AD NUMBER

AD387513

LIMITATION CHANGES

TO:

Approved for public release; distribution is unlimited.

FROM:

Distribution authorized to U.S. Gov't. agencies and their contractors; Critical Technology; 16 JAN 1968. Other requests shall be referred to Naval Air Development Center, Johnsville, Warminster, PA 18974. This document contains export-controlled technical data.

AUTHORITY

NAWCAD memo dtd 22 Feb 2017

22 Feb 2017

MEMORANDUM FOR THE RECORD

FROM: Division Director EO & Special Mission Sensors, Avionics, Sensors and E* Warfare Dept (AIR 4.5.6)

TO: Office of Counsel, Naval Air Warfare Center, Aircraft Division (NAWCAD)

Subj: SECURITY RECOMMENDAION FOR FOIA REQUEST, DON FOIA CASE FILE NUMBER 2015-008952

Ref: (a) SECNAVINST 5720.42F, DON FOIA Program, 06 Jan 99

(b) Executive Order 13526

1. Releasable Recommendations. The following documents were reviewed by AIR 4.5.6. Each of the following documents were found to be releasable in their entirety:

   a. Document (1) of Subj. NAVAIRDEVCEN Report No. NADC-AW-L5902, 24 Mar 1959, "Investigation of a Towed-capsule Installation of the AN/ASH-2 Condensation Nuclei Detector" (ADB966296)
   b. [redacted]
   c. Document (16) of Subj. NAVAIRDEVCEN Report No. NADC-AE-6759, 16 Jan 1968, "Modified Reconofax VI Infrared Mapping Set with Real Time Inflight Display" (AD-387513)
   d. Document (17) of Subj. NAVAIRDEVCEN Report No. NADC-AE-6828, 12 Nov 1968, "Modified AN/AAD-2(XE-2) Infrared Detecting Set with Real-Time Inflight Display (AD-500493)
   e. Document (18) of Subj. NAVAIRDEVCEN Report No. NADC-72167-AE, 10 Apr 1973, "Index of Performance for FLIR (Forward Looking Infrared) Imaging Devices" (AD-525116)

2. Partially Releasable Recommendations. AIR 4.5.6 recommends pages 27 through 68 are releasable the following report: Document (20) of Subj. Naval Research Laboratory Memorandum Report 3240, Proceedings of the Electro-Optics/Meteorology Meeting on 7 Aug 1975, Mar 1976 "FLIR Performance Modelling and its Dependence upon Climatology and Meteorology "(AD-D516929L). All other data in this report is not under the technical authority of AIR 4.5.6.

3. [redacted]

4. Basis of Recommendation. All information was reviewed with current class guides and what is considered open source information. Appropriate recommendations made above with respect to findings. Documents found with portions releasable were sanitized based on class guides and reference (b). Such disclosure of Department of the Navy classified information would give potential adversaries insight that would present a significant threat to national security.

5. Exemptions Utilized. Two separate exemptions were utilized in the determination of what information should be sanitized or exempted from release via Freedom of Information Act (FOIA) request process. All current Classified Military Information (CMI) has been sanitized out of the document under FOIA Exemption 1, Executive Order 13526 Section 3.3(4). This Executive Order Section covers CMI that was originally classified over 25 years ago from date of this memorandum. Subject matter experts within AIR 4.5.6 were utilized in making the exemption determinations.

6. Point of Contact. The point of contact for this security review and recommendation is Mr. Paul W. Reimel, AIR 4.5.6 Division Director, paul.reimel@navy.mil, 301-342-0100.

2/28/2017

X Paul W. Reimel

Paul W. Reimel

Signed by: REIMEL.PAUL.W.1229241016

Distribution:

NAWCAD 7.4

NAWCAD 4.5.6

COPY

NAVAL AIR DEVELOPMENT CENTER

Johnsville, Warminster, Pennsylvania

Report No. NADC-AE-6759 16 Jan 1968

MODIFIED RECONOFAX VI INFRARED MAPPING SET WITH REAL-TIME INFLIGHT DISPLAY

FINAL REPORT

DEPARTMENT OF THE NAVY
U. S. NAVAL AIR DEVELOPMENT CENTER
JOHNSVILLE
WARMINSTER, PA. 18974

Aero-Electronic Technology Department

REPORT NO. NADC-AE-6759 16 January 1968

MODIFIED RECONOFAX VI INFRARED MAPPING SET WITH REAL-TIME INFLIGHT DISPLAY

FINAL REPORT

A Reconofax VI infrared (IR) mapping set was modified to operate in the 8- to 13-micron IR band, provided with a long-persistence-phosphor cathode-ray-tube (B-scope) display, installed in a VAP-61 RA-3B aircraft, and used over North Vietnam for road, waterway, and bridge reconnaissance. Real-time tactics were developed, and strikes were called against transient targets based on information provided by the inflight display.

Reported by: P. M. Moser
P. M. Moser
Applied Research Division

Approved by: William S. Lee
W. S. Lee, Superintendent
Applied Research Division

D. W. Mackiernan
D. W. Mackiernan
Technical Director

S U M M A R Y

INTRODUCTION

Under a previous project, the Naval Air Development Center (NAVAIRDEVCEN) flight tested three experimental infrared (IR) mapping sets. Subsequently, VAP-61 (Heavy Photographic Squadron SIXTY-ONE) stated that an immediate requirement existed for an IR reconnaissance sensor to improve RA-3B aircraft night reconnaissance capabilities in Southeast Asia operations, and requested that such equipment at NAVAIRDEVCEN be installed in a VAP-61 aircraft. Arrangements for the installation were coordinated by the Office of the Chief of Naval Operations.

RESULTS

An HRB-Singer, Incorporated, Reconofax VI IR mapping set was modified to operate in the 8- to 13-micron IR band by equipping it with a Santa Barbara Research Center mercury doped germanium detector, cooled by a Malaker Laboratories, Incorporated, Mark VII-C "Cryomite" cryostat. A long-persistence-phosphor cathode-ray-tube real-time (B-scope) display was adapted for use with the Reconofax VI scanner. The resulting IR reconnaissance set was installed in VAP-61 RA-3B aircraft, BuNo. 144834, during June 1966 and used successfully over North Vietnam for road, waterway, and bridge reconnaissance, for bomb damage assessment, and for general surveillance. Real-time tactics were developed and strikes were called against transient targets based on information provided by the inflight display.

CONCLUSIONS

IR reconnaissance equipments with real-time inflight displays can be installed in current Navy jet aircraft and operated successfully in a combat environment by military personnel. These devices can be used for road, waterway, and bridge reconnaissance, for bomb damage assessment, and for general surveillance. Vehicles can be detected at night on an inflight display, and tactics have been developed for calling successful air strikes against the vehicles. IR imagery recorded on film complements aerial reconnaissance imagery produced by conventional photographic means.

RECOMMENDATIONS

It is recommended that additional equipments of this same general type, but possessing the attributes of improved resolution, greater reliability, and carrier suitability, be procured and installed in additional RA-3B aircraft.

TABLE OF CONTENTS

B A C K G R O U N D

During the period January through March 1966, the Naval Air Development Center (NAVAIRDEVCEN) flight tested simultaneously three experimental infrared (IR) mapping sets under WEPTASK No. RAV08J005/2021/F001-05-05, Problem Assignment No. 1, as described in reference (a). Reference (b) stated that an immediate requirement existed for an IR reconnaissance sensor to improve RA-3B aircraft night reconnaissance capabilities in Southeast Asia operations and requested that such equipment in use at NAVAIRDEVCEN be installed in a VAP-61 (Heavy Photographic Squadron SIXTY-ONE) aircraft.

Reference (c) commented that there existed no IR capability in fleet reconnaissance aircraft. Reference (d) replied that the only equipment available was a modified Reconofax VI IR mapping set and that a quick non-carrier-suitable installation of the set could be made at NAVAIRDEVCEN in the first available RA-3B if desired. Reference (e) re-emphasized the desire of the squadron to obtain IR reconnaissance equipment. Reference (f) stated that the modified Reconofax VI with a long-persistence-phosphor cathode-ray-tube (B-scope) display would be available by 31 May 1966 and indicated that NAVAIRDEVCEN would provide field engineering services/training and instruction in IR image interpretation. Reference (g) indicated VAP-61 plans to deliver RA-3B aircraft, BuNo. 144834, to NAVAIRDEVCEN for installation of the IR sensor.

D E S C R I P T I O N O F E Q U I P M E N T

The Reconofax VI IR mapping set was procured from HRB-Singer, Incorporated, under Contract N62269-2202 of 27 June 1963 and delivered to NAVAIRDEVCEN on 15 October 1963. The equipment was installed in an F-8 aircraft for a series of flight tests. In these flight tests, satisfactory imagery was obtained during daytime operations, but the equipment lacked adequate sensitivity for producing satisfactory nighttime imagery. During January and February 1966 the equipment was updated by replacing its relatively insensitive liquid-nitrogen-cooled indium antimonide detector by a liquid-helium-cooled copper doped germanium detector. A description of this modified equipment and of results obtained with it are given in reference (a).

Upon completion of the reference (a) flight test program, the Reconofax VI was further modified by replacing its liquid-helium-cooled copper doped germanium detector by a Santa Barbara Research Center mercury doped germanium detector mounted on a Malaker Laboratories, Incorporated, Mark VII-C "Cryomite" closed-cycle cryostat, which had been procured previously under the continuing development program of references (h), (i), (j), and (k).

Changes in the electronic circuitry of the Reconofax VI were made to compensate for the different electrical characteristics of the new detector. A modified display/control unit, type 59945, originally procured under reference (j) early in 1963 from HRB-Singer, subsequently modified and subjected to a fleet operational investigation as an ASW display device by OPTEVFOR under Project F/O 143, was modified again for use with the Reconofax VI. This device was divided into two units: a display unit and a control unit.

The major component of the display unit was a Thomas Electronics, Incorporated, type 10M37P7 long-persistence-phosphor cathode-ray tube, providing a 9-1/2-inch (height) by 2-1/4-inch (width) viewing area. A small scanner control unit was fabricated at NAVAIRDEVCEN to permit remote control of the Reconofax VI scanner independent of the modified scanner/control unit. The combination of these four units, i.e., the modified Reconofax VI scanner unit, the modified type 59945 display/control unit, the display unit, and the scanner control unit comprise what has been informally designated as IR Recon Set No. 1.

IR Recon Set No. 1 weighs 114 pounds and occupies a volume of 3.5 cubic feet. It consumes electric power at the rate of 752 watts. It achieves a spatial resolution of 3 to 4 milliradians on its 70-mm film recordings and 8-milliradian resolution on the inflight display. The lateral field-of-view of the equipment is 120 degrees. It operates in the 8- to 13-micron band of the IR spectrum and exhibits a thermal resolution (noise-equivalent-temperature difference) of 0.16 C°.

A I R C R A F T I N S T A L L A T I O N

From 18 to 24 May 1966, a prototype installation of the equipment was made in NAVAIRDEVCEN RA-3B aircraft, BuNo. 144839. Local flight tests were made on 24, 26, and 27 May. Although the equipment exhibited a number of deficiencies on each flight, no fundamental problems were encountered. The performance of the B-scope display was considered marginal. On 27 May, the equipment and its mounting provisions were removed from the NAVAIRDEVCEN aircraft for reinstallation in the VAP-61 aircraft. On 31 May, RA-3B aircraft, BuNo. 144834, arrived at the NAVAIRDEVCEN; installation and ground checkout of the equipment were completed on 5 June. Three local flight tests were made on 6 and 7 June. On 8 June, the aircraft and the equipment departed NAVAIRDEVCEN for return to NAS Agana, Guam.

The scanner unit was mounted on a door which replaced the aircraft's aft access hatch and displaced the antenna for Radio Compass AN/ARN-6. Figure 1 shows the scanner unit mounted on the hinged door in its open position. The display unit and the scanner control unit were mounted in the third crewman's instrument console as illustrated in figure 2. The modified display/control unit, shown in figure 3, was installed under this console.

The aircraft arrived at NAS Agana, Guam, on 13 June. Commencing 14 June and continuing through July 1966, flights were made to check the equipment, train operators, and evaluate the equipment against various targets of interest. During this period the equipment was plagued by numerous problems attributed to combinations of the following factors:

1. the age and previous extensive usage of the equipment,

2. its having been designed according to commercial rather than military standards, and

3. an operating environment quite different from that encountered in the Middle Atlantic states.

For example, problems were encountered with deteriorating electric contacts between fuses and their mounting clips and between the mating contacts in electric connectors. Printed circuit boards had to be kept scrupulously clean to prevent the development of spurious current paths. Bolts loosened and wires broke. Nevertheless, most of the worn components had been replaced by August 1966 and the set began to operate with sufficient reliability that, by 27 December 1966, 97 IR missions (including 30 combat missions) had been flown.

EQUIPMENT USAGE

A primary current mission of VAP-61 is to perform nighttime road reconnaissance over North Vietnam. The previously-employed procedure consisted of: attempting to fly along roads at night to take photographs for which illumination was provided by use of photoflash cartridges dispensed from the aircraft, returning to the aircraft carrier, processing the films, and studying the imagery. This procedure suffered a number of limitations: the aircraft spent only a fraction of its time over the roads; the use of pyrotechnic devices made the aircraft particularly vulnerable to ground fire; and the system provided no real-time capability.

IR Recon Set No. 1 was the first IR reconnaissance equipment to be used operationally by the U. S. Navy. This device produced passively, even in complete darkness, imagery of the scene overflown by virtue of differences in effective temperatures of various objects in the scene. The device provided both real-time inflight pictures on its B-scope display and permanent recordings on photographic film. The real-time display enabled the third crewman to guide the pilot along the roads and to call strikes against transient targets. Figure 4 is an example of IR imagery recorded by the modified Reconofax VI over North Vietnam. In references (l) and (m), CINCPACFLT has strongly recommended that additional improved equipments be procured and installed in RA-3B aircraft.

MAINTENANCE AND TRAINING

Contract N62269-3779 was granted to HRB-Singer on 10 June 1966 for overseas field services of a senior electrical engineer for 60 working days and a senior IR image interpreter for 30 days. The NAVAIRDEVCEN provided to VAP-61 on Guam, services of a senior physicist and a senior electrical engineer from 9 to 17 June and the services of a Navy enlisted man (PH1) from 9 to 24 June. These men provided instruction in the basic concepts of IR radiation and detection, operation and maintenance of the equipment, and interpretation of the imagery it produces.

The HRB-Singer field engineer and IR image interpreter arrived on 13 and 16 June, respectively, to continue this support to the squadron. This contract has been modified several times to provide continuing engineering services. NAVAIRDEVCEN provides spare parts as required.

REFERENCES

(a) CONF Report No. NADC-AE-6718, 18 Aug 1967; Flight Evaluation and Analysis of AN/AAS-10(XE-1), Reconofax VI, and Reconofax IX Infrared Mapping Sets (U).
(b) VAP-61 CONF msg 060153Z; May 1966.
(c) CINCPACFLT CONF msg 070319Z; May 1966.
(d) CNO CONF msg 092154Z; May 1966.
(e) VAP-61 CONF msg 170819Z; May 1966.
(f) CNO CONF msg 201507Z; May 1966.
(g) VAP-61 CONF msg 250824Z; May 1966.
(h) WEPTASK No. RUDC-4B000/2021/WS-031-02, 4 Sep 1962.
(i) WEPTASK No. RUDC-4B000/2021/WS-031, 30 Jul 1963.
(j) WEPTASK No. RUDC-4B000/2021/WS-031, 11 Aug 1964.
(k) WEPTASK No. ASW-213000/2021/WS-031, 8 Oct 1965
(l) CINCPACFLT SECRET msg 190344Z; Aug 1966.
(m) CINCPACFLT SECRET msg 232331Z; Nov 1966.

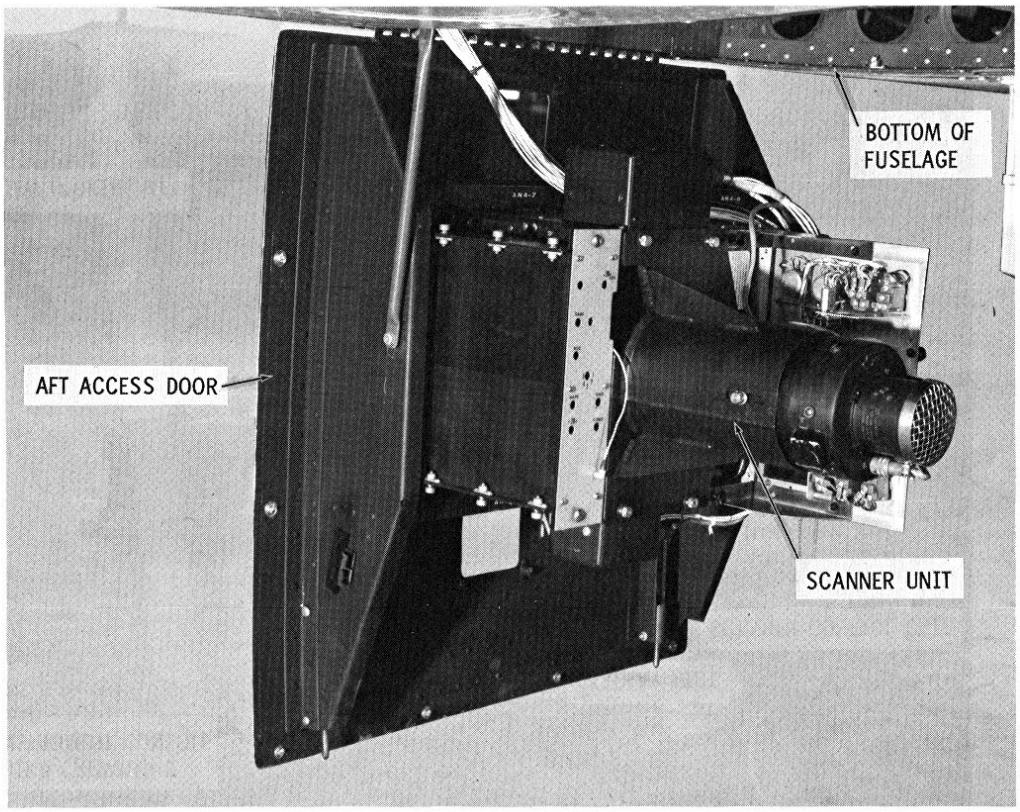

FIGURE 1 - Modified Reconofax VI Scanner Unit Mounted on the Open Aft Access Door of RA-3B Aircraft

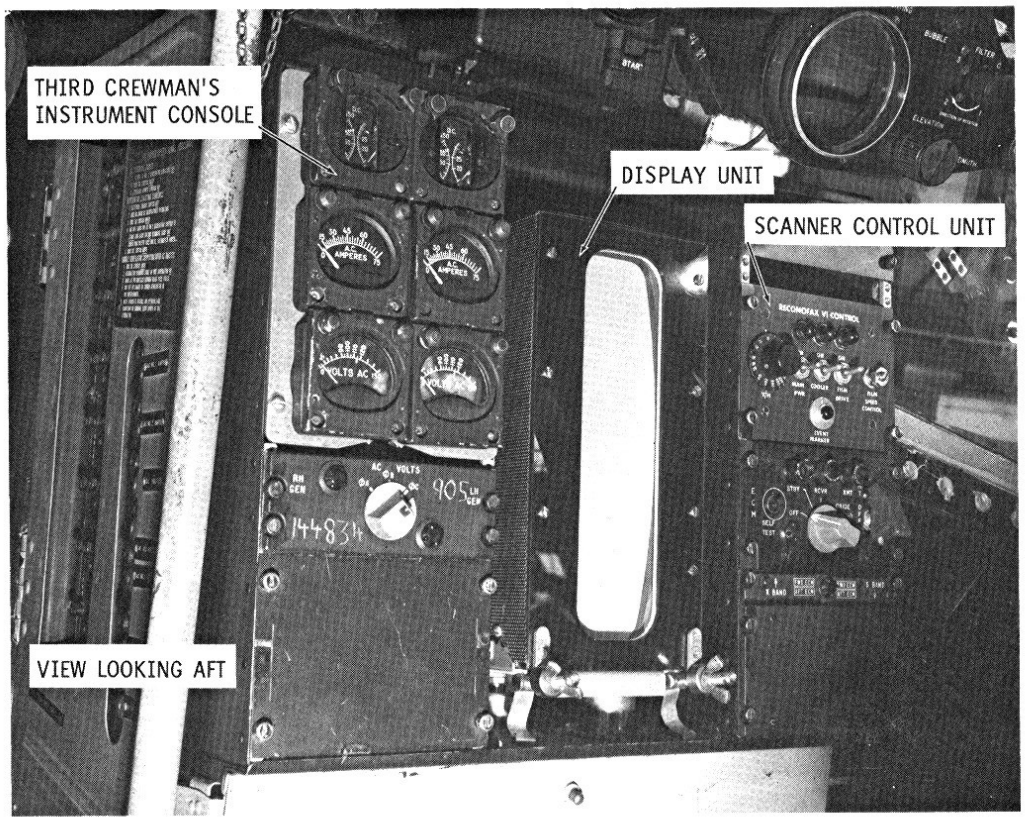

FIGURE 2 - Display Unit and Scanner Control Unit Mounted in Third Crewman's Instrument Console in RA-3B Aircraft

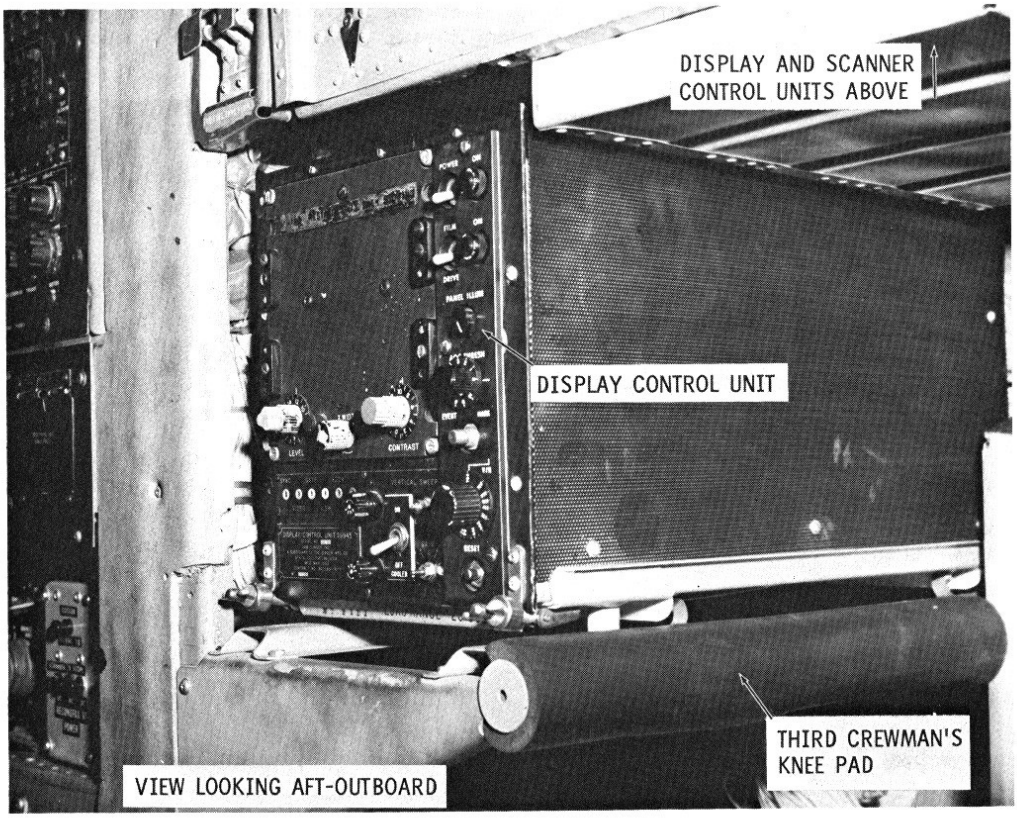

FIGURE 3 - Modified Display Control Unit Mounted Under Third Crewman's Instrument Console in RA-3B Aircraft

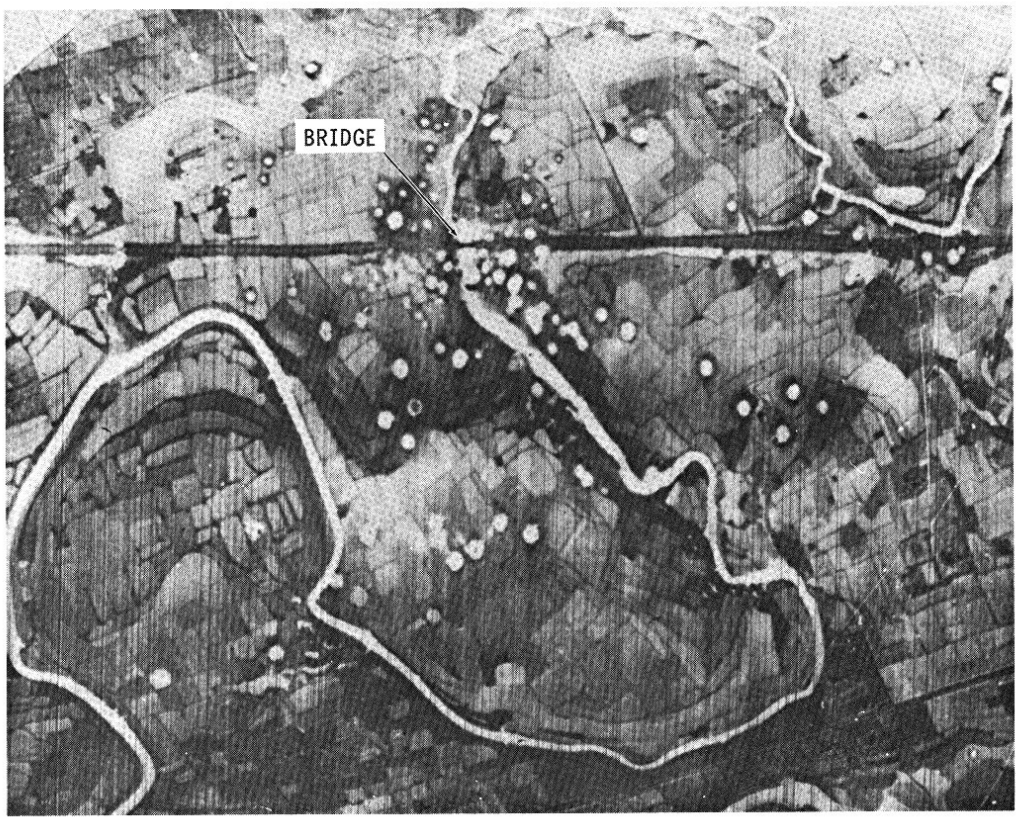

FIGURE 4 - Reconofax VI IR Imagery of Intact Thuan Le Highway Bridge Surrounded by Numerous Bomb Craters. A number of vehicles can be seen along the highway on the original picture.

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* AERO-ELECTRONIC TECHNOLOGY DEPARTMENT NAVAL AIR DEVELOPMENT CENTER, JOHNSVILLE, WARMINSTER, PENNSYLVANIA 18974	2a. REPORT SECURITY CLASSIFICATION 2b. GROUP

3. REPORT TITLE

MODIFIED RECONOFAX VI INFRARED MAPPING SET WITH REAL-TIME INFLIGHT DISPLAY

4. DESCRIPTIVE NOTES *(Type of report and, inclusive dates)*

FINAL REPORT

5. AUTHOR(S) *(First name, middle initial, last name)*

P. M. MOSER

6. REPORT DATE 16 JANUARY 1968	7a. TOTAL NO. OF PAGES 16	7b. NO. OF REFS 13
8a. CONTRACT OR GRANT NO. b. PROJECT NO. c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) NADC-AE-6759 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*	

10. DISTRIBUTION STATEMENT

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY NAVAL AIR DEVELOPMENT CENTER

13. ABSTRACT

A Reconofax VI infrared (IR) mapping set was modified to operate in the 8- to 13-micron IR band, provided with a long-persistence-phosphor cathode-ray-tube (B-scope) display, installed in a VAP-61 RA-3B aircraft, and used over North Vietnam for road, waterway, and bridge reconnaissance. Real-time tactics were developed, and strikes were called against transient targets based on information provided by the inflight display.

DD FORM 1 NOV 65

S/N 0101-807-6811

Security Classification

A-31408

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
INFRARED MAPPING SET RECONOFAX VI INFLIGHT DISPLAY OPERATIONAL TEST ROAD RECONNAISSANCE						

DD FORM 1 NOV 65 1473

S/N 0101-807

D I S T R I B U T I O N L I S T

REPORT NO. NADC-AE-6759

	Copy No.
NAVAIRSYSCOM, AIR-604	1 thru 12
(Copies 1, 2 for retention)	
(Copy 3 for AIR-360)	
(Copy 4 for AIR-370)	
(Copy 5 for AIR-503)	
(Copy 6 for AIR-5103B1)	
(Copy 7 for AIR-5105A2)	
(Copy 8 for AIR-535)	
(Copy 9 for AIR-53303)	
(Copy 10 for AIR-5333E)	
(Copy 11 for AIR-539)	
(Copy 12 for PMA-33)	
CNM	13,14
(Copy 13 for ASW-00)	
(Copy 14 for PM-7)	
CNO	15 thru 20
(Copies 15, 16 for Op-03EG)	
(Copy 17 for Op-03R)	
(Copy 18 for Op-07T)	
(Copy 19 for Op-346)	
(Copy 20 for Op-506E1)	
COMOPTEVFOR	21
NAVSHIPSYSCOM, Code 2021	22
NELGEN, San Diego	23
NAVWPNSCEN, China Lake	24
NRL	25
NOL White Oak	26
NAVPGSCOL	27
NAVIONICFAC	28
NAVMISCEN	29
ASD (ASAX), WPAFB	30
AFSC STLO-NADC	31
COMNAVAIRPAC (J. Sweeney)	32
CINCPAC (Dr. Joel Lawson)	33
CINCPACFLT	34
Joint Reconnaissance Center, Joint Chiefs of Staff, Pentagon, Rm 20921 (LCDR V. B. C. Wolke)	35
ONR, Code 421	36
VAP-61, C.O., Guam, M. I.	37
VAP-62, C.O., NAS Jacksonville, Fla.	38
NRTSC, Code 83	39
NAVAIRTESTCEN, WST Div	40
OCRD/DA-CE	41
Army Electronic Command, Fort Monmouth, N.J. (AMSEL-HL-CT-PD)	42

DISTRIBUTION LIST (continued)

	Copy No.
NRDL	43
MDL	44
AFAL, WPAFB	45,46
(Copy 45 for AVRO, K. Grimberg)	
(Copy 46 for AVRS)	
EMIRC, RADC, Griffis AFB (J. A. Stringham)	47
APGC, Eglin AFB, Code PGTOC (B. Toole)	48
DDC	49 thru 68