detected targets in the early months of the program's operation, because Seventh Air Force or ABCCC were directing resources against other objectives. 7/

Operation of the IGLOO WHITE System

IGLOO WHITE consisted of three main components:

a. Battery-powered sensing devices which detected seismic, acoustical or electrical (radio-frequency energy emitted from vehicle engines) signals generated by the presence of enemy vehicles or personnel. The sensors were either implanted in the ground or were para-dropped and allowed to hang in the upper layers of the jungle canopy.

b. An airborne platform (EC-121R, QU-22B, or C-130) designed to monitor the sensors and either relay the information to a ground facility or have it manually read out by specially trained personnel aboard the aircraft.

c. An Infiltration Surveillance Center (ISC) which received sensor data from the airborne monitor and performed detailed intelligence analysis of enemy movement patterns as well as relayed the information to strike agencies in useable form for immediate action. This facility was provided by Task Force Alpha (TFA) which began operations at Nakhon Phanom Royal Thai Air Force Base (RTAFB), Thailand, on 1 December 1967. 8/

Sensor strings were placed along Lines of Communications (LOCs) which intelligence sources (photographic reconnaissance, FACs, Special Intelligence [SI], etc.) had indicated were actual or potential enemy supply routes. The types of sensors and their exact locations were determined by TFA after consideration of soil composition, the extent of tree canopy, and the possibility that terrain features (or terrain "masking") might interfere with proper monitoring of the sensors by the relay aircraft. 9/

TFA was also responsible for managing the sensor field by assigning a unique radio "signature" or "address" to each sensor to prevent two

Task Force Alpha installation at
Nakhon Phanom Royal Thai Air Base

Figure 2.

sensors from broadcasting on the same wave length. At the start of the COMMANDO HUNT VII campaign, there were 40 sensor channels available with 64 separate signatures on each channel. Allowing for a certain number of signatures which had to be kept vacant at all times to enhance signal separation and facilitate sensor management, a maximum field of approximately 200 strings (seven sensors each) was possible.[10/] Three of these channels were permanently assigned to the XXIV Corps sensor field in the RVN (known as DART I), and were managed by that command.[11/]

When sensor-implant coordinates and radio frequencies were determined, the 25th Tactical Fighter Squadron (TFS), Ubon, RTAFB, delivered the sensors on the basis of precomputed Sentinel Lock/Range Navigation (LORAN) coordinates. The F-4s dropped the sensor at a speed of 550 knots from altitudes of between 500 feet and 2,000 feet. A string of up to eight sensors could be implanted on one pass, with the sensors being automatically released at pre-selected intervals. Delivery speeds were faster and release altitudes lower than those used for normal ordnance delivery. The exact location of the sensor was determined afterwards by the use of sensor ballistic tables and photography taken by the F-4 during its delivery run. To effectively detect trucks, sensors generally had to be within 100 meters of the road they were monitoring, although this varied depending on terrain and canopy conditions.[12/]

The most common detection method used by IGLOO WHITE at the time of this report were signals from seismic sensors, although engine-ignition detection devices were being introduced into the system in small numbers. Upon receiving a seismic/ignition indication, the sensor would automatically broadcast a ten second electronic pulse which was received, amplified and then relayed by the monitoring aircraft to TFA through any of five 10 foot, 12 foot or 30 foot diameter S-Band antennae (See Figure 3). From these antennae, the signals were fed into an IBM 360/65 computer (See Figure 4) which in turn displayed the data in usable form on an IBM 2250 display console (See Figure 5). Signals were used by a Ground Surveillance Monitor (GSM), a highly trained officer familiar with the sensor field and the Laotian route structure that was responsible for monitoring a specified group of sensor strings. His task was to combine his experience and judgment with the computerized tools at his disposal to assess sensor activations in order to detect recognizable sequences which would reveal the presence of "movers" (enemy vehicles detected moving along an LOC). The GSM entered confirmed movers into the data base and relayed the information to the TFA control room for possible action.

Seismic/ignition activations were presented electronically to the GSM in a format similar to that used on the Coincidence Filtering Intelligence Reporting Medium (CONFIRM) sheets which were available as print-out copies from the computer (See Appendix I for an explanation of these sheets). The major presentation difference between hard copy CONFIRM sheets and the GSM's 2250 display was that, while the console depicted the past 30 minutes of activations on each string, the sheets showed the last 40 minutes.

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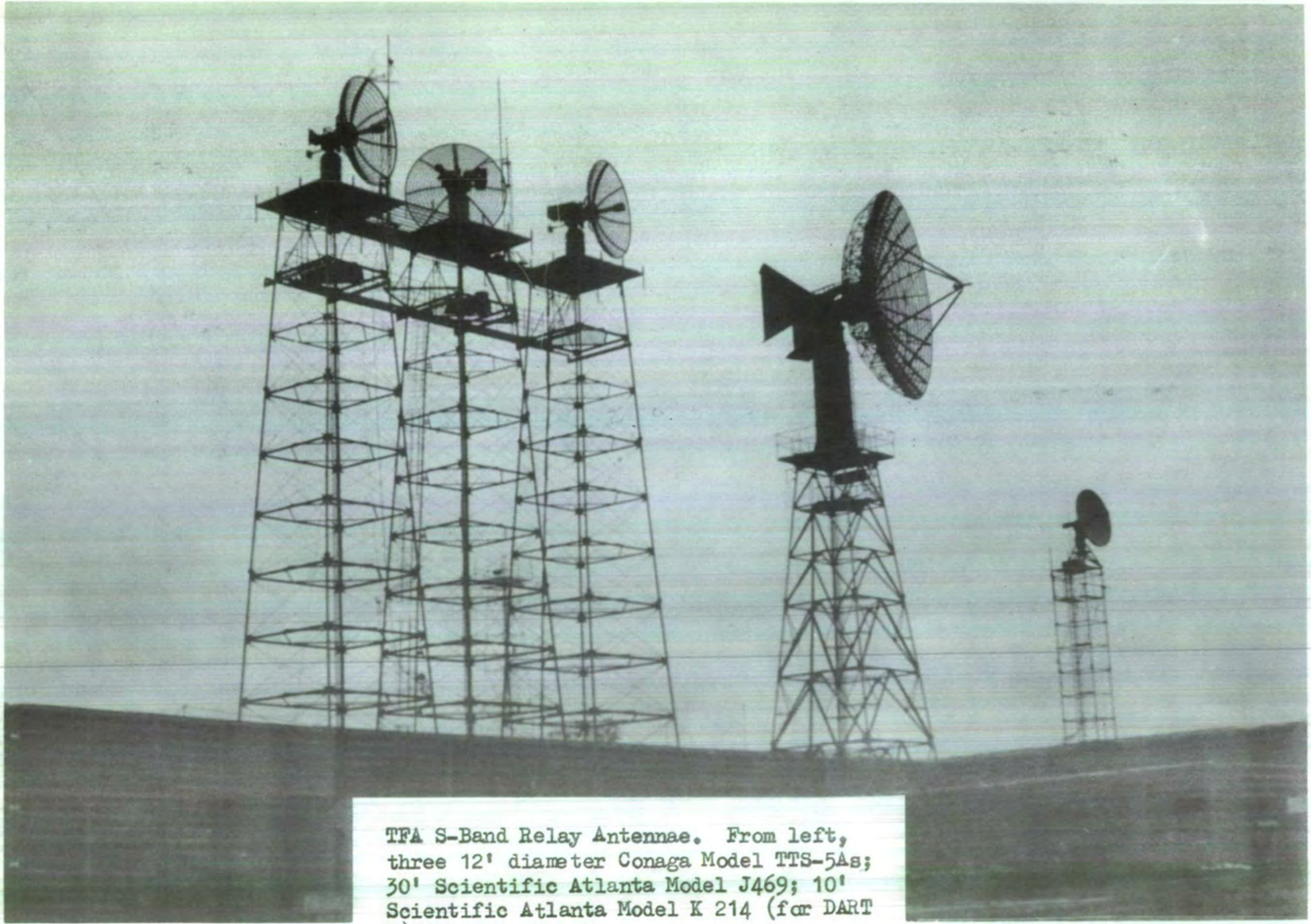

TFA S-Band Relay Antennae. From left, three 12' diameter Conaga Model TTS-5As; 30' Scientific Atlanta Model J469; 10' Scientific Atlanta Model K 214 (for DART I). Figure 3.

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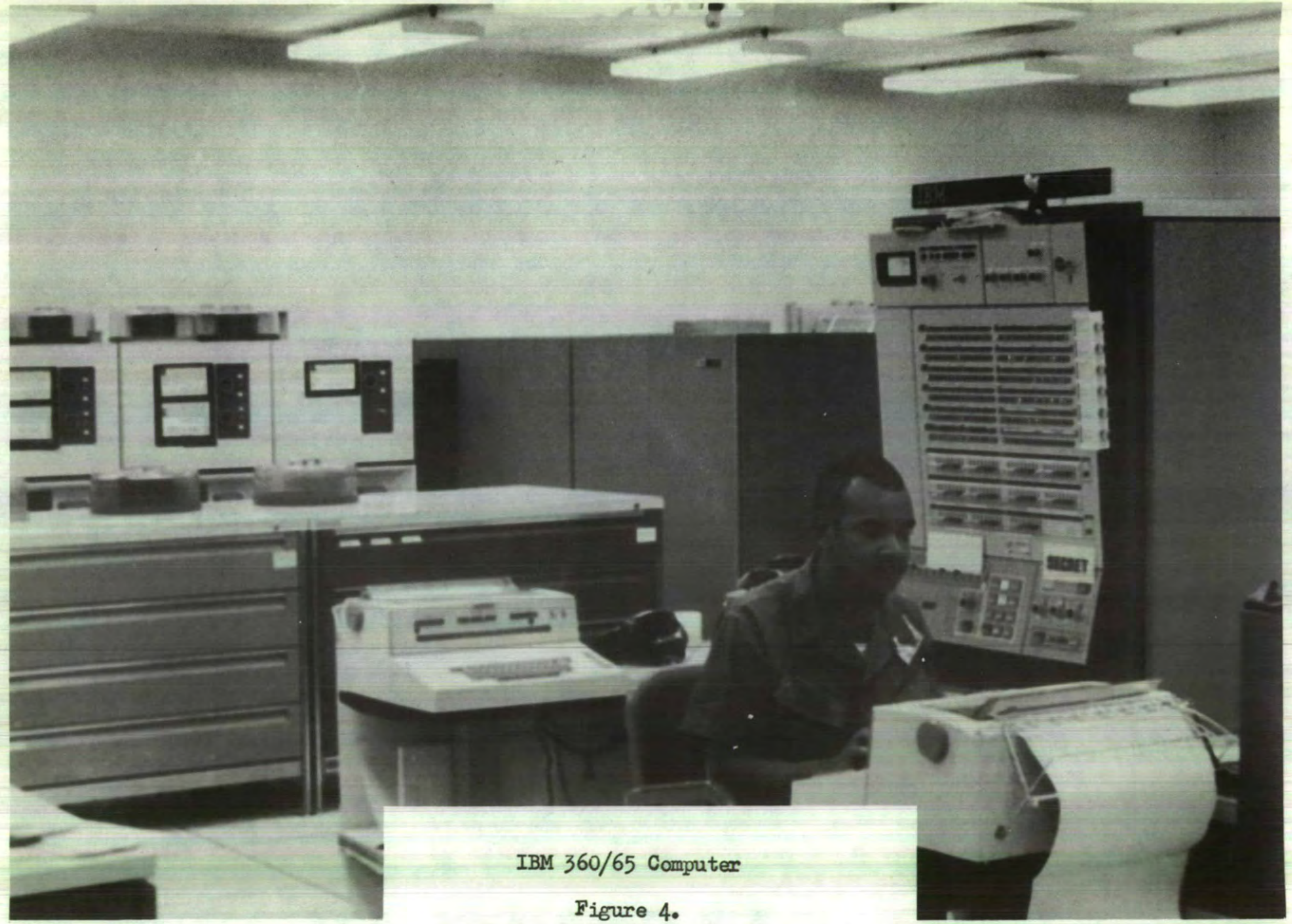
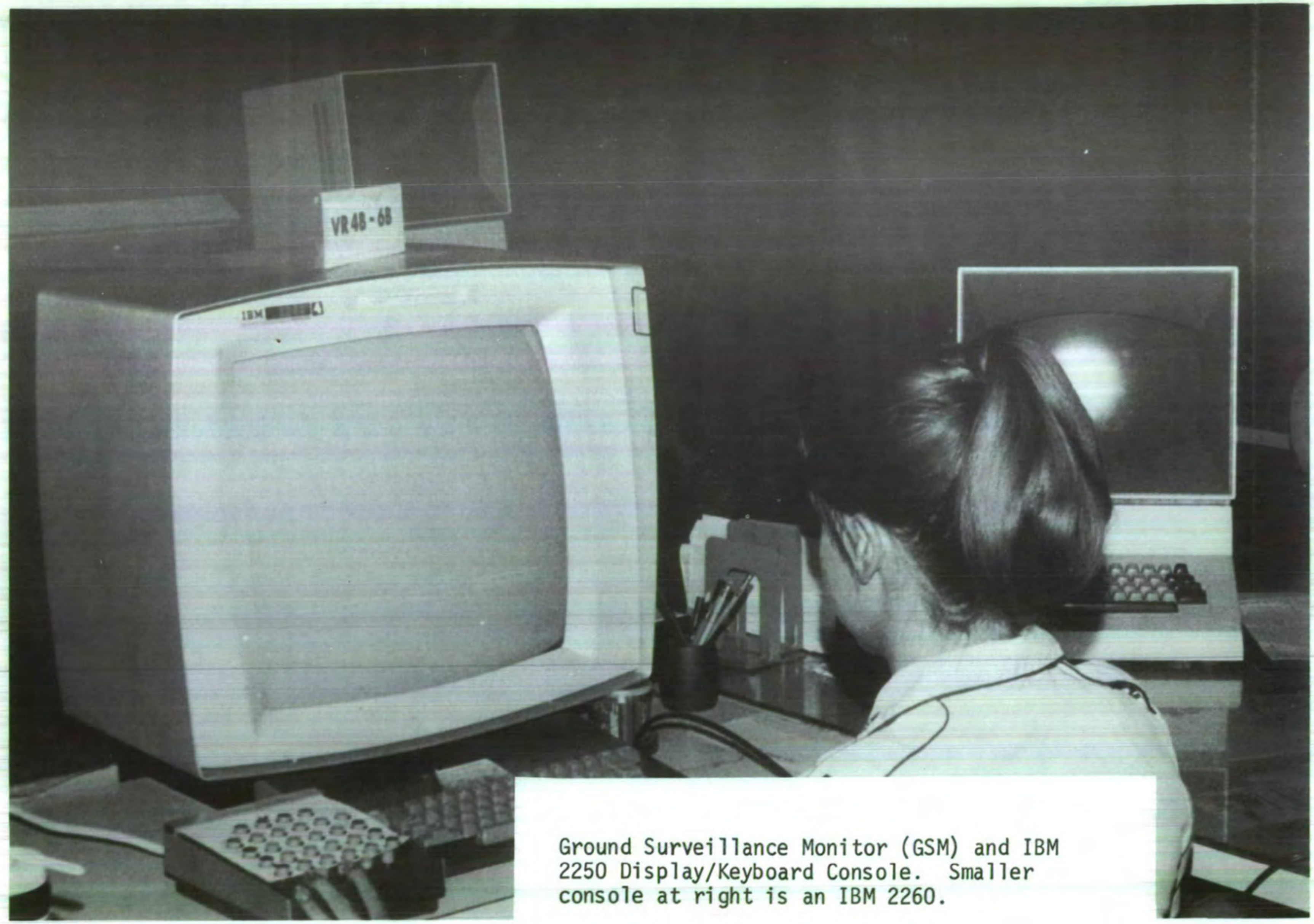


IBM 360/65 Computer

Figure 4.



Ground Surveillance Monitor (GSM) and IBM 2250 Display/Keyboard Console. Smaller console at right is an IBM 2260.

FIGURE 5

TABLE 1

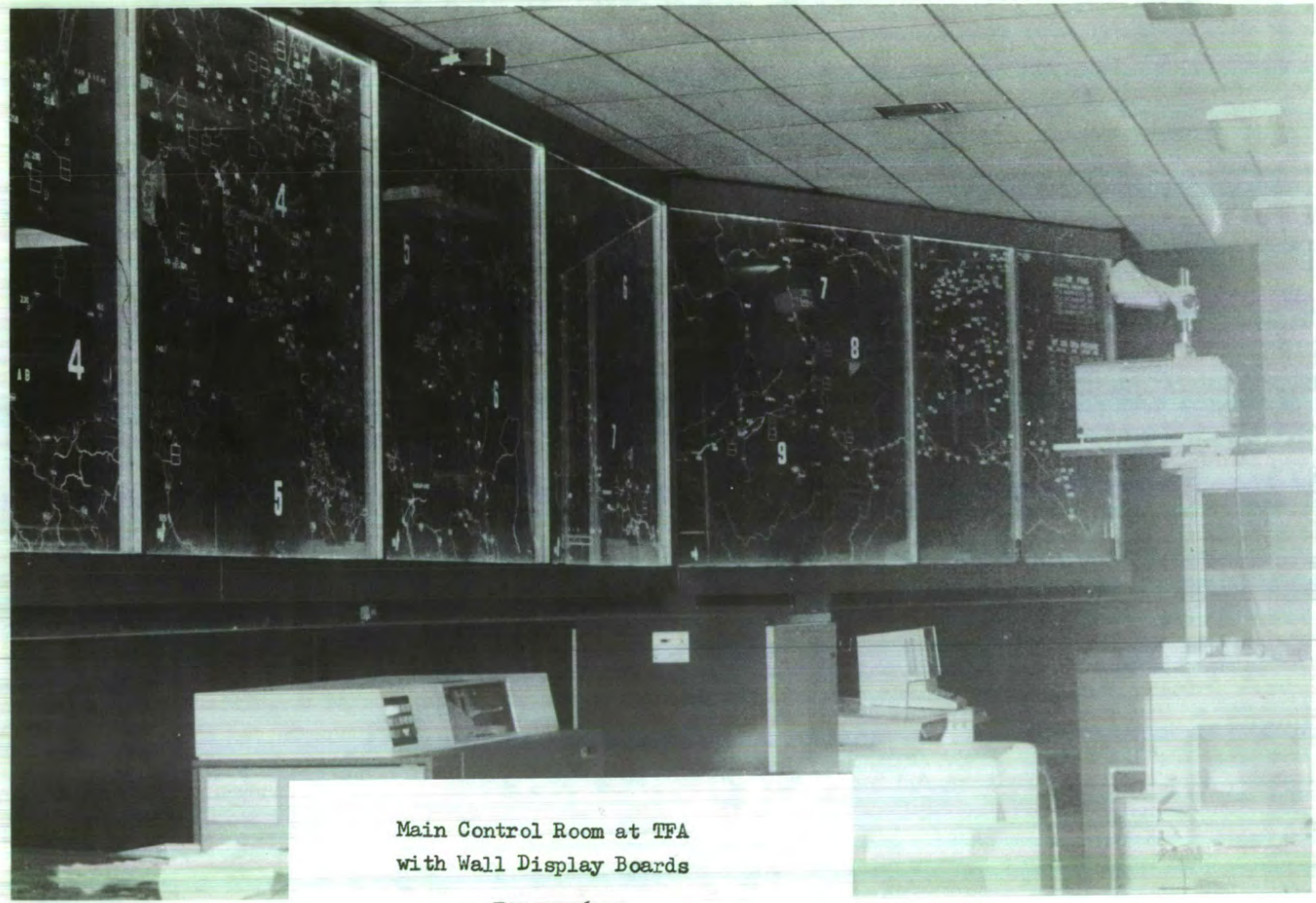
EFFECTIVE DETECTION RANGES OF IGLOO WHITE SENSORS[13/]

(IN USE FOR COMMANDO HUNT VII)

	Trucks	Personnel
Seismic		
ADSID III	100-150 meters	30-50 meters
Acoustic		
COMMIKE III	300-1500 meters	30-100 meters
Seismic and Acoustic		
ACOUSID III	100-300 meters	30-50 meters
Ignition		
EDET III	100-200 meters	-

The GSM was able to direct the computer to display up to eight sensor strings (depending on the number of sensors in each string) on the 2250 screen as rapidly as he could scan the console display. On nights of heavy activity the sensor field was divided between at least two 2250 consoles/GSMs to facilitate the monitoring of all sensor strings as often as possible.

Acoustic sensors differed from seismic/ignition types in that they sent signals only on command from radio operators in the ISC plot room. Two procedures were followed in "polling" (commanding to send audio)

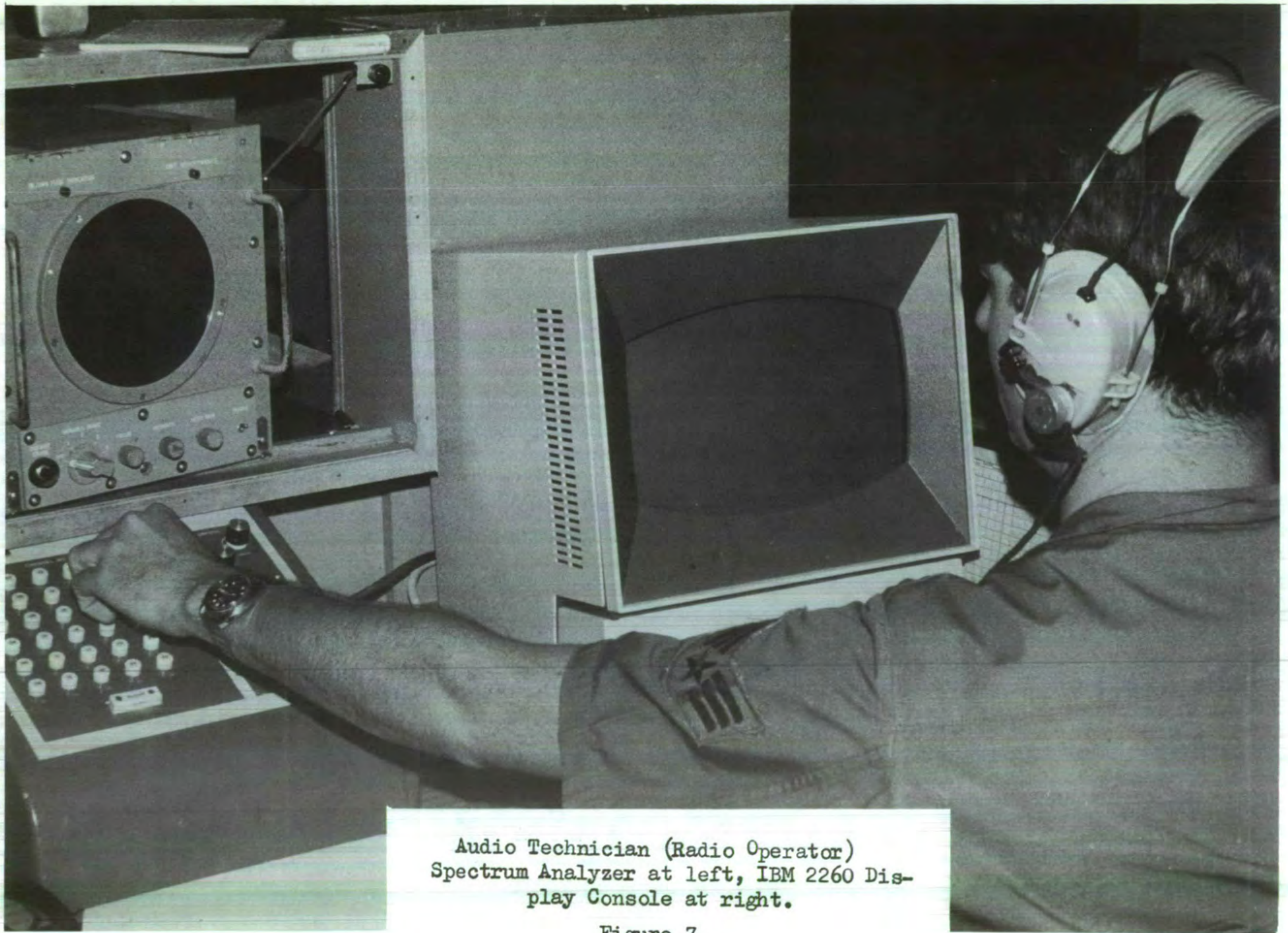


Main Control Room at TFA
with Wall Display Boards

Figure 6.

acoustic sensors. If a seismic/ignition sensor displayed an activation, the GSM immediately determined if there were active acoustic sensors in the string. If so, he directed the Radio Operator to poll the acoustic sensor in an attempt to determine the nature of the activity. By listening directly to the sounds and using a Spectrum Analyzer to supplement his knowledge and experience, the Radio Operator assessed the source of the sounds and entered this assessment into the computer by means of an IBM 2260 display console/keyboard (See Figure 7). The computer simultaneously entered this assessment onto the 2250 display in front of the GSM. The Spectrum Analyzer (See Figure 7) was basically a cathode ray tube on which were displayed patterns generated by the acoustic signals. Since moving vehicles and aircraft had distinct patterns, the Radio Operator used the highly sensitive analyzer to detect the presence of trucks when their engine sounds were either too faint for the human ear, or were covered by exploding ordnance or aircraft noise.

The second procedure used to monitor acoustic sensors was a random polling by the Radio Operator of selected sensors at 15-30 minute intervals. This was done through the 2260 console at each audio-monitoring station, again by means of the operator's assessment of sounds and use of the Spectrum Analyzer. The number of sensors which could be effectively polled was limited during periods of activity, however, by the operator's tendency to concentrate his attention on COMMIKEs which were showing activations and neglect other acoustic sensors.[14/] By the start of COMMANDO HUNT VII, combinations of acoustic, seismic, and ignition-detection



Audio Technician (Radio Operator)
Spectrum Analyzer at left, IBM 2260 Display Console at right.

Figure 7.

sensors showed promise of eventually replacing this procedure.

The preceding account of IGLOO WHITE sketches the system's operation as of September 1971. In the following description of IGLOO WHITE's evolution from 1968-1971, these procedures remained generally the same throughout the whole period. Changes which occurred primarily concerned the introduction of new equipment and automated procedures designed to enhance the effectiveness of existing procedures and automate previously manual operations.

CHAPTER II

IGLOO WHITE IN COMMANDO HUNTS I-IV

Khe Sanh - 1968

The IGLOO WHITE concept of detecting enemy movement by remotely monitored ground sensors was first used operationally in January 1968 during the seige of Khe Sanh. TFA monitored sensors were used throughout this campaign in northern RVN to direct air and artillery strikes and obtain intelligence about enemy movements. As a result of experience gained at that time, TFA found it necessary to refine its capability to differentiate between sensor activations caused by friendly ordnance and those resulting from enemy activity.[15]

COMMANDO HUNT I (Nov 1968 - Mar 1969)

SYCAMORE Control. During this campaign 7th Air Force revised its previous position and assigned TFA operational control of designated strike aircraft in the COMMANDO HUNT area (STEEL TIGER north of 16°30')[16] as a function complementary to its target development and truck counting activities. TFA was expected to provide these aircraft with targets by "rapidly" exploiting IGLOO WHITE information. A Combat Operations Center (COC) known as SYCAMORE Control was activated at TFA in October 1968 to accomplish this, and was designed to function "...as an extension of the 7th Air Force Command Center for the direct control of all air resources within the Commando Hunt area."[17] To expedite the operational effectiveness of the TFA COC, controllers from the Airborne Command and

Control Center (ABCCC) aircraft based at Udorn RTAFB were assigned TDY to TFA to assist SYCAMORE Control personnel. ABCCC controllers retained operational direction of strike aircraft in northern Laos (BARREL ROLL) and in southern STEEL TIGER outside of the COMMANDO HUNT area.[18/]

Lucrative moving targets were called by phone to the intelligence team in the SYCAMORE Control center by the Traffic Assessment Officers (TAO, later Ground Sensor Monitors). These officers identified enemy truck sequences and patterns from computer-produced CONFIRM sheets, since IBM 2250 and 2260 display consoles had not yet been introduced at TFA.[19/]

These sheets covered all active sensors and were updated every five minutes.[20/] Depending upon the value of the target, FAC availability, the current tactical situation, and weather in the target area, potential targets were passed to the FAC controller and then to an on-station FAC as a target nomination.[21/] These nominations were called SPOTLIGHT reports.[22/] In cases where the sequence fell outside of the direct SYCAMORE Control/COMMANDO HUNT area, the information was passed via secure voice circuit to the appropriate ABCCC, where the on-board intelligence officer again determined whether to pass the target to strike aircraft depending on the tactical situation.[23/]

Localized-activity sequences frequently indicated the presence of fixed targets (truck parks, transshipment points, etc.). These were given to the Target Intelligence Officer (TIO) who had access to past

IGLOO WHITE, FAC, road-watch team, and photographic interpretation reports, by which he determined the value of the target. If the lead appeared promising, it was repassed to SYCAMORE Control as a recommended target.[24]

Difficulties with SYCAMORE Control's SPOTLIGHT procedures arose as the campaign progressed. The long time lag from the initial sensor activation, to interpretation by the TAO, to relay to the controller, and from him to FAC and strike aircraft frequently resulted in the target having disappeared by the time ordnance arrived in the area.[25] An attempt to correct this shortcoming led to the Special Strike Zone (SSZ) concept, which in many respects was a direct predecessor of the future COMMANDO BOLT and Traffic Advisory Service programs.

Special Strike Zones (SSZ). The SSZ concept had been considered in early IGLOO WHITE planning, but the imperative need for anti-infiltration systems in the RVN and Laos precluded operational testing. As finally implemented in December 1968, groups of three sensor strings (of three to six sensors each)[26] were implanted along selected LOCs so as to detect not only the presence of traffic, but convoy location, size, direction, and speed as well. Careful analysis of the CONFIRM sheets enabled a prediction of the future location of the convoys. This information was passed through the COC to the airborne FAC who would locate the convoys and direct strike aircraft against them.[27]

Starting in March and April 1969 bombing based on Long Range Navigation (LORAN) coordinates was teamed up with the SSZ concept to further refine the use of real time IGLOO WHITE information:[28/]

> *By time-tracking trucks along sensor strings, a strike could be made at predicted intercept points by aircraft equipped with accurate navigation equipment and area munitions... As enemy convoys proceeded through the SSZ sensor strings, an estimated time of arrival at the intercept point was relayed form the ISC to the ABCCC controlling strikes for that area. F-4 aircraft....were brought...to the intercept zones by the use of... LORAN equipment in the lead aircraft. When directly over the intercept point, at the time when the trucks were predicted to arrive, CBU-24 munitions were ripple released, spreading BLU bomblets over a wide area to destroy trucks and supplies.*

In anticipation of deteriorating weather in the approaching Southwest Monsoon Season (COMMANDO HUNT II), this system was further developed to improve the ability to allow strikes without visual target acquisition by the pilot.[29/]

Towards the end of COMMANDO HUNT I, the decision was made to discontinue SYCAMORE Control, and terminate TFA's role as a direct controller of strike aircraft. SYCAMORE Control had experienced difficulty in communicating with aircraft operating in the southeast portion of its area, and had been forced to relay information through other aircraft. The communications range of the ABCCC aircraft corrected this problem, so control of the entire interdiction area was turned over to airborne controllers.[30/]

The COMMANDO HUNT report of 20 May 1969 summed up the role of IGLOO WHITE in the 1968-69 campaign: 31/

> *IGLOO WHITE sensor information assisted in the nightly deployment of the force to the most lucrative route segment. Sensor information was also used effectively to assist FACs in locating larger convoys. In real-time, IGLOO WHITE information was available to FACs, strike aircraft and gunships when they were not otherwise occupied with targets. When this occurred and IGLOO WHITE information was used, it was demonstrated to be an accurate means of locating enemy traffic. It directly assisted in the real-time location of slightly more than 20 percent of the targets attacked.*

COMMANDO HUNT II (Apr - Oct 1970)

Operational control was not officially turned over to the ABCCCs until 13 April 1969, after the formal conclusion of the COMMANDO HUNT I campaign. SYCAMORE Control continued to function as a backup in case the ABCCC proved unable to handle the increased traffic, but ABCCC encountered no difficulties of this kind. TFA's command and control function finally terminated on 26 April, 32/ although plans apparently existed at that time to reactivate this capability at the start of COMMANDO HUNT III. 33/ The rest of IGLOO WHITE's Southwest Monsoon (wet) season effort was devoted to maintaining certain key sensor fields to detect any enemy supply efforts, and developing the SSZ concept to allow LORAN-equipped F-4s to execute nonvisual strikes on moving convoys, based on sensor-derived real-time information. 34/

KEYWORD File. Of major importance for the future of TFA and IGLOO WHITE was the introduction during COMMANDO HUNT II (in May 1969) of a computerized listing of target information designated the KEYWORD File. This file contained information vital to coordinated target development in a centralized and usable form on short notice, and facilitated the fusion of sensor data with other intelligence sources. As of September 1971, seven functional categories of information made up the file:[35/]

a. General intelligence category: Initial and supplementary photographic interpretation reports, FAC mission summaries, FAC bulletins and Controlled American Source (CAS) reports.

b. Tac Air function: Nomination, strike, and bomb damage assessment (BDA) data for tac air targets.

c. Arc Light category: Nomination, strike, and BDA data for B-52 targets.

d. Night-targeting category: Nomination, strike, and BDA data for the night-fixed targeting program.

e. Fac Liaison Program (FACLO) category: TFA visual reconnaissance (VR) requests and resulting responses from FACs concerning eastern STEEL TIGER as well as other information generated by FACs on areas of interest. Also includes route status information based on FAC VR.

f. Sensor data: Information which indicated the presence of localized, fixed, or semifixed target activity such as truck parks, storage areas, transshipment points, and road repair work. Sensor data which did not provide such leads was not included.

g. Special Intelligence (SI) category: Information of this kind was not entered into the file, but the presence of SI backup for a particular target area was indicated.

The KEYWORD File was used for target development during the three hours each day that the computer was available for this program. If photographic, FAC, SI, or sensor reports indicated a possible target area during periods when the computer was engaged in other tasks, a daily print out containing the last 30 days of inputs into the File was always available for determining the extent of observed activity within a specified distance of the point. Based upon this history of the area, a decision was made whether to initiate strike nominations, recommend further VR of the areas, or take no action at that time.

The KEYWORD File also served as an accounting and evaluation device and recorded the number of areas nominated by the various targeting programs, the number of strikes, and the resultant BDA. In addition, the KEYWORD File was used to justify requests for photography if the File showed a high level of activity in an area not recently covered.[36/] The anticipated expansion of the KEYWORD File for the COMMANDO HUNT VII campaign is discussed in Chapter VI.

<u>COMMANDO HUNT III (Oct 1969 - Apr 1970)</u>

In COMMANDO HUNT III, IGLOO WHITE built on lessons learned in the previous campaigns and became an integral part of the interdiction effort in STEEL TIGER.[37/] Aircraft command and control responsibilities were not returned to TFA for this campaign, and emphasis instead was placed upon intelligence gathering and targeting.[38/] The most significant event during COMMANDO HUNT III was the introduction of a refined and improved SSZ concept designated COMMANDO BOLT. This program analyzed real time sensor data to obtain future locations of enemy convoys to which strike aircraft could be directed. Like the SSZ program, targets were passed for both visual and LORAN strikes. A certain number of FAC and strike aircraft were fragged directly to TFA each night to operate against COMMANDO BOLT targets.

<u>COMMANDO BOLT</u>. The basis of the COMMANDO BOLT operation was a minute-by-minute monitoring of sensor activations within specially designed sensor strike strings. As soon as vehicle movement was detected within one of the strings, the activity was monitored by a SPARKY FAC team located on the balcony of the TFA control room. SPARKY FAC consisted of the following three-man team:[39/]

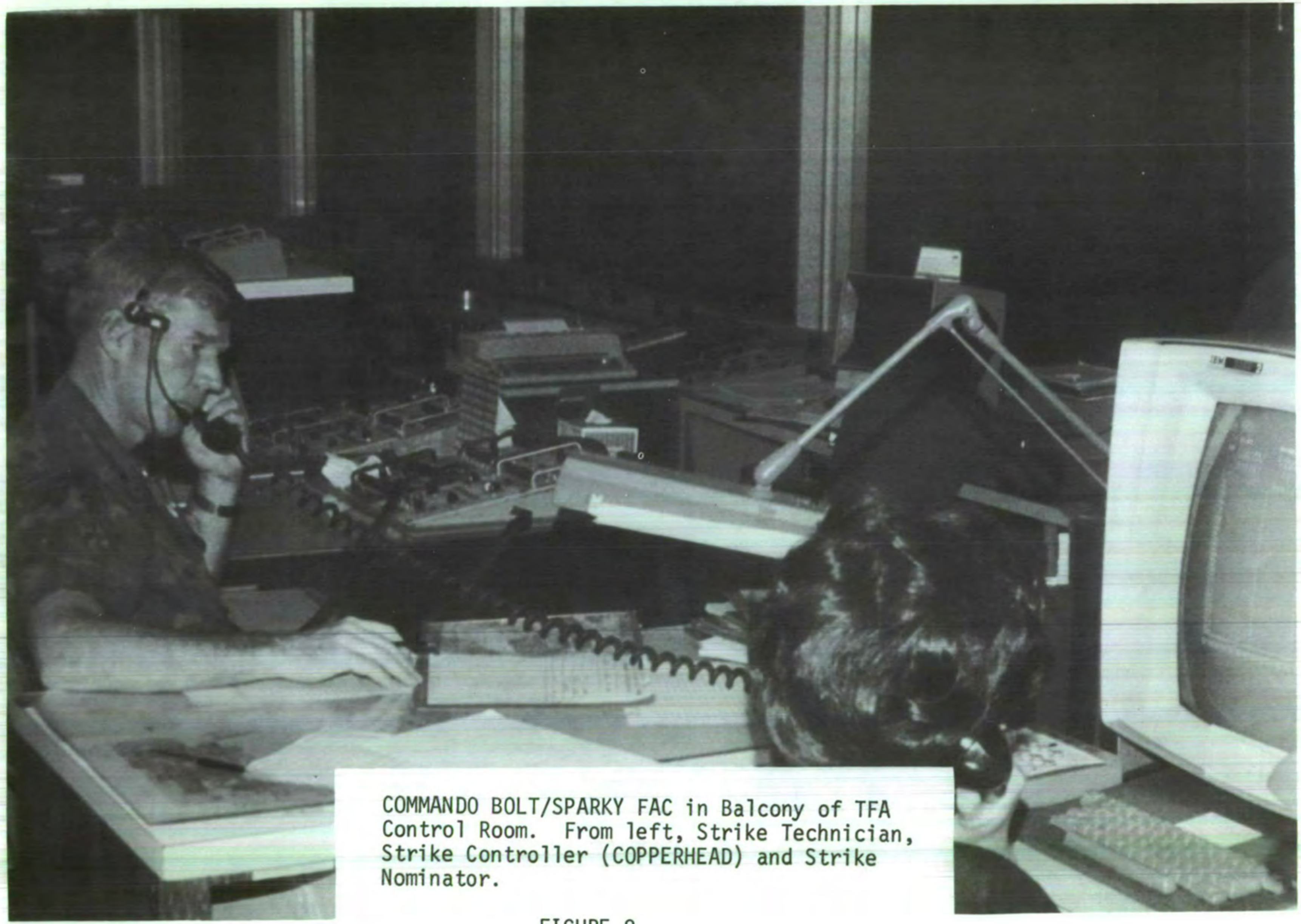
a. <u>Strike Nominator</u>: An intelligence officer experienced in assessing sensor-derived data who monitored real time sensor activations on an IBM 2250 console and determined the number, direction, and velocity of potential targets by means of continuously up-dated displays. The 2250 console and data display were identical to those used by CSMs to monitor the entire sensor field. The SPARKY FAC display, however, monitored only COMMANDO BOLT strings.

b. <u>Strike Controller</u>: An experienced field grade fighter pilot familiar with tactical aircraft capabilities and trained in the interpretation of sensor-derived data. His duties were to direct night FACs and strike aircraft to sensor-revealed truck movements on a real time basis in order to deliver attacks. He was also responsible for coordinating aircraft employment with ABCCC and 7th Air Force Command Post.

c. <u>Strike Technician</u>: An enlisted technician trained in ground-air radio procedures responsible for monitoring radio transmissions, relaying instructions and information to ABCCC, maintaining data logs, and assisting the strike controller.

Central to the COMMANDO BOLT system were specially designed sensor strings normally consisting of from three to six sensors.[40/] These sensors were emplaced at intervals of approximately 200 meters along an LOC segment which had been observed receiving heavy enemy truck traffic. Sometimes as many as four strings were placed along a certain route to form a COMMANDO BOLT "strike module." Desired Mean Points of Impact (DMPI) were located by LORAN coordinates at certain intervals along the strike module. When the sensors revealed the presence of enemy vehicles moving through the module, the large number of sensors allowed the direction and speed of the vehicles to be calculated by the computer so as to obtain an estimated time of arrival (ETA) at a pre-selected DMPI through which they would pass. The newly-installed Coordinated LORAN Sensor Strike System (COLOSSYS) enabled the computer to perform these tasks, and made available to the SPARKY FAC team graphic displays of the route system showing locations of sensors, strike modules, DMPIs and moving targets. These displays could be presented on the 2250 console (See Figures 8 and 9).[41/]

Upon obtaining a target ETA the Strike Controller alerted FAC or strike aircraft, specifically assigned to COMMANDO BOLT, to the developing target and passed a Time on Target (TOT) for the DMPI coinciding with the previously determined ETA. The pilot entered the LORAN coordinates for the specified DMPI into his on-board computer and then adjusted the speed or flight path of his aircraft so that his TOT would

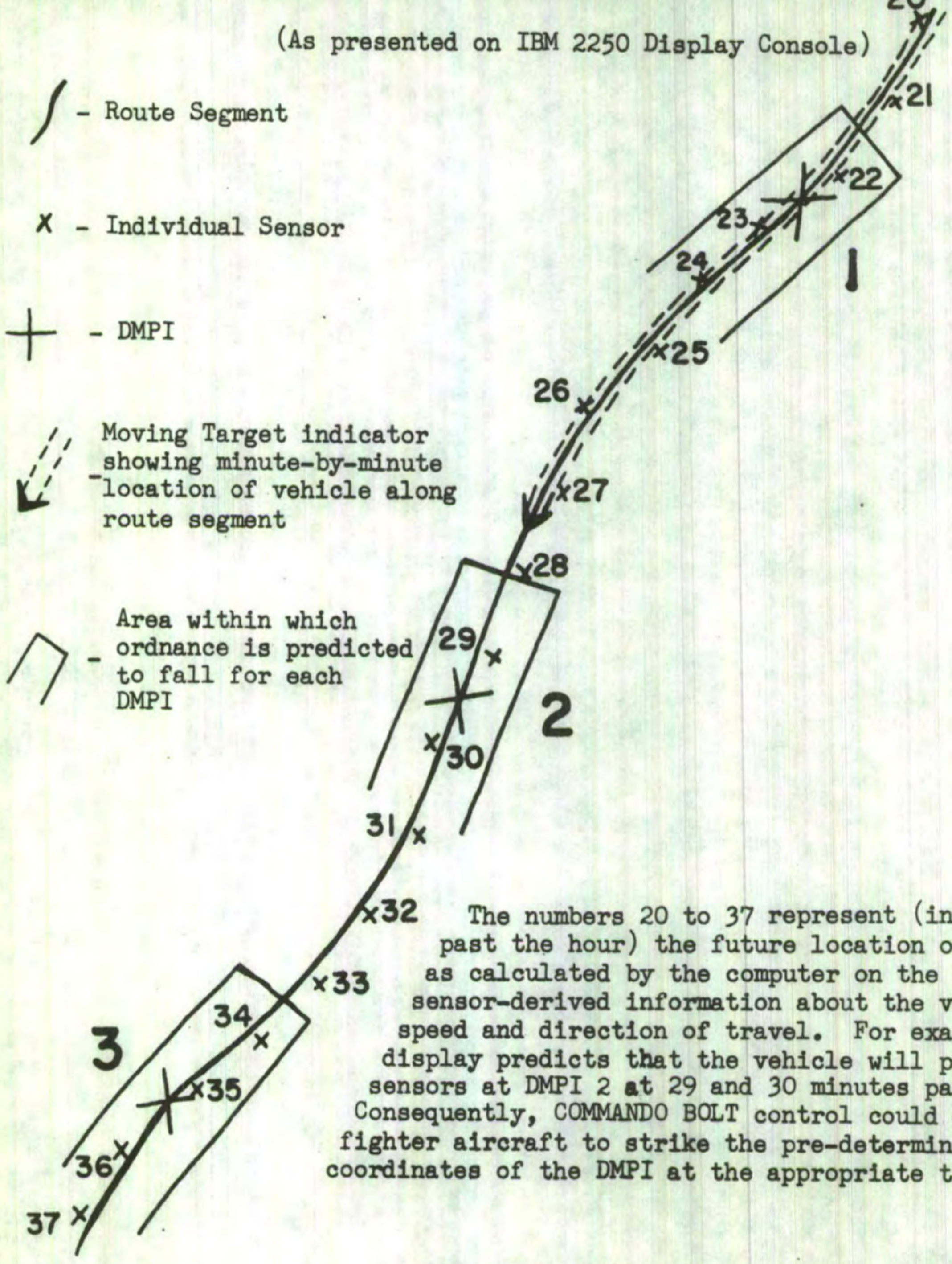


COMMANDO BOLT/SPARKY FAC in Balcony of TFA Control Room. From left, Strike Technician, Strike Controller (COPPERHEAD) and Strike Nominator.

FIGURE 8

COMMANDO BOLT
MOVING TARGET GEOGRAPHIC DISPLAY

(As presented on IBM 2250 Display Console)



The numbers 20 to 37 represent (in minutes past the hour) the future location of a vehicle as calculated by the computer on the basis of sensor-derived information about the vehicle's speed and direction of travel. For example, the display predicts that the vehicle will pass the sensors at DMPI 2 at 29 and 30 minutes past the hour. Consequently, COMMANDO BOLT control could direct a fighter aircraft to strike the pre-determined LORAN coordinates of the DMPI at the appropriate time.

FIGURE 9

coincide with TFA's TOT. The Strike Nominator continually monitored the progress of the target through the module and revised the ETA/TOT if changes in speed were observed. Flights of aircraft designated Panther and Flasher Teams were assigned to operate on the basis of SPARKY FAC sensor-derived target intelligence.[42/]

Panther Team. A Panther Team consisted of any strike aircraft operating with a FAC to attack sensor-detected targets, although it originally consisted of an OV-10 or O-2 night FAC equipped with a Night Observation Device (NOD) and accompanied by two A-1 strike aircraft. When a vehicle target was detected by SPARKY FAC, an ETA/TOT for the appropriate Panther Point (a DMPI associated with all sensor strings) was transmitted to FAC and strike aircraft assigned to COMMANDO BOLT by ABCCC. If the FAC was able to acquire the trucks visually, he marked the target for strike aircraft and standard night strike tactics were followed. If additional ordnance was required the FAC requested it through the TFA COMMANDO BOLT control center (call sign COPPERHEAD) which coordinated the request with ABCCC.[43/]

Panther Teams initiated COMMANDO BOLT operations on 20 November 1969 in an area near Ban Karai Pass designated CB-1 (See Figure 10). Three FAC and eight A-1 aircraft normally provided continuous strike coverage from 1815 to approximately 2315 hours Laos time. Increasing North Vietnamese Antiaircraft Artillery (AAA) defenses and adverse weather forced the Panther Teams to abandon CB-1 on 21 December and move their operations to a CB-2 area north of the previous one. The teams operated in CB-2 from 26 December 1969 to 6 February 1970 when

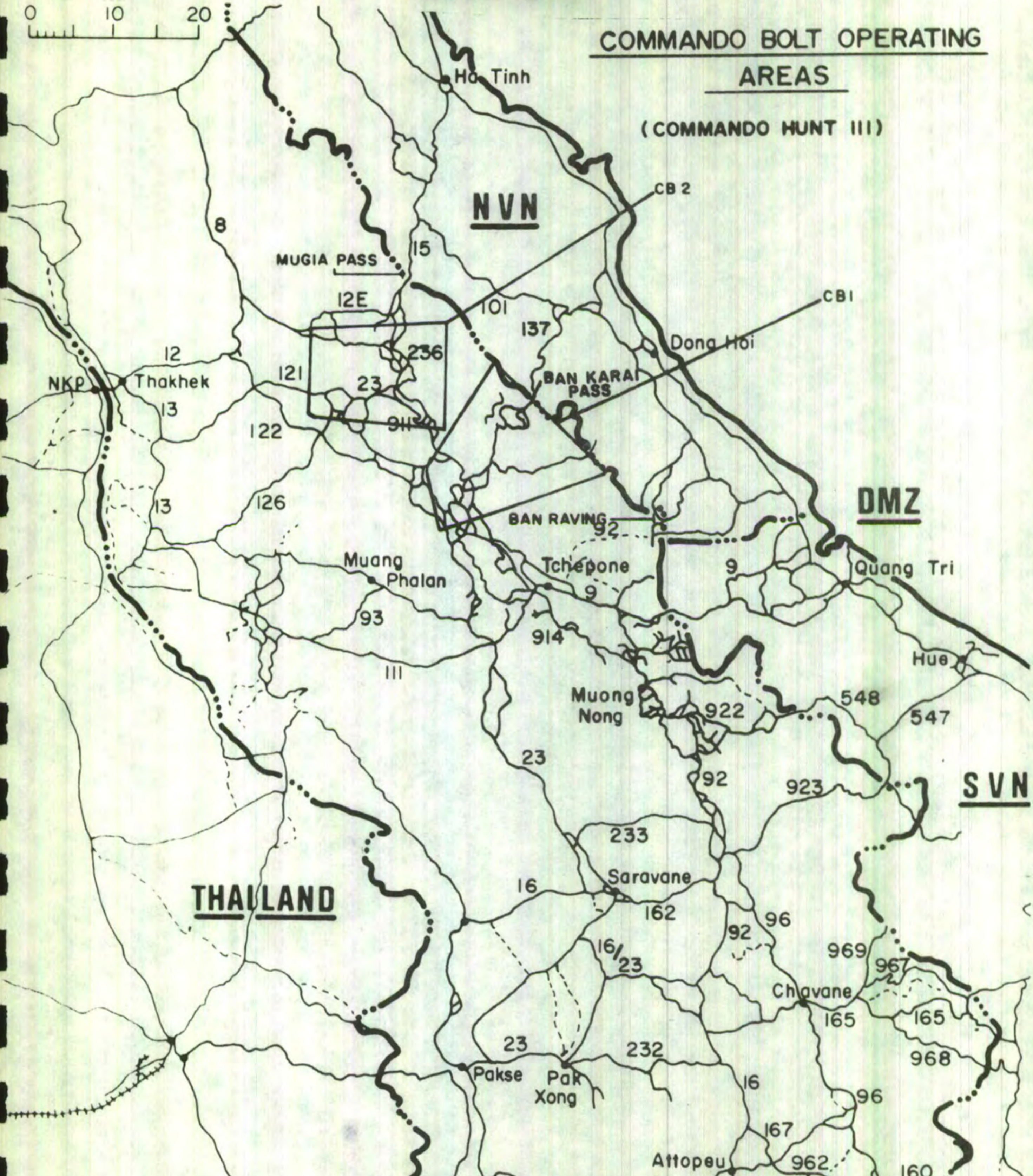

COMMANDO BOLT OPERATING AREAS
(COMMANDO HUNT III)
0 10 20
NVN
DMZ
SVN
THAILAND
Ha Tinh
MUGIA PASS
CB 2
CB1
Dong Hoi
BAN KARAI PASS
BAN RAVING
NKP
Thakhek
Tchepone
Quang Tri
Muang Phalan
Hue
Muong Nong
Saravane
Chavane
Pakse
Pak Xong
Attopeu
8
15
12E
101
137
236
12
121
23
911
13
122
126
92
9
93
914
111
548
547
922
923
233
16
162
96
969
967
16/23
165
968
232
167
962
182
160
110
512

FIGURE 10

air space overcrowding resulting from the employment of gunships in the area forced Panther Teams to terminate operations there also. On 7 February, Panther Teams returned to CB-1 for the remainder of the campaign, although recurring hazards of adverse weather and enemy AAA activity restricted operations to its southern part. 44/

From 20 November 1969 to 30 April 1970 A-1s flew 378 COMMANDO BOLT sorties, although the number of days that these aircraft were employed in COMMANDO BOLT operations was reduced by bad weather, Search and Rescue (SAR) diversion, and the requirement to support operations in BARREL ROLL. 45/ Table 2 summarizes the results of the 378 COMMANDO BOLT A-1 strikes.

Flasher Teams. Flasher Teams consisted of LORAN or Airborne Moving Target Indicator (AMTI)-equipped F-4s or A-6s operating directly with SPARKY FAC under nonvisual conditions against sensor-detected targets. On occasion aircraft without LORAN and AMTI apparatus accompanied those so equipped and dropped their ordnance on signal from the lead aircraft. These teams became operational on 24 November 1969, with Air Force LORAN F-4s leading other aircraft in strikes in the CB-1 area. Navy and Marine A-6s began operations on 4 and 6 December, respectively, and the program was expanded to CB-2 on 26 December. 46/

TABLE 2

COMMANDO BOLT

PANTHER A-1 RESULTS FOR COMMANDO HUNT III 47/

Type Target	Destroyed and Damaged	Secondaries
Trucks	164	466
Truck Parks & Storage Areas	-	22
AAA	1	20

TABLE 3

COMMADO BOLT

FLASHER AIRCRAFT RESULTS FOR COMMANDO HUNT III 48/

Type Target	Destroyed and Damaged	Secondaries
Trucks	888	2055
Truck Parks & Storage Areas	-	478
AAA	26	131

Due to the stereotyped nature of COMMANDO BOLT Flasher operations directed against the same DMPIs day after day, enemy AAA defenses in the target area underwent a steady buildup. Flak-suppression sorties by Navy A-7s and Marine F-4s accompanied A-6 Flasher missions, while

Marine EA-6s provided Electronic Countermeasures (ECM) support. These measures gave only temporary relief, however, as the predictability of COMMANDO BOLT target areas encouraged intense and accurate AAA opposition.49/

During the course of the campaign, substantial evidence accumulated that the enemy was monitoring strike frequencies and reacting to intercepted transmissions. Although DMPIs were designated by a code name which was changed daily, this was compromised as soon as a DMPI was struck. In early February 1970 secure voice cipher was instituted for transmitting target and strike information, and special mission encoders were used to encode DMPIs and TOTs for aircraft without cipher equipment. Simultaneous with this action enemy AAA accuracy decreased and after 20 February, the Navy discontinued flak suppression sorties.50/

Flasher aircraft began working with Panther FACs during February 1970. From 24 November 1969 to 30 April 1970, Flasher aircraft flew a total of 3920 sorties, 361 of which were in support of Panther operations.51/ Flasher results for COMMANDO HUNT III are presented in Table 3.

Since Flasher Team strikes were often conducted against non-visual targets (obscured by darkness or weather) with ordnance released on specific LORAN coordinates, damage assessment was often hampered and sometimes impossible.52/

Summary of Panther/Flasher COMMANDO BOLT Results. Table 4 compares the results of Panther A-1 strikes against trucks with similar BDA obtained by other A-1s. The Panther A-1 teams achieved a slightly lower overall kill rate than did other A-1s operating against enemy trucks, although Panther truck kills were 78 percent higher than other A-1s during January 1970 operations in CB-2. Flasher aircraft overall truck kill rate was 88 percent of that of all other F-4s, A-6s and A-7s, in spite of being 27 percent higher during February.[53/] These results are summarized in Table 5.

TABLE 4

A-1 RESULTS AGAINST TRUCKS IN STEEL TIGER[54/]

COMMANDO HUNT III

	Nov	Dec	Jan	Feb	Mar	Apr	Total
Sorties							
Panther A-1s	34	54	82	70	54	52	346
Other A-1s	249	431	575	320	148	263	1986
Trucks Destroyed/Damaged							
Panther A-1s	5	14	86	45	14	20	184
Other A-1s	112	201	340	189	83	162	1087
Destroyed/Damaged per Sortie							
Panther A-1s	.15	.26	1.05	.64	.26	.38	.53
Other A-1s	.45	.47	.59	.59	.56	.62	.55

TABLE 5

FLASHER AIRCRAFT RESULTS AGAINST TRUCKS IN STEEL TIGER [55/]

COMMANDO HUNT III

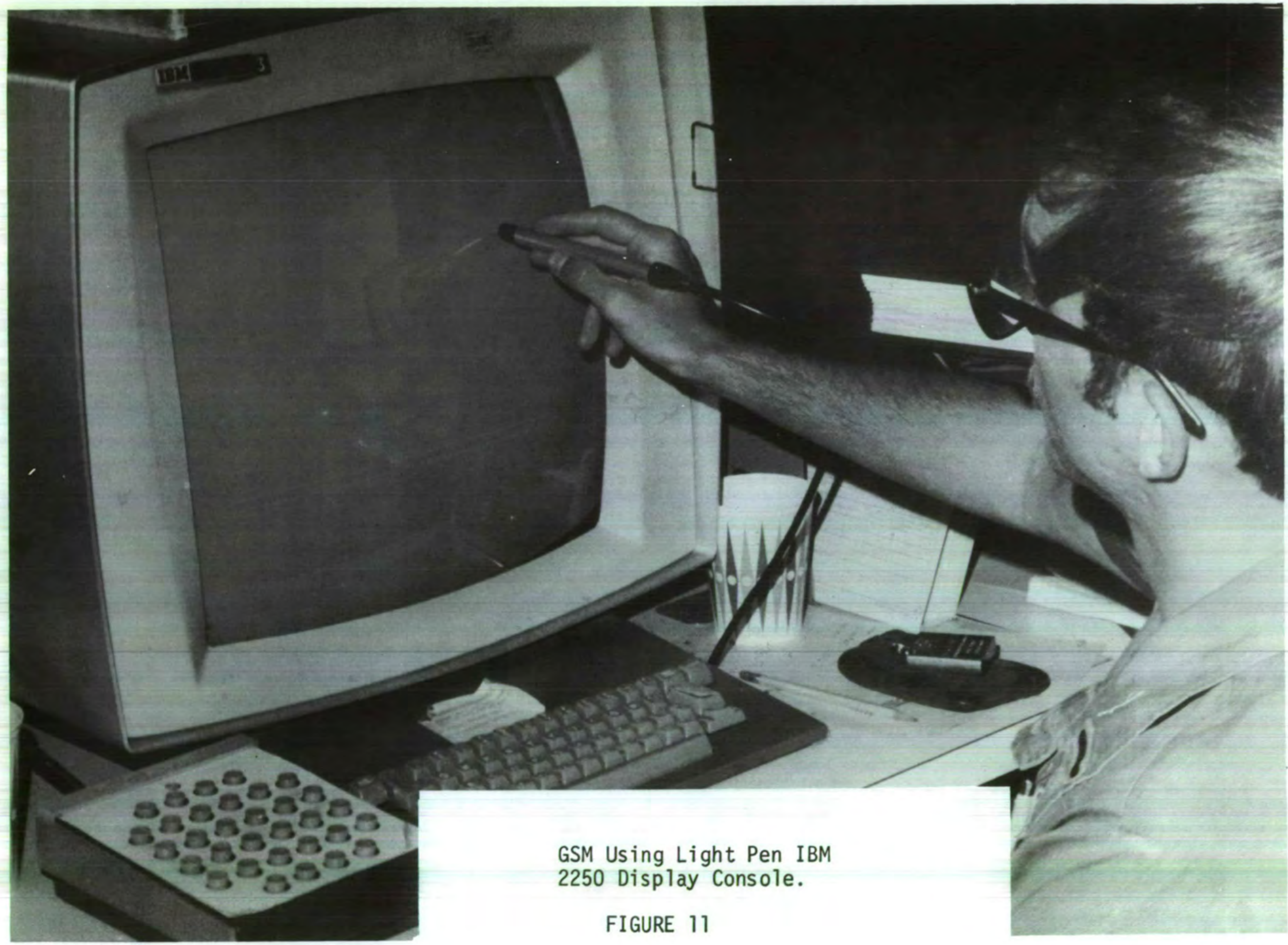
	Nov*	Dec	Jan	Feb	Mar	Apr	Total
Sorties							
Flasher Aircraft	83	639	1032	481	462	381	3078
Other F-4, A-6, A-7	541	1291	1464	1625	1357	1202	7480
Trucks Destroyed/Damaged							
Flasher Aircraft	8	173	287	204	97	119	888
Other F-4, A-6, A-7	158	390	486	539	474	407	2454
Destroyed/Damaged per Sortie							
Flasher Aircraft	.10	.27	.28	.42	.21	.31	.29
Other F-4, A-6, A-7	.29	.30	.33	.33	.35	.34	.33

*F-4 only

TFA's command and control role in COMMANDO BOLT differed from that in SYCAMORE Control primarily by restricting SPARKY FAC's authority only to aircraft operating in support of the strike modules. During COMMANDO HUNT I, TFA exercised direct control over all aircraft operating in the interdiction area. Under COMMANDO BOLT, however, ABCCC retained control of the gunships and all FAC and strike aircraft not specifically fragged to SPARKY FAC. TFA continued to provide ABCCC with SPOTLIGHT reports of vehicles passing through other sensor strings in STEEL TIGER; however, TFA could only advise that the activity was occurring, and had no authority to order aircraft to that location.

Coordinated LORAN Sensor Strike System (COLOSSYS). The introduction of COLOSSYS into IGLOO WHITE during COMMANDO HUNT III automated previously manual operations and formed the basis of the COMMANDO BOLT and HEADSHED systems. A principal feature of COLOSSYS was an IBM 2250 display console which was capable of projecting constantly updated CONFIRM sheet-type displays of all active sensor strings as rapidly as the Ground Sensor Monitor (GSM) could scan the console screen. These displays were updated every minute and reflected the past 30 minutes of activity on each string. This allowed a GSM to observe continually all sensor inputs (seismic, acoustic, and ignition) from the portion of the sensor field selected for his station. Formerly, seismic and acoustic activations were read from printed CONFIRM sheets which were updated every five minutes for each sensor string.

COLOSSYS displays allowed sensor activations to be monitored on a minute-by-minute basis by use of the same diagonal "step" patterns used on CONFIRM sheets. Since the COLOSSYS display indicated the type and reliability of sensors in each string, the GSM was able to determine whether acoustic sensors were present, and, if so, to request an audio assessment from the radio operator to verify further the nature of the activation. If the sequence passed these tests and was accepted as a mover, a touch of a light pen to the console screen (See Figure 11) would command the computer to calculate the number of movers, their speed, and their direction. Based on the number and duration of the



GSM Using Light Pen IBM
2250 Display Console.

FIGURE 11

sensor activations, the GSM would also determine the number of movers in the sequence, and compare his estimate with that of the computer. In case of conflict, the GSM would override the computer and adjust its assessment to agree with his own, insuring that the analytical judgment and background of the operator were always the final authority. The total number of movers detected by the GSMs was incorporated into the ISC Traffic Summary for that night. At the same time as the sequence was entered into the data base, the same touch of the light pen instantaneously transferred all information on the mover(s) to the TFA control room for possible HEADSHED Traffic Advisory Action.

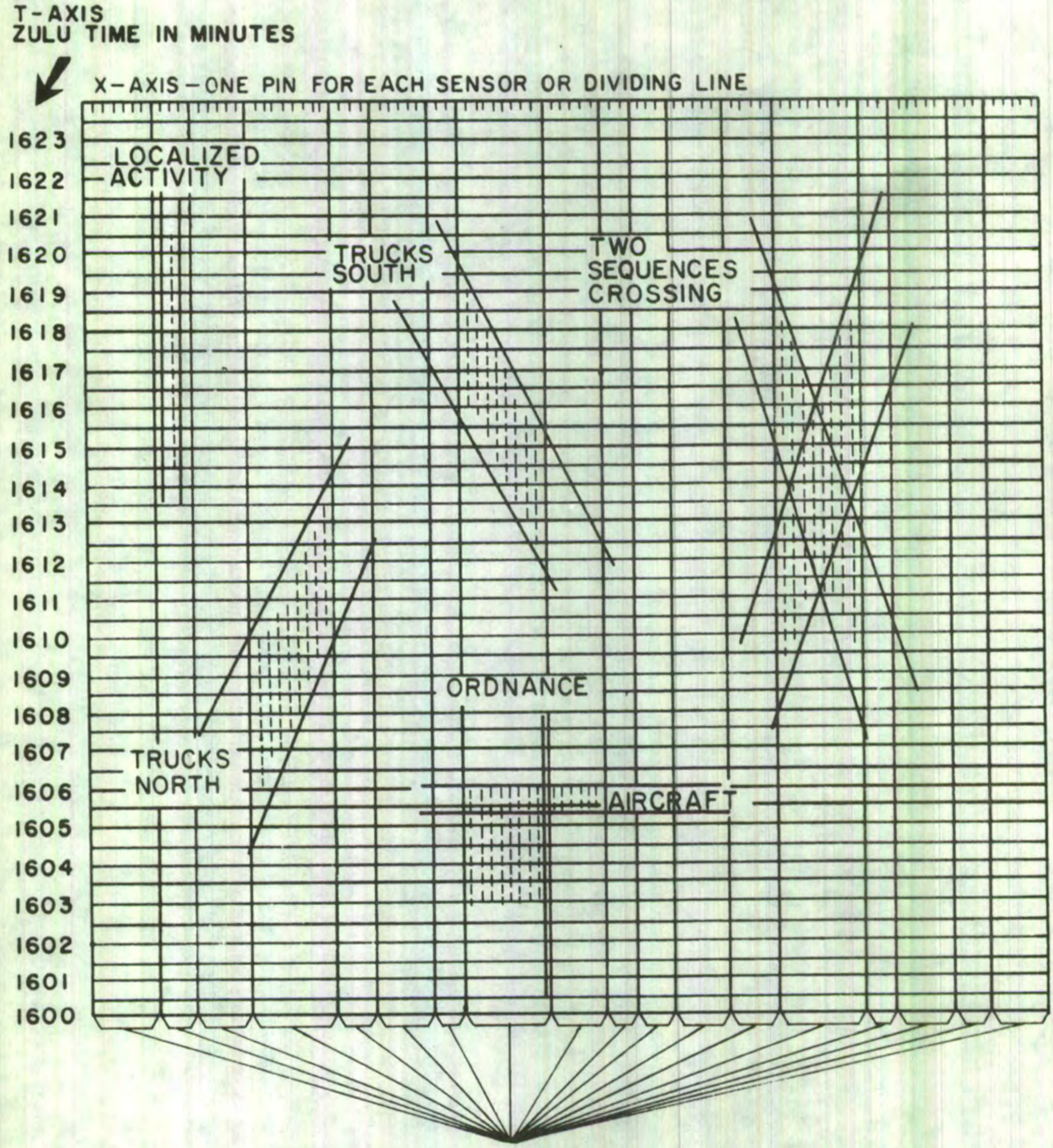
COLOSSYS also made possible the graphic displays of route segments, sensor locations, moving targets, and DMPIs which were used to determine the TOT for COMMANDO BOLT strikes. While a real time strike operation could be run from manual print outs or X-T Plotters, the number of COMMANDO BOLT and HEADSHED advisories which could be issued would be drastically reduced, and many of these would not reach strike aircraft until the target had left the vicinity of the string. Real time targeting could possibly be conducted in a manual mode on nights with small numbers of movers. But at the height of the dry season activity COLOSSYS was vital to a coherent and systematic effort designed to strike enemy trucks while they were still in the vicinity of a known location.[56/]

FERRET III. Another real time targeting aid introduced during COMMANDO HUNT III was the 553d Reconnaissance Wing's (RW) FERRET III program which began on 18 February 1970. This newest of the FERRET operations was designed to provide real-time sensor-derived target advisories[57/] and differed from previous versions by the installation of X-T Plotters on the 553RW's EC-121Rs (call sign BATCAT). Before the introduction of this device FERRET operations were conducted by airborne operators who monitored sensor activations on manual sensor-display stations known as Tell Tale displays. Vehicular or personnel targets derived from this read out were passed to ABCCC with follow-on reports to the ISC and 7th AF. The operator was required to keep manual logs and had difficulty in monitoring more than five sensor fields simultaneously.[58/]

Each X-T Plotter featured 99 electro-static metal "pins" which were arranged horizontally so that a constantly revolving roll of paper marked off in Greenwich Mean Time periods brushed against them (See Figure 12 and 13). One pin represented a single (usually seismic) sensor. All sensors in a particular string were assigned to contiguous pins, with the northernmost sensor usually being on the left of the group and the southernmost on the right. In practice, less than 99 sensors could be monitored on each plotter, since one pin was reserved between every two strings to mark a line separating them. This was necessary for clarity and to help the operator distinguish clearly between strings. Upon receiving a sensor activation, an electrical

[redacted]

DISPLAY OF SENSOR ACTIVATIONS ON X-T PLOTTER

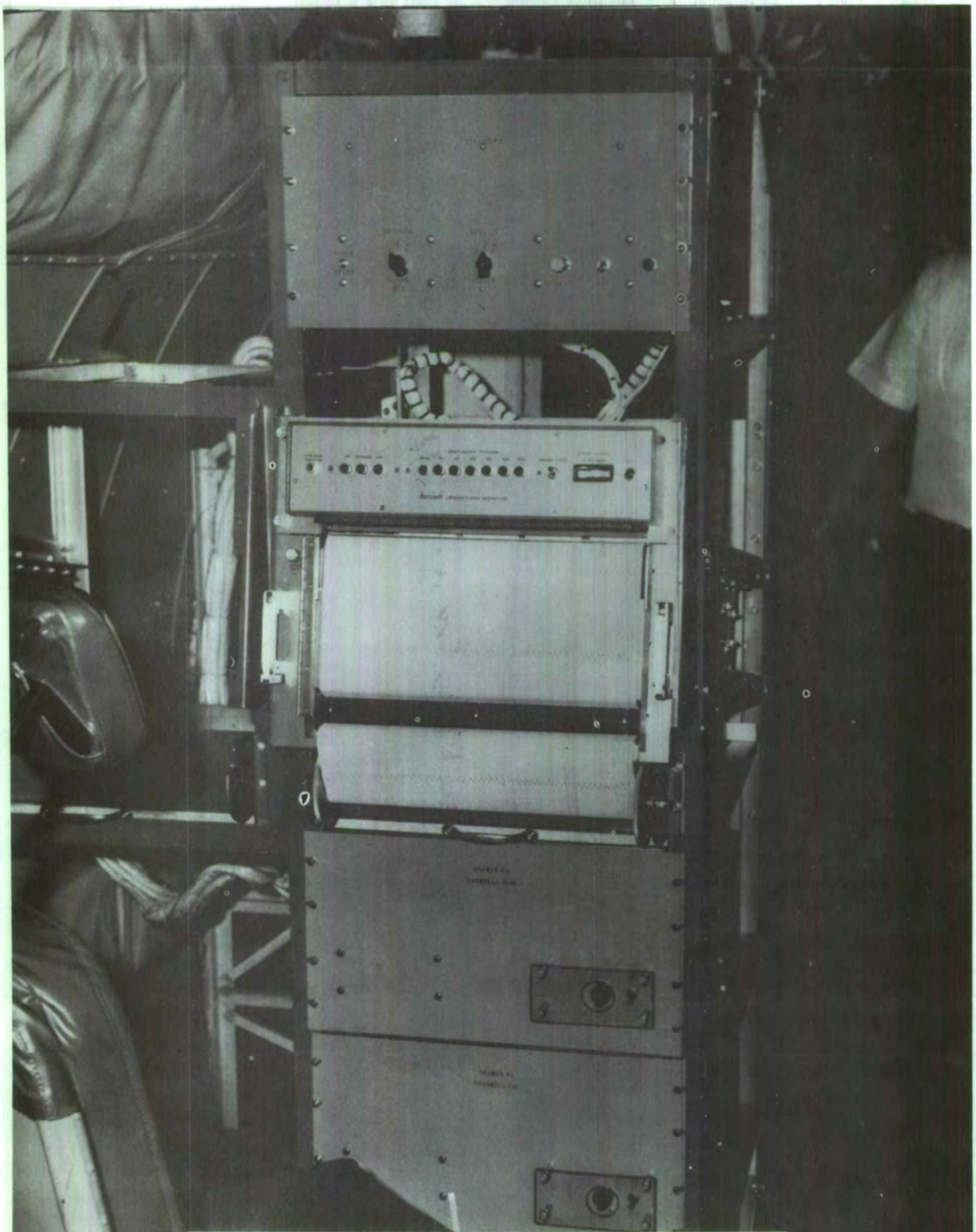


EACH GROUP OF PINS/SENSORS REPRESENTS ONE SENSOR STRING

FIGURE 12

[redacted]

[redacted]



X-T Plotter Mounted aboard EC-121R
BATCAT for FERRET III Operations.

FIGURE 13

[redacted]

charge which "burned" a short line in the paper was sent through the particular pin. While the CONFIRM sheets and console displays used by the GSM showed the total number of 10-second activations recorded by a sensor for any given period, the X-T Plotter displayed a separate mark for each activation. These marks were registered as they occurred, rather than being totalized and displayed after the end of the minute. In this sense, X-T Plotters gave information of a more "real time" nature than the ISC, although the lack of a computer and automatic relay of information required all operations to be conducted manually. Activations were interpreted into sequences and movers by means of patterns similar to those found on CONFIRM sheets. A limited audio assessment capability was present which aided in distinguishing movers from activations caused by wind, rain, aircraft, and hyper-active sensors. The lack of a Spectrum Analyzer, however, significantly limited FERRET III's ability to assess precisely the nature of the activations.[59/]

BATCAT-mounted X-T Plotters were especially useful on Purple Orbit in extreme southern STEEL TIGER where distances were too great to relay sensor data to TFA for COMMANDO BOLT or advisory service action.[60/] Sequences interpreted by the on-board GSM as representing movers were passed in a near-real time basis to FACs and gunships for strike action. Upon arrival on-station, FERRET III BATCATs would clear with ABCCC and then pass their advisories directly to strike aircraft operational frequencies. Upon completion of their on-station time, the EC-121R would again clear through ABCCC and obtain visually-reported results of FERRET III-initiated strikes from the FACs.[61]

From 1-15 May 1970 a special evaluation was conducted by TFA and the 553D RW to determine the relative effectiveness of FERRET III compared with the SPOTLIGHT program in which mover sequences were relayed from the ISC to ABCCC for strike action. SPOTLIGHT reports were passed to ABCCC only after the developing sequence had been entered into the computer by the GSM and had been determined to equal or exceed the minimum number of trucks (usually five) which ABCCC required before a sequence would be accepted. During the two week evaluation, SPOTLIGHT sequences were called to ABCCC an average of 13 minutes after the trucks began to exit the string. The test was conducted with both SPOTLIGHT and FERRET III monitoring the same 10 Blue Orbit strings. Results are depicted in Table 6. FERRET III calls were made to strike aircraft on a real time basis as a sequence was developing, while the time lag noted in SPOTLIGHT allowed the trucks to leave the vicinity of the sensors, take alternate routes, or pull into truck parks. During the evaluation, BATCAT assessed 1998 trucks against the ISC's 1946 on the same 10 Blue Orbit strings.[62]

The evaluation report cited the following factors as contributing to FERRET III success:[63]

a. Real time operation.

b. Ability of experienced personnel to distinguish between random activations and true truck sequences.

c. Ability of experienced personnel to determine numbers and direction.

d. Ability of BATCAT to monitor UHF strike frequency communications and determine if strike aircraft were available and free to accept the sequence.

TABLE 6

RESULTS OF EVALUATION OF SPOTLIGHT AND FERRET III

1-15 MAY 1970[64]

	SPOTLIGHT	FERRET III
Number of Advisories Passed to FACs	22	341
Number of Trucks Passed to FACs	126	809
Number of Advisories Investigated	22	105
Number of Trucks Confirmed	-	133
Number of Trucks Struck	7	67
Number of Trucks Destroyed	0	12
Number of Trucks Damaged	0	11

An earlier study of FERRET III had identified two limitations:[65]

a. FACs and gunships were frequently engaged in strikes and could not be interrupted by further advisories.

b. Strike aircraft sometimes were operating at a distance from the area to which the sequence of advisory applied.

During discussions with TFA personnel, the effectiveness of FERRET III in detecting enemy activity was generally confirmed, but its ability to accurately distinguish random activations from truck sequences, and to determine numbers of movers was questioned. These deficiencies would be corrected in part by the addition to the system of a complete audio assessment capability (including a Spectrum Analyzer capability). The limited number of pins available for assignment to individual sensors also adversely affected the operation. This limit necessitated a trade-off between monitoring all sensors in fewer strings, or only certain sensors in a larger number of strings. One option limited the size of the areas that could be monitored, while the other restricted the amount of information available to assess the nature of the activation, and the direction, speed, and number of possible movers.[66/]

COMMANDO HUNT IV (Apr - Oct 1970)

During the 1970 Southwest Monsoon, COMMANDO BOLT operations continued in the Ban Karai area. After the Mu Gia entry corridor closed down in March, COMMANDO BOLT operations were shifted south in response to enemy activity. With the concurrence of 7th AF, a third COMMANDO BOLT area was established in the Ban Raving area, west of the DMZ. Certain LOC monitoring strings along Routes 1036/1039 were lengthened and converted into COMMANDO BOLT strike strings on 25-26 April. Terrain masking problems affecting the lengthened strings required a slight relocaticn of Green Orbit for adequate monitoring. From 15 April to 15 June 802 COMMANDO BOLT sorties were flown in the Ban Karai area and another 101 in support of the Ban Raving program.[67/]

A number of changes occurred at TFA during COMMANDO HUNT IV. Since the termination of SYCAMORE Control in April 1969, much of TFA's large Directorate of Operations (DO) had become superfluous. The subsequent emphasis on intelligence and targeting rather than operations activities finally resulted in the abolishment of DO on 30 June 1970. Certain important operational functions (such as the Sensor/Munitions Division and COMMANDO BOLT) were redistributed to the remaining directorates, Technical Operations (TO) and Intelligence (IN).[68/]

The second major change implemented during this period involved the removal of one of TFA's two IBM 360/65 computers. This economy measure resulted in a loss of backup capability and a certain degree of flexibility. During the rest of COMMANDO HUNT IV and for subsequent campaigns, the remaining computer was used for real time read out and processing of sensor data for COMMANDO BOLT operations from later afternoon to around 0500 Laos time daily. The daylight time (approximately 11 hours) was used for data base and machine maintenance, as well as a variety of data processing functions.[69/] These two reductions resulted in the elimination of 155 military manning slots by 30 June 1970.[70/]

COMMANDO HUNT V (Oct 1970 - Apr 1971)

Plans were prepared in August 1970 to increase the number of COMMANDO BOLT strings for COMMANDO HUNT V from the rainy season's six to approximately 20.[71/] At the same time, COMMANDO BOLT strike strings were lengthened from a maximum of six to a maximum of eight sensors apiece.[72/] Strike modules were composed of two or three of these strings, although exceptionally long strings of 18 sensors were used occasionally.[73/] This was to insure strings of adequate length to determine accurately truck speed and direction as well as allow TFA to continue monitoring the trucks until strike aircraft could arrive.[74/]

COMMAND BOLT operations continued in the Ban Karai and Ban Raving areas as well as along Routes 920, 911 and 922. The performance of COMMANDO BOLT measured in terms of trucks destroyed and damaged per sortie varied greatly as the campaign proceeded and as the route became more and then less lucrative. This is depicted graphically in Figure 14.[75/] Since many attacks were conducted under non-visual conditions, inability to accurately assess target damage was a major factor in determining results.[76/]

Airspace crowding problems similar to those which occurred in COMMANDO HUNT III's COMMANDO BOLT operations reappeared during COMMANDO HUNT V. It was difficult to conduct COMMANDO BOLT operations when gunships were in the same sector. On 6 March 1971 7th AF directed TFA to identify COMMANDO BOLT areas that would have the least interference with gunship operations. Gunships were the primary source of truck BDA and 7th AF was anxious to cover the most lucrative truck-hunting areas with these aircraft.[77/]

COMMANDO HUNT V

TRUCKS DESTROYED OR DAMAGED PER SORTIE OF COMMANDO BOLT OPERATIONS

76/

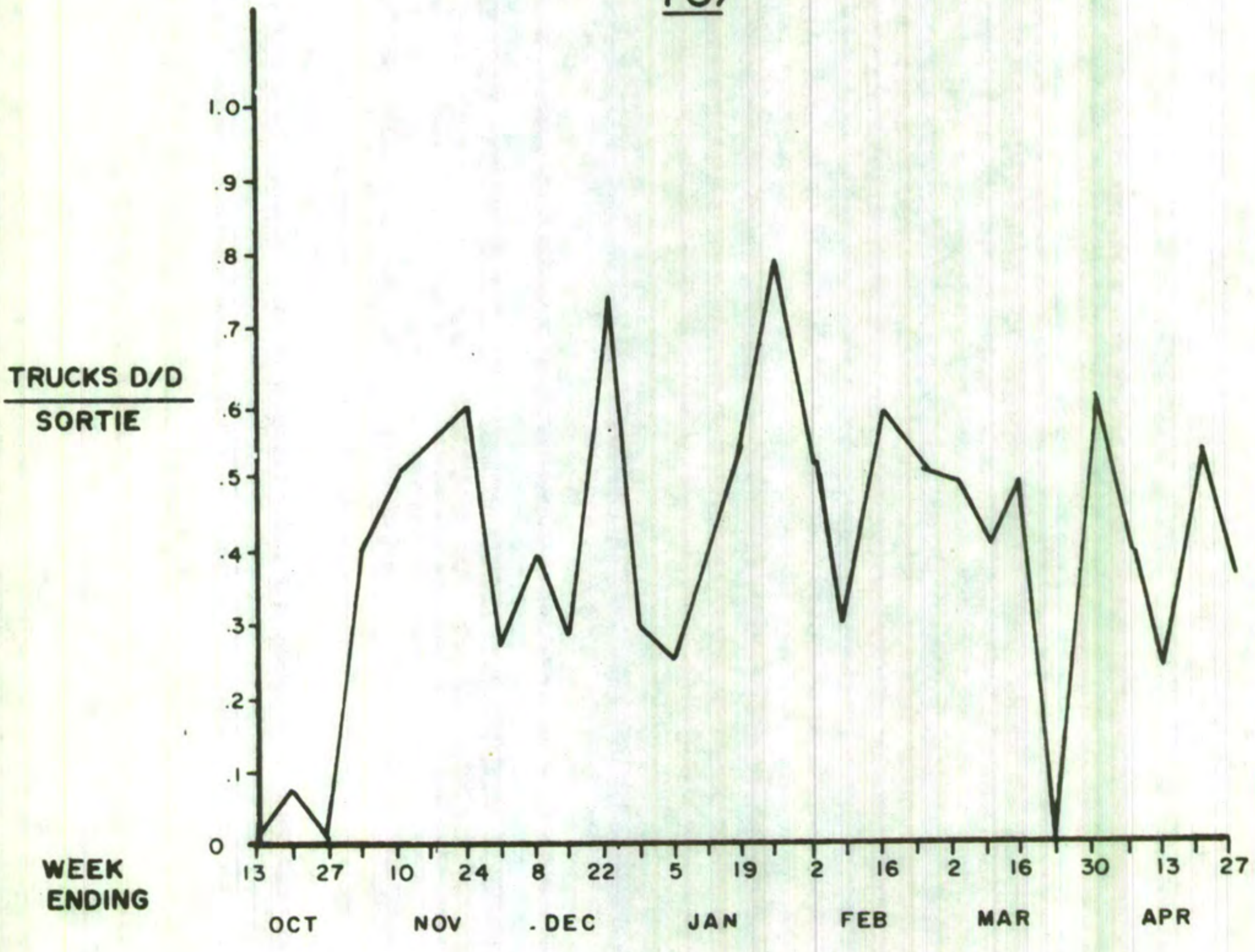


FIGURE 14

These circumstances definitely limited COMMANDO BOLT by reducing its number of strikes on movers, especially after gunship operations increased during January and March. COMMANDO BOLT aircraft occasionally were forced to expend on fixed targets when the presence of gunships prevented them from attacking targets passing through strike strings. At no time, however, were COMMANDO BOLT strike strings allowed to expire because gunships prevented their regular use.[78/]

Partly as a result of conflicts with gunships, COMMANDO BOLT regularly began to strike fixed targets in STEEL TIGER. Many of these targets were identified by TFA's target development branch (INTT) through the Night Fixed Targeting Program. These new COMMANDO BOLT tactics required that the precise LORAN coordinates for the targets be determined so that they could be attacked under non-visual conditions by either offset bombing (COMMANDO NAIL) or LORAN (PAVE PHANTOM) techniques. Strike pilots followed procedures similar to those employed against moving targets with the only differences being that no course or speed adjustments had to be made to insure a specific TOT. COMMANDO BOLT fixed targets also were struck when weather prevented daytime visual strikes, or when no sequences occurred through strike modules upon which pre-fragged strike aircraft could expend ordnance.[79/]

There were further indications during COMMANDO HUNT V that the enemy was monitoring US strike frequencies and using this information to adjust their truck movements. A 12 December 1970 message from TFA reported that truck movement had been observed to increase at the end of aircraft on-station time and decrease as aircraft would check in with COPPERHEAD. TFA requested that in the future aircraft report their "playtime" by means of secure voice communications or use encyphering methods for those transmissions broadcast in the clear.[80]

Traffic Advisory Service. A Traffic Advisory Service for FACs and gunships and the newly arrived B-57G was introduced during COMMANDO HUNT V. This service was developed in an effort to make better use of sensor information in acquiring real time targets and as a replacement for the EC-121Rs of the FERRET III program. The EC-121R was scheduled to be replaced during the campaign by QU-22B monitor/relay aircraft which had no capabilities for on-board sensor read out.

The advisory service became operational on 24 October 1970[81] and was based on the COLOSSYS computer program (See Figure 15). By use of the light pen, the GSM instantaneously transferred developing sequences to the advisory service controller (call sign HEADSHED) where it was displayed on his IBM 2260 console. The display contained the following information:[82]

a. Beginning time of sequence.

b. VR sector and sensor string number.

c. Size, type, direction and speed of mover(s).

d. Time when advisory was displayed.

e. Automatic Sequence Routing (ASR) number. (ASR was a computer process by which the above information was automatically relayed from TFA to ABCCC and 7th AF, and stored for eventual incorporation into the TFA data base).

[redacted]

HEADSHED Night Traffic Advisory
Station in TFA Control Room.

FIGURE 15

[redacted]

Upon receipt of this information, the HEADSHED controller was able to communicate directly with strike aircraft by radio and alert them to the target in near-real time. This was just an advisory, however, and unlike COMMANDO BOLT, the strike aircraft still retained the option of ignoring the reported target if engaged in other activities or attacks. This operation also differed from COMMANDO BOLT in that advisories were passed to gunships as well as fighters, and attacks were made on a visual basis rather than according to LORAN coordinates. It was the responsibility of the strike aircraft to locate a strikeable target once HEADSHED had informed him of an area in which sensors indicated activity. By late December, 17 additional sensor strings had been emplaced specifically to support the Target Advisory Service.[83/]

Prior to initiation of this advisory service, this information had been passed as a SPOTLIGHT report to ABCCC for relay to strike aircraft. ABCCC, however, was limited in the manner of advisories it could control at one time, and TFA had been allowed to pass only sequences which contained a specified minimum number of movers (usually five). The new procedure removed this limitation and greatly increased the number of advisories passed.[84/] The instantaneous, automatic data relay between the GSM and HEADSHED made possible by COLOSSYS was also a great improvement over the telephone procedures used in SPOTLIGHT, and significantly reduced the time between target identification and notification of strike aircraft.[85/] Table 7 reflects TFA Target Advisory Service activity during the most active truck-killing months of COMMANDO HUNT V.

TABLE 7

TFA NIGHT TRAFFIC ADVISORY SERVICE SUMMARY[86]

(HEADSHED)

JANUARY-APRIL 1971

SEQUENCES:	
Number of Sequences Processed	69,723
Number of Sequences Passed	21,363
SEQUENCES PASSED TO:	
COMMANDO BOLT	7,716
FACs	3,911
Gunships	4,863
Armed Recce	1,889
ABCCC	2,984
7AF Command Post	10
OPREP-4 REPORTED BDA RESULTED FROM ADVISORIES:	
Trucks Destroyed	2,739
Trucks Damaged	586
Explosions	1,793
Fires	1,490

Phase III Sensors. Conversion of the IGLOO WHITE field to Phase III sensors was completed during COMMANDO HUNT V. Phase III sensors featured greater flexibility in assignment of monitoring frequencies and other advantages which are discussed in Chapter III. At the beginning of the campaign, 88 percent of the STEEL TIGER sensor field consisted of Phase III devices. The northernmost third of the field was entirely converted to Phase III by 1 October, the central by 1 November and the remainder by 17 February 1971.[87/]

Sensor String "Band" Concept. During previous interdiction campaigns LOC-monitor sensor strings had been located in a linear fashion along the roads of STEEL TIGER. This method of emplacement accurately recorded enemy vehicle traffic through a particular area since no known alternative routes existed. By COMMANDO HUNT V, however, the Laotian route structure had expanded and the great number of bypasses and alternate routes as well as ever-growing numbers of truck parks and storage areas allowed enemy truck traffic to avoid (often unknowingly) sensor strings and consequently not be included in the overall picture of traffic patterns. TFA awareness of this problem led to the "band" concept of sensor emplacement by which strings were placed on all possible routes, bypasses, and alternates in lines cutting across strategically located choke points, areas where routes converged, and across exit gates (See Figures 16 and 17). Any vehicles passing through a band would be detected by one sensor string and

COMMANDO HUNT V

SENSOR STRING DEPLOYMENT CONCEPTS

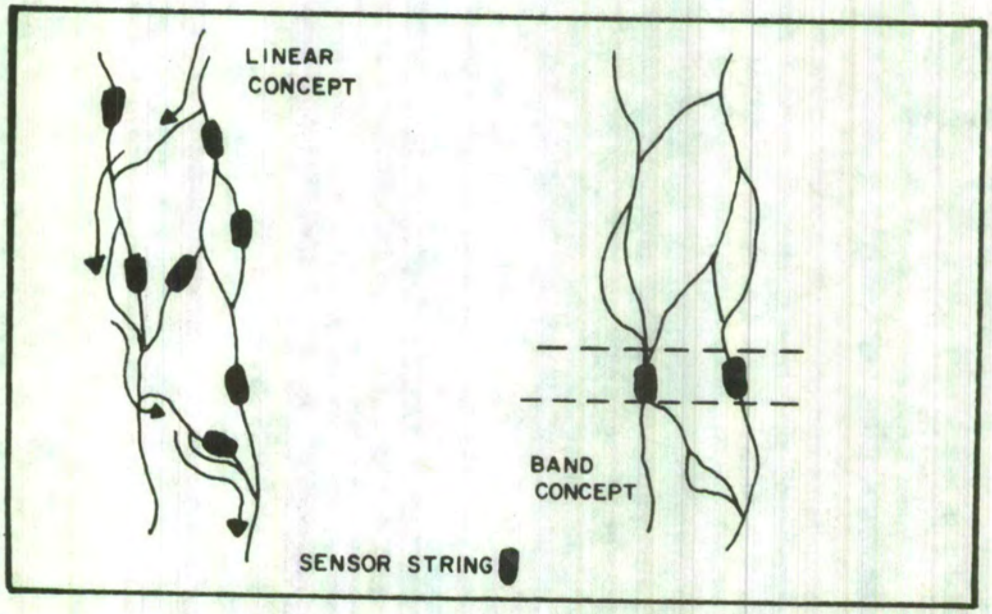


FIGURE 16

[redacted]

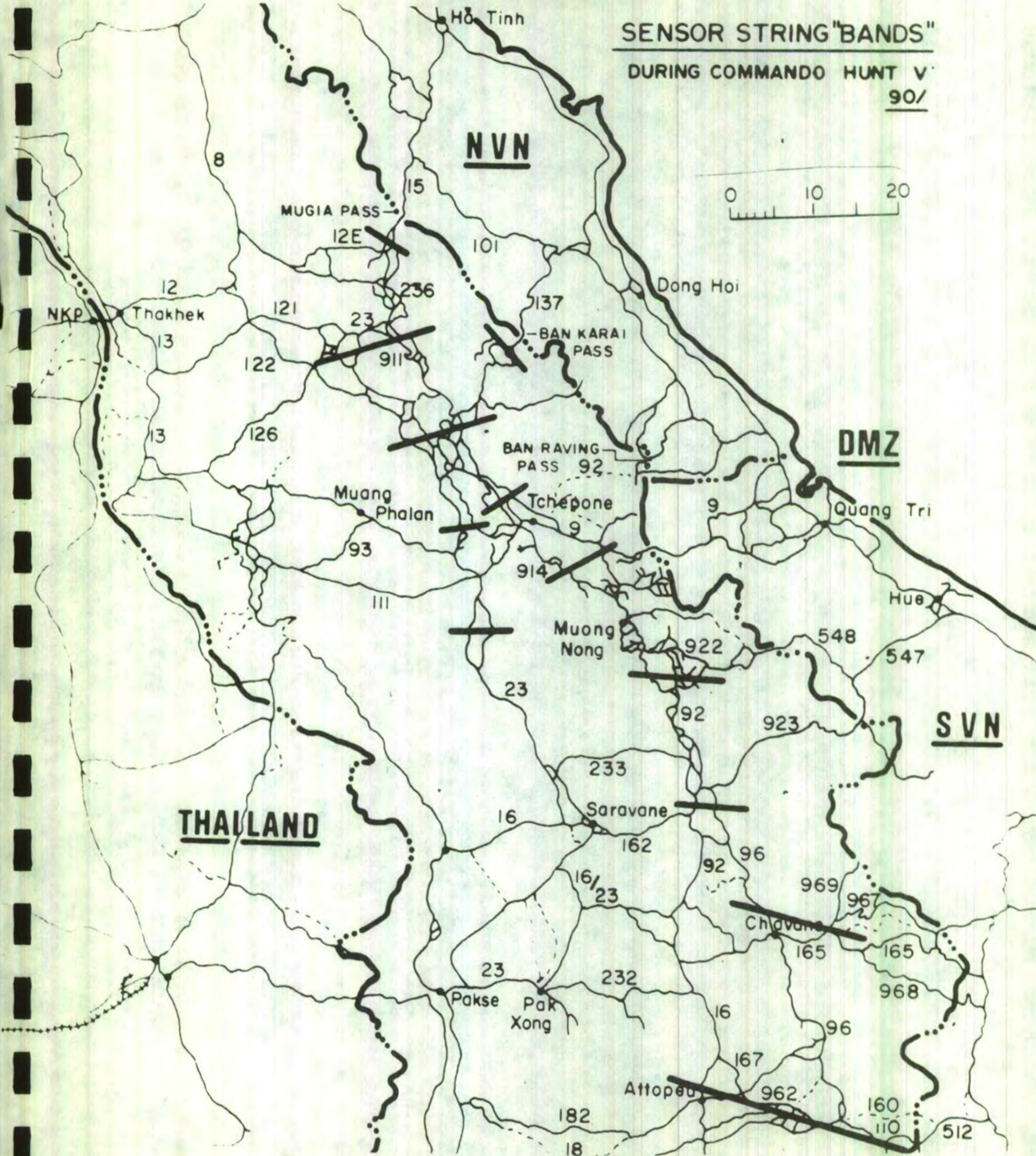


FIGURE 17

[redacted]

counted only on that string, regardless of the road used.[88] This configuration also sought to minimize double-counting of trucks.[89]

Night Fixed Targeting Program. On 5 January 1971, TFA initiated a night fixed targeting effort utilizing sensor-derived information. By analyzing sensor patterns and enemy truck movements, areas were singled out as possible locations of currently active targets such as truck parks, storage areas, or transshipment points. Based on UTM coordinates, a print out was obtained from the KEYWORD File giving all activity noted in the area for the past 30 days. This recent history of the target area was correlated with the sensor lead, and the targets officer selected a target based upon his analysis of the collated data. In many cases, recent film coverage or Special Intelligence (SI) data would also support target selection. When this process was complete, the target coordinates were passed to TFA strike controllers, 7th AF COC, the ABCCC or FACs for strike and/or prompt visual reconnaissance. COMMANDO BOLT aircraft were frequently used to deliver ordnance the following night. If collateral intelligence supporting the sensor-derived lead was insufficient, the lead was referred to FACs, PIs and targets personnel for further development.[90]

The night fixed targeting program differed from normal target development in that the leads were derived primarily from an analysis of sensor intelligence rather than from FAC, SI, or photographic information.

Lucrative leads from sensors could be quickly supported by other intelligence sources from the KEYWORD File and strike recommendations made the same night that the initial indication was received. Previous target development procedures required nominations to 7th AF by message and a lengthy process before the location was finally fragged and struck (normally three days for Tac Air and four days for Arc Light targets).[91] This program supplemented rather than replaced the normal targeting process and was a further attempt to derive useful targets from IGLOO WHITE's ability to provide real time information on enemy activity.

Night-fixed targets were classed as "A" or "B" targets. "A" targets were those which were expected to be lucrative for less than 48 hours and required immediate strike action. Examples were certain truck parks and storage areas in use for only a short time. "B" targets were expected to remain lucrative for as long as 30 days. These latter were passed to the day targeters for further development, rather than immediate nomination and strike.[92]

The night-fixed targeting program reported the following results for the period 5 January through 15 September 1971:[93]

	NOMINATED	STRUCK	STRUCK WITH POSITIVE BDA
"A" Targets passed for strike within 48 hours	819	125	65
"B" Targets passed for further development	471	161	109

X-T Plotter. In late January 1971, the installation of an X-T Plotter was completed in the plot room at TFA. For the past year this device had been mounted in EC-121R sensor-monitor aircraft as the basis of the FERRET III program and had given these aircraft the ability to read out a selected set of up to 99 sensors per plotter. This capability allowed the EC-121Rs to send near-real time traffic advisories direct to FACs and gunships and performed many functions of an airborne ISC. 94/

While this device greatly enhanced the EC-121R's capabilities, FERRET III experience had demonstrated that the computerized surveillance center at TFA was still superior to the X-T Plotter in detailed analysis: 95/

> *Identification of sensor-detected movers by X-T Plotter readout is not as reliable as when accomplished by the computer-aided process used at TFA which includes greater audio and spectrum analysis validation capability. However, the X-T Plotter does provide read out in areas where relay of sensor data to TFA is not possible (extreme southern STEEL TIGER) and in other areas when the TFA computer is not on the line.*
>
> *. . .the X-T Plotter provides targets only in the sense that it identifies that movers are passing through a sensor string, and this information is used to provide traffic advisories to aircraft in near-real time. At very best it could pinpoint the location of a mover to within the detection range of a given sensor. Direction of movement is apparent, but speed of movement can be determined only approximately.*

TFA's X-T Plotter served as a backup when the computer was unavailable because of required maintenance or was engaged in data processing and analysis tasks. The X-T Plotter was also employed for periodic daylight monitoring of Green and Blue Orbits during March and April 1971, and for the round-the-clock monitoring of certain sensor strings in the Lam Son 719 area during that operation. Other roles for the plotter included an operator training function in conjunction with the computer in which comparisons of computer and plotter read-outs for the same sensor strings produced excellent results. TFA's X-T Plotter read out the deployable Automatic Relay Terminal (DART I) field in northern RVN from 7-24 March 1971 when this system's read out facility was down for maintenance and again during July when the DART facility at Quang Tri was dismantled for transfer to TFA. The presence of the X-T Plotter also served to partially compensate for the removal of one of TFA's two IBM 360/65 computers.[96/]

Lam Son 719. The tight security precautions which characterized preparations for Lam Son 719 prevented the inclusion of a plan for the employment of IGLOO WHITE in the initial planning for the operation. Once the security hold was lifted, however, the Army implanted and read out sensor strings for security along Route 9 and around Khe Sanh.[97/] Marine OV-10s also emplaced 41 strings in the same areas in support of ground forces. During the withdrawal phase of the operation an additional 12 strings were emplaced by F-4s along Routes 9 and 925 and again around Khe Sanh.[98/] Sensors were credited with detecting 5232 targets,[99/] 694 of which were engaged by artillery, 14 by mortars and three by remotely-triggered mines. No BDA was recorded since the majority of the responses occurred at night or during inclement weather. There are no records of USAF sorties directed against sensor-derived targets because the target source was not specified in the mission reports.[100]

As the operation progressed, the ARVN commander was notified of the availability of F-4 implanted sensor strings. Two route-monitor strings subsequently were requested and implanted. Advisors also emphasized to ARVN forces the opportunity to implant stay-behind sensors as friendly forces withdrew. ARVN commanders, however, were reluctant to become involved in emplacing these devices since equipment and teams familiar with implant techniques were not readily available. ARVN approval was finally given during the withdrawal phase of the operation, but it was by then too late to implement the plan.[101]

The major lesson learned concerning the use of sensors during Lam Son 719 was that sensors can be used in an effective and timely manner in large ground operations only if they are incorporated into the operational planning from the beginning.[102] The utilization of stay-behind sensors also requires careful advance planning so that the necessary equipment, skills and relay/read out capabilities are available. Terrain masking problems should also be examined beforehand.[103]

COMMANDO HUNT VI (Apr - Oct 1971)

The COMMANDO HUNT VI rainy season plan reduced the maximum number of active sensor strings in STEEL TIGER from COMMANDO HUNT V's high of 128[104/] to 96.[105/] After consultation with 7th Air Force, it was decided to begin the campaign with the maximum number of sensor strings and then eliminate strings as the enemy abandoned the routes they monitored.[106/] Towards the end of the campaign, the total number had fallen to approximately 50.[107/]

DART I Transfer. Of major importance to the future role of TFA was the transfer in early July of the Air Force-operated DART I sensor read out facility from Quang Tri, RVN, to TFA. The DART I system monitored sensor fields within northwestern RVN, including the Western Reconnaissance Zone (WRZ - western Quang Tri Province, RVN), the western Demilitarized Zone (DMA) and the A Shau Valley for the U.S. Army's XXIV Corps. The combination of DART I and IGLOO WHITE at one location was expected to provide a real time target correlation and strike capability against enemy forces infiltrating through the DMZ and along the Laos/RVN border. At the same time, the DART I data base was combined with TFA's.[108/]

Additional Sensor Channels. Early planning for the COMMANDO HUNT VII campaign envisioned a sensor field substantially larger than that for COMMANDO HUNT V because of the anticipated expansion of IGLOO WHITE to LOCs in western STEEL TIGER.[109/] With the 32 sensor channels then available for use, the maximum number of sensor strings possible consisted of approximately 150 strings. Requests by 7th AF in May resulted in eight additional channels being allocated to IGLOO WHITE, and a further eight being reserved for possible future use.[110/] Seventh Air Force expressed hopes in July that new transmitters would be available for installation in sensors during September, so the new channels could be utilized. With 40 channels available for sensor operations (including three allocated to DART I/XXIV Corps), the maximum number of strings (with seven sensors apiece) technically feasible rose to approximately 200.[111/] Plans to reduce the maximum number of sensors per string to four or five for COMMANDO HUNT VII would make a significantly larger number of strings possible.

COMPASS FLAG. Another important addition to TFA during COMMANDO HUNT VI was the COMPASS FLAG program. This was a Special Intelligence (SI) collection program which was expected to greatly improve TFA's effectiveness:[112/]

> *COMPASS FLAG affords TFA the opportunity for more timely fusion of SI data with that from sensors and other sources of information. Proximity of the COMPASS FLAG ground terminal to the ISC means that results of preliminary analysis of the COMPASS FLAG product by USAF Security Service (USAFSS) personnel will be readily available for TFA use. Conversely, reports on enemy activity based on sensor activations may enable USAFSS analysts to produce a more complete product from COMPASS FLAG collection.*

It should be kept in mind that COMPASS FLAG was not part of IGLOO WHITE but was established at TFA so the two programs could mutually support each other.

As originally conceived, the QU-22B aircraft was to have provided air support for COMPASS FLAG activities by flying a special mission over STEEL TIGER designated Yellow Orbit.[113/] QU-22B difficulties in August 1971, however, resulted in an evaluation of the C-130 as an alternate platform.[114/] Although hopes were expressed that IGLOO WHITE and COMPASS FLAG functions could be combined in the same aircraft, the 6908th Security Squadron (SS) at TFA pointed out that both programs were designed around different orbits neither of which could be altered without degrading one or the other mission. Another potential problem was the desire to perform both functions by means of C-130s flying ABCCC missions. The 6908SS feared that communications transmissions necessary to the ABCCC would interfere seriously with COMPASS FLAG.[115/]

<u>Reactivation of DO</u>. Most significant of all for the future of TFA was the reactivation on 22 May 1971 of a Directorate for Operations (DO).[116/] This office had been deleted during COMMANDO HUNT II after SYCAMORE Control had been abolished and the direct control of strike aircraft operating over STEEL TIGER removed from TFA. The development and steady expansion of the COMMANDO BOLT system, the initiation of the Night Traffic Advisory Service and the move of DART I to the ISC resulted in TFA acquiring increased responsibilities in the operational sphere. Consequently, a central office was needed to effectively control and coordinate the efforts of these different functions.

A further indication of this increased operational orientation was the decision in late June to make TFA predominately a night operation. Instead of the former practice of operating the ISC on the basis of three roughly equal shifts daily, the majority of TFA's personnel were placed on a 1700 to 0500 work schedule to match the daily period of peak enemy activity. Skeleton crews remained on duty during the day to perform such functions as computer off-line operations, round-the-clock DART I monitoring and certain analysis functions.[117/] Although this new schedule was modified as enemy activity declined for the rainy season, the precedent had been set for subsequent dry season campaigns.

<u>Use of IGLOO WHITE Outside of STEEL TIGER and South Vietnam</u>

<u>Cambodia</u>. The involvement of Cambodia in hostilities against Communist forces opened this country for the first time to the possible employment of IGLOO WHITE sensors. A 19 May 1970 message from 7th AF Directorate of Targets Intelligence to TFA reported "considerable high level interest in the future need for sensor string coverage in northeastern Cambodia."[118/] A proposed area of interest was specified and TFA was instructed to determine the feasibility of such a Cambodian sensor field and the requirements for a read out orbit.[119/] On 5 June 1970, a Hq 7AF staff paper discussed guidance from Military Assistance Command Vietnam (MACV) Directorate of Special Operations (JE-04) concerning sensor operations in Cambodia:[120/]

a. U.S. forces would be out of Cambodia by 30 June 1970.

b. There would be no U.S. artillery firings across the border from the RVN after 30 June unless targets are definitely lucrative and firings are approved by Hq MACV (J-3).

c. Sensors left in Cambodia by U.S. forces were for intelligence purposes only.

d. Status of RVN forces in Cambodia after 30 June was unknown at that time.

The staff paper went on to review the approximately 170 stay-behind sensors emplaced by the 25th Infantry Division and the 1st Cavalry Division. These were all capable of being read out from relay points situated on mountains within the RVN (Nui Ba Den and Nui Ba Ra) as part of the Army's Battlefield Area Surveillance System (BASS) facilities. Also discussed was the need to relocate Orange Orbit if 7th AF assumed responsibility for monitoring Cambodian sensor fields and the impact this would have on existing IGLOO WHITE and DART requirements.[121/]

By 24 June, TFA decided that a sensor field of 20 strings would satisfy the minimum requirements of the coverage desired. Maps had been obtained and special photography to assist sensor implant planning was on order. A review of the Cambodian project, however, mentioned two difficulties: TFA had always been responsible for Laotian LOCs, and prior to the Allied incursion into Cambodia had no information concerning that country's route structure. The second and most difficult problem related to the fluid ground situation: FACs flying over Cambodia reported difficulties in distinguishing civilian from military traffic and friendly military from enemy military traffic. If these problems were not resolved it would be difficult to successfully apply IGLOO WHITE to Cambodia. The study also reported that the projected 20 string Cambodian sensor field would require two new read out orbits, since neither Purple nor Orange Orbits could be moved without serious detriment to IGLOO WHITE coverage of Southern Laos or the RVN.[122/] By 30 July, the proposed field had been expanded to 25 strings, but plans for actual implementation of the sensor implants had been put "on the shelf" at 7th AF.[123/]

On 27 September 1970, 7th AF directed that three sensor strings be implanted in northeastern Cambodia along Routes 13, 136, and 94 in hopes that they would detect an anticipated increase in enemy traffic from southern Laos into Cambodia.[124/] The three strings were implanted on 3 and 4 October and two-three hours of Purple Orbit were diverted each day to monitor them.[125/] These strings were monitored for a total of 36 hours from 4-16 October on a random basis, with one mover being detected along Route 13 on the night of 12 October. From these results, 7th AF concluded that the enemy was not moving vehicle traffic at night along the three routes.[126/] In conjunction with this evaluation, 7th AF also indicated its desire to retain the FERRET III EC-121Rs as long as possible in any phase down of these aircraft, in order that X-T Plotters could provide real time traffic advisories to strike aircraft if the full Cambodian contingency plan were ever implemented.[127/]

By the end of October, 7th AF Directorate of Targets Intelligence had decided that the objectives of a sensor field in northeastern Cambodia would be to "monitor the input routes from southern Laos into Cambodia and to monitor the throughput routes from southern Laos into southern MR III."[128/] Since the October test had been designed to monitor the

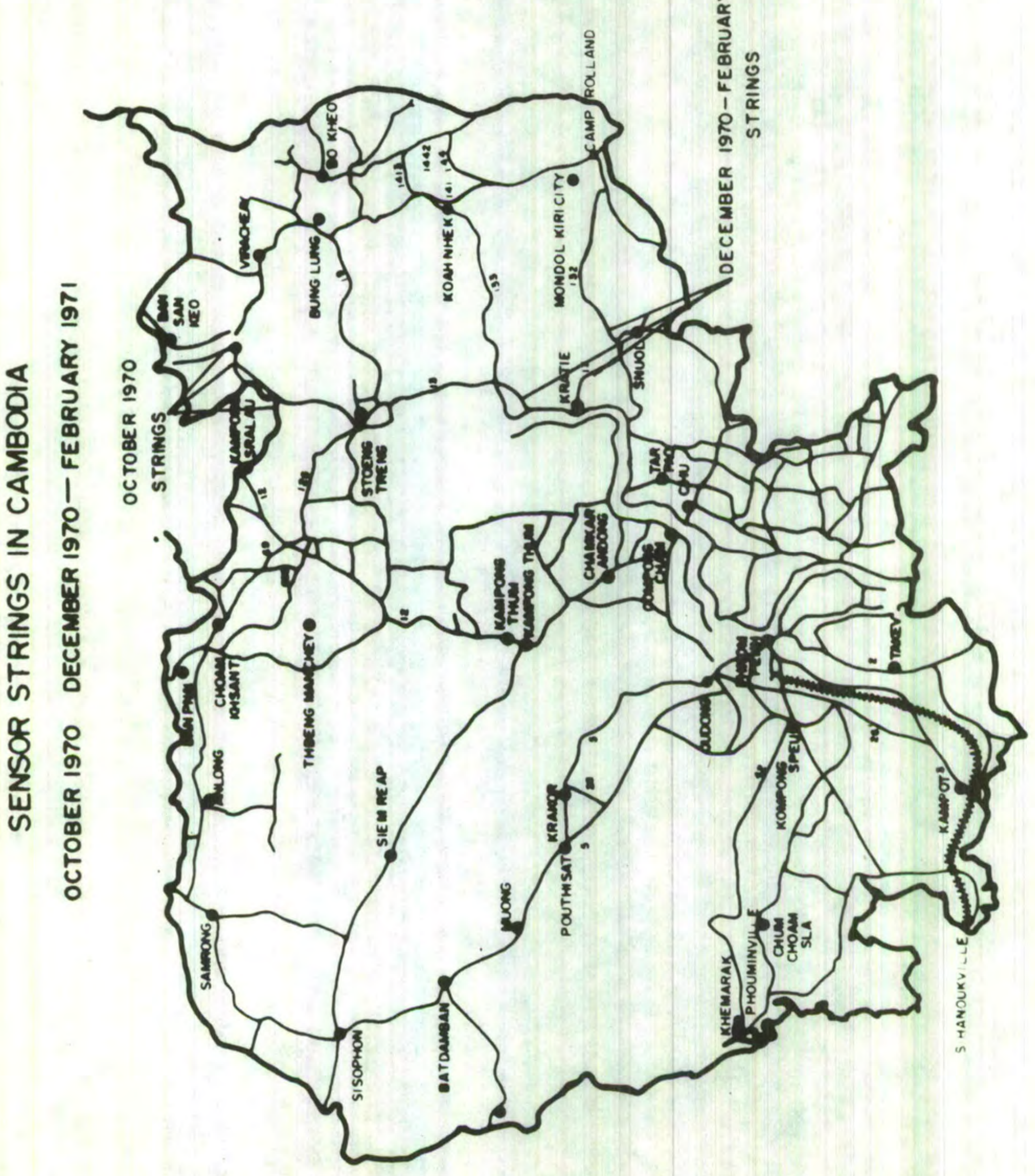

SENSOR STRINGS IN CAMBODIA
OCTOBER 1970 DECEMBER 1970— FEBRUARY 1971
OCTOBER 1970
STRINGS
DECEMBER 1970—FEBRUARY 1971
STRINGS
CAMP ROLLAND
BO KHEO
VIRACHEY
BAN SAN KEO
BUNG LUNG
KOAH NHEK
MONDOL KIRI CITY
KRATIE
SNUOL
STOENG TRENG
KAMPONG THUM
KAMPONG THOM
CHAMKAR ANDONG
THBENG MANCHEY
CHOAM KHSANT
AN LONG
SIEM REAP
SAMRONG
SISOPHON
BATDAMBANG
POUTHISAT
KRAKOR
KOMPONG SPEU
TAKEV
KAMPOT
CHUM CHOAM SLA
PHOUMINVILLE
KHEMARAK
S HANOUKVILLE

FIGURE 18

input routes, a second set of three sensor strings was implanted on 20 December along potential throughput Routes 13 and 132 in Cambodia.[129/]

Unlike the strings in October, these sensors were Army devices which were hand-implanted by Vietnamese Air Force (VNAF) helicopter-borne personnel in areas where significant traffic had been observed. The orbit of the Tactical Air Control Center (TACC) EC-121R (TACC-A, or Black Orbit) was modified to permit monitoring of these strings, which continued from 21 December to 7 February.[130/] During this time, two movers were detected on 24 December, one mover on 4 January and 11 on 14 January. A traffic advisory on one of the 24 December movers was passed to an AC-119G SHADOW gunship, but no results were reported. After the expiration of the sensor life spans, MACV felt that it was unlikely that a continuing sensor capability in that area would be worth the effort needed to monitor it effectively. It was recommended that if additional strings were desired, they should be placed on Routes 110A and 166B in southern Laos in order to detect traffic moving into Cambodia.[131/]

<u>BARREL ROLL</u>. Sensor strings were first employed in BARREL ROLL (Northern Laos) in August 1969 to determine enemy traffic patterns and levels during a critical ground campaign. A special Rose Orbit had been established to monitor the strings by manual read out. Additional sensors were utilized along Route 7 in October and November,[132/] but the changing situation made their continued employment unnecessary, and Rose Orbit was terminated on 24 January 1970.[133/]

In August 1971, the 7th AF Deputy Chief of Staff for Operations commented on the possibility of the BARREL ROLL Airborne Command and Control Center (ABCCC) C-130E performing a role similar to that successfully undertaken by its STEEL TIGER counterpart and monitoring a sensor field on Route 7 east of Ban Ban. An investigation by TFA of terrain masking problems and enemy threat to the monitor-relay aircraft determined that a favorable orbit with minimal risk could be established, although certain sections of the route would have to be monitored from a second orbit that would expose the aircraft to a certain degree of risk from AAA, MIGs, and Surface-to-Air Missiles (SAMs) fired from within North Vietnam.[134] Since no read out would be possible aboard the relay aircraft, the data would have to be transmitted to TFA for interpretation. It was proposed to use the recently installed DART antenna and receiver for this purpose if the need ever arose, since all other equipment was required to support IGLOO WHITE and COMPASS FLAG.[135] No decision was made to proceed with a BARREL ROLL sensor field at that time.

<u>North Vietnam</u>. Another area for which the employment of IGLOO WHITE sensors was considered briefly was North Vietnam. Intelligence reports in late 1970 had indicated the deployment of four SAM Firing Battalions into the North Vietnamese panhandle south of 18° north latitude, probably to attack USAF aircraft operating against Laotian LOCs near North Vietnam's border. Since none of the Firing Battalions had been located, 7th AF intelligence on 7 December requested a study to determine the feasibility of placing sensors on LOCs along which SAMs would have to be moved to reach convenient firing positions. Since

SAM units were believed to require seven or eight hours to prepare for action after occupying a firing position, sensor detection of their movement into position would give sufficient warning of the impending attack to allow aircrews to be alerted. The request suggested that electrical engine ignition signatures might be useful in differentiating SAM equipment from other vehicles.[136/] A 15 December message from the Commander, U.S. Military Assistance Command, Vietnam (COMUSMACV) commented on this feasibility study (then being conducted at TFA) and indicated that if the study were favorable a request would be prepared asking for authority for sensor implants in North Vietnam.[137/]

TFA concluded that the project was not feasible with current equipment and knowledge. Seismic sensors were unable to distinguish between different vehicles, while acoustic sensors were limited by the ability to differentiate only tracked from wheeled vehicles. Another problem was that the enemy would still be able to move SAM equipment at times when the ISC was not in operation. Sensors in North Vietnam would have to be read out by Green Orbit; a move toward North Vietnam would place the aircraft beyond the MIG Combat Air Patrol (CAP) line, while a more secure location would significantly degrade Green Orbit's ability to perform its primary mission of monitoring sensors in the Ban Karai and Ban Raving areas.[138/]