AIRBORNE AND GROUND
DATA COLLECTION PROGRAM
FINAL REPORT
FILE #79

Prepared by

[redacted]

25X1

30 October 1964

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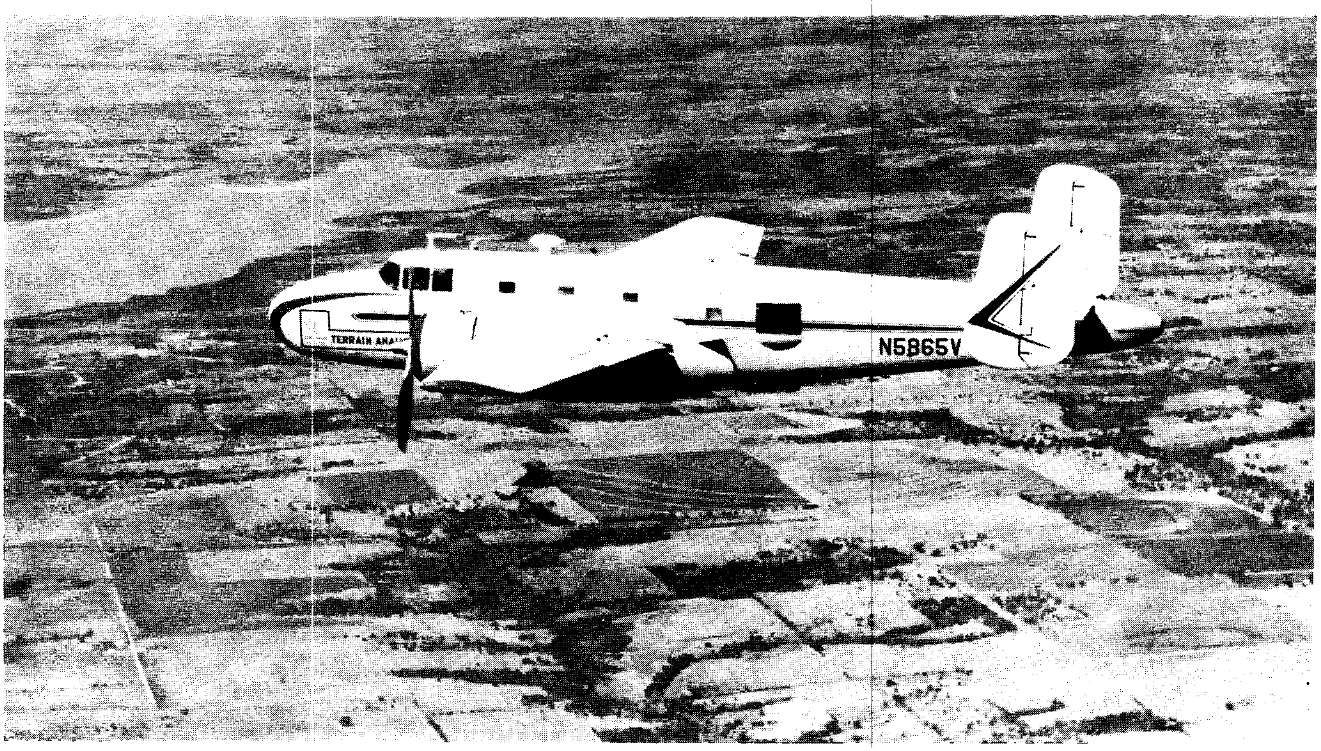

25X1 Frontispiece - [redacted] Multisensor System

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PREFACE

File #79 (TI Project 56040) represents one of the most significant recent undertakings in the field of remote reconnaissance and ground truth data collection. Its importance lies in the frequency and duration of reconnaissance overflights and in the completeness of concurrent ground truth data.

In this program, daytime photography and around-the-clock
25X1 [redacted] were accomplished. Two-man ground truth teams were assigned to each of seven pre-selected target areas. Their mission was to collect those data inherent to each target site that would facilitate or enhance remote reconnaissance interpretations. These collected data were then reduced and assembled into unique image and ground truth data packages.

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Though the performance of this comprehensive data collection program is significant in itself, its true value remains to be derived. This will be accomplished as a result of the forthcoming interpretation phase.

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SECTION I

INTRODUCTION

A. PURPOSE AND SCOPE

25X1 This report describes [redacted] Project 56040 data collection to initiate a comprehensive research program
25X1 for determining the value of [redacted] as an adjunct to aerial photography when applied to specific targets qualifying as indicators of military build-up. Total program emphasis is not directed toward imagery acquisition methods, but to the problem of imagery analyses and exploitation techniques. The objective of this project was to collect sufficient data to
25X1 allow a thorough evaluation of [redacted] relative to data acquired from photography collected a few hours earlier. Required data fell into three primary categories:

1. Daytime aerial photography
25X1
2. [redacted]
3. Complete ground truth

Project 56040 was restricted to data collection and reduction and was exclusive of interpretation.

B. PROJECT ORIENTATION

1. General

Initial project efforts were to select a geographic area which contained the seven target types specified by the task order, critical to the project. This geographic area was to exhibit a minimum of flight restrictions either natural or artificial, while satisfying the many program requirements. These included accessibility to ground teams. Equipment necessary for the performance of the project was then selected and tested. Both airborne and ground operations were then planned and executed.

The largest project segment, exclusive of data collection operations, was data reduction immediately following field operations. Here all airborne information was identified, collated and select reproductions made. Ground truth data from the seven selected sites were reduced to a uniform format. Final efforts involved preparation of this report.

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2. Target/Area Selection

Seven target types were established as indicators of military build-ups as follow:

Target No. 1 - a civilian airport

Target No. 2 - a railroad yard

Target No. 3 - a trucking terminal

Target No. 4 - a port and its associated facilities

Target No. 5 - a facility under rapid construction

Target No. 6 - a storage facility

Target No. 7 - a military motor pool

Several metropolitan areas in the United States were studied to identify which contained the above target types and was best suited to the program objectives. Tentative areas were compared on a target basis (See Table I-1) and from this and other supporting data, San Diego, California, was selected. In addition to containing each target type in a relatively confined area, San Diego weather was predictable. This area contains many ancillary military and naval targets and exhibits constantly changing activity levels. Basing facilities for the data collecting aircraft were also readily available near the selected target sites.

Having selected San Diego, the project manager, chief scientist and two project engineers visited the city, accompanied by sponsor representatives, to confirm target selection, make initial contacts and observe target level-of-activity. From this visit, the suitability of the seven target sites (military build-up indicators) was confirmed. These sites were specified as follows:

Site No. 1 - Lindburgh Field - San Diego's municipal airport, accommodating both major airline traffic, private and other commercial traffic. The field is located at the north end of San Diego Bay.

Site No. 2 - Santa Fe Railway marshalling yards - is a train make-up yard located near U. S. highway 101 and Sigsbee Street.

Site No. 3 - Pacific Transfer Warehouse and Terminal - a trucking facility which is one of the most active in the city. It is located near U. S. highway 101 and Sigsbee Streets across U. S. 101 from Site No. 2.

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TABLE I-1

TARGET/AREA COMPARISONS

LOCATION	Airfields	R. R. Yards	Truck Terminal	Rapid Construction	Military Storage Depot	Military Motor Pool	Sea Ports & Facilities	Total
Dallas/Ft. Worth	3	2	3	3	0	2	0	13
Houston/Galveston	3	3	3	3	2	2	3	19
San Diego	2	2	3	2	3	3	3	18
Balt. /Wash.	3	3	3	2	3	3	3	20
Buffalo	3	3	3	2	0	0	2	14
New Orleans	3	2	3	2	0	0	2	12

Rating

3 Complete facility, heavy traffic, large capacity

2 Complete facility, moderate traffic, capacity

1 Smaller facility, little traffic, capacity

0 None or unknown

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Site No. 4 - Tenth Avenue Terminal (Dock and Port Facility) - is located at the southern end of Tenth Avenue. This facility supports around-the-clock shipping activity.

Site No. 5 - Luther Tower - is located at the corner of Second and Beach Streets. This building was undergoing "rapid" construction and at the time of survey had attained 13 of the planned 17 floors.

Site No. 6 - U. S. Naval storage facility - is located near Site No. 7 (following) and contains a wide variety of Naval store items. Activity, however, was restricted to daylight hours.

Site No. 7 - U. S. Naval motor pool - is located on the Naval Station at the extension of Eighth Street (National City). This site exhibits high daytime activity.

Selection of the above sites as containing the targets of interest was verified by the sponsor as meeting program requirements, i. e, they (1) exhibited the desired activity level, (2) were generally large in area, (3) contained a wide variety of target sub-units, and (4) were readily accessible.

25X1

3. Equipment Selection

[redacted]

4. Operations

Program operations, as shown in Figure I-1, can be segmented into the following units:

a. Planning
b. Systems Tests
c. Airborne data collection
d. Ground data collection
e. Data reduction
f. Materials presentation
g. Reporting

Each of these operations are described in the following section.

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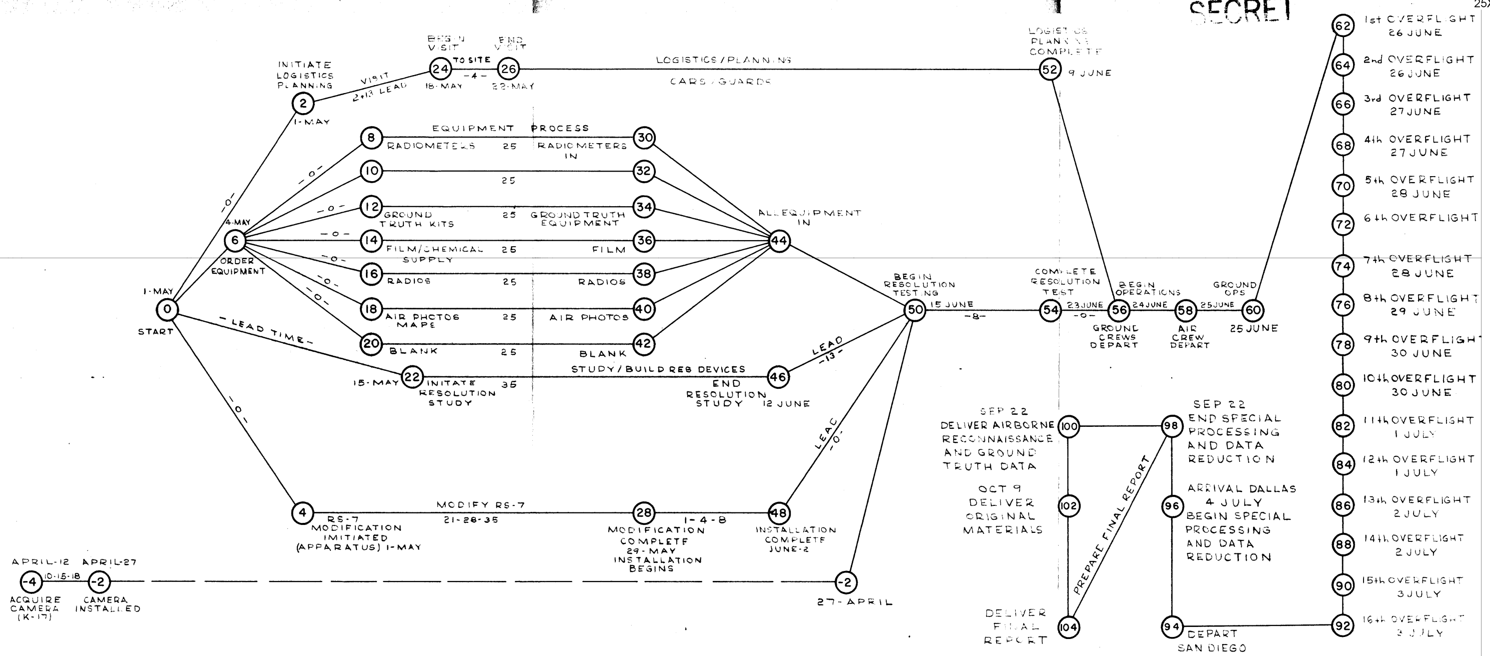

FIGURE I-1 PROGRAM OPERATIONS

SECTION II

OPERATIONS

A. PREPARATIONS

Program Evaluation and Review Techniques (PERT) type planning (Figure I-1) was employed for this program. This allowed close control of preparations necessary for the program.

1. Airborne Systems*

a. <u>K-17C Aerial Camera</u> - The existing K-17C 25X1
aerial camera and A-28 stabilized camera mount installation was extensively tested in the month prior to program data collection operations. These included general operations and resolution tests. Proper system operation was achieved with system resolution being defined in tests over prescribed targets.

The primary camera resolution target is shown in Figure II-1. It consists of alternating black and white painted strips on plywood, 30 inches by 18 feet. These painted strips exist in the following widths:

24 inches White (W) and Black (B)
19 inches (W) and (B)
15-1/8 inches (W) and (B)
12 inches (W) and (B)
9-5/8 inches (W) and (B)
7-5/8 inches (W) and (B)
6 inches (W) and (B)
4-3/4 inches (W) and (B)
3-3/4 inches (W) and (B)
3 inches (W) and (B)
1-7/8 inches (W) and (B)

Stereoscopic targets were also constructed. These consisted of white-painted cardboard boxes placed on poles at various elevations above the terrain as follows:

Stereo Target No. 1 - 19" x 19" x 21.5" (top of target 36 inches above ground)
Stereo Target No. 2 - 25" x 25" x 25" (top of target 25" above ground)

*All airborne systems are described in detail in Section IIB.

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Stereo Target No. 3 - 22" x 22" x 25" (top of target 36 inches above ground)
Stereo Target No. 4 - 30.5" x 30.5" x 27.5" (top of target 49 inches above ground)
Stereo Target No. 5 - 28.5" x 28.5" x 28" (top of target 58 inches above ground)

A third type target was a gray scale board. This plywood board was 30 inches wide by 18 feet long and painted in 18 steps ranging from black, through the grays, to white (Figure II-2).

The initial K-17C field resolution tests were conducted at Texas Instruments Flight Test Center, Addison Airport (Dallas). Figure II-3 shows the target layout plan. Figures II-4 and II-5 are K-17C contact prints of the test plot. From the negatives of Figures II-4 and II-5 taken at 2500 ft with 6-inch focal length, the computed maximum resolution was 33 lines per millimeter, following the formula

$$D = (h/f)\ (1/RP)$$

where: D = minimum resolvable dimension (ft)
h = altitude above terrain (ft)
f = focal length (ft)
RP = resolving power in lines per ft

No study of the gray scale significance or stereo capability was conducted during these tests.* The gray scale and black and white bar boards were also witnessed for each daylight mission in San Diego. They were placed at Site No. 1, San Diego Municipal Airport, as located in Figure II-6.

b. <u>SSD/RS-7 System</u> - The SSD/RS-7 [redacted] was performance 25X1
tested following system modification prior to the San Diego mission. The objective of these tests were to establish operational worthiness and field optical and thermal resolution.

Optical resolution targets used during these tests consisted of aluminum strips affixed to the asphalt apron of Texas Instruments Addison Airport facility (see Figure II-5). The plan layout of these strips is shown in Figure II-7. To test the field thermal resolving capability of the system, two types of "resolution boards" were constructed. Type No. 1 consisted of two four-by-four foot flat black aluminum sheets one layed out on a regular

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*The original negatives of Figures II-4 and II-5 are on file at Texas Instruments, if detailed gray scale or stereo capability study is required.

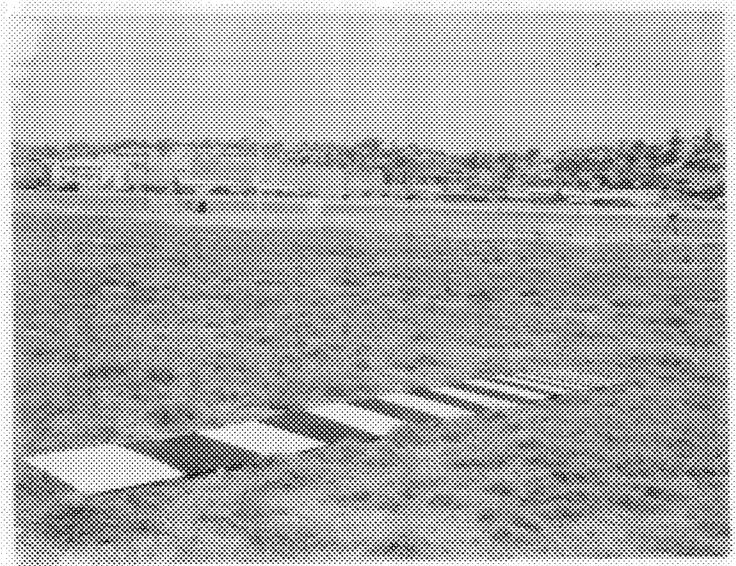


Figure II - 1 K-17C Optical Resolution Target

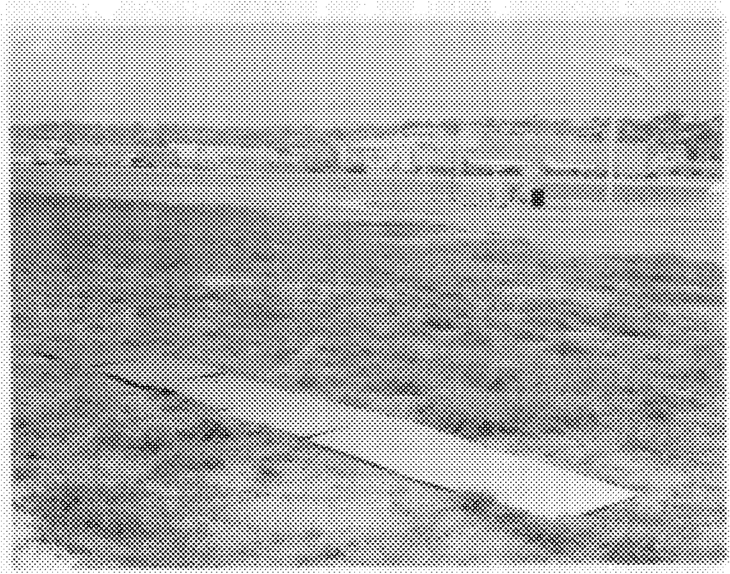


Figure II - 2 Gray Scale Chart

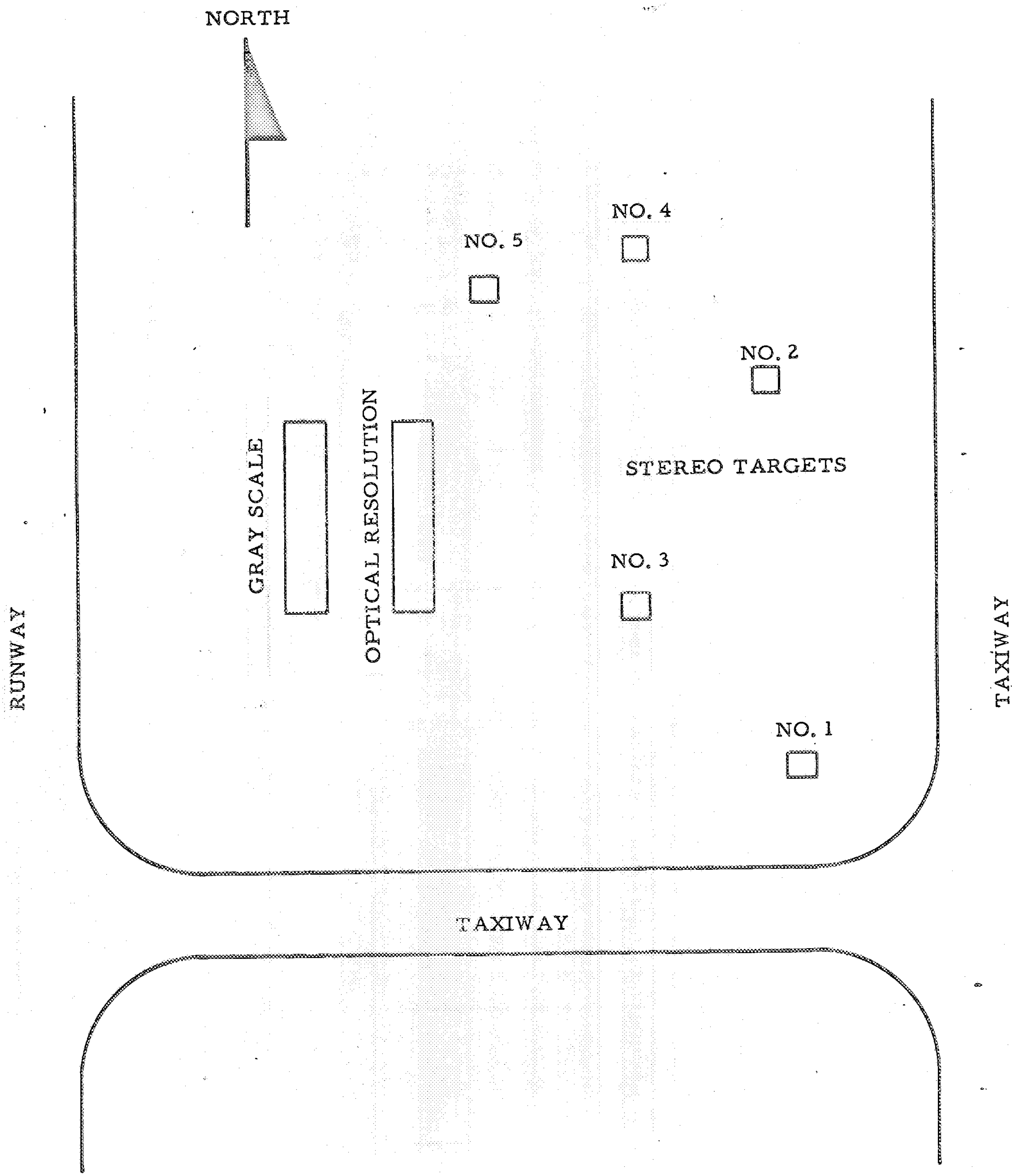


Figure II - 3 Camera Resolution Devices Layout Sketch

Figure II - 4 and 5 K-17C Stereo Pair of Resolution Targets

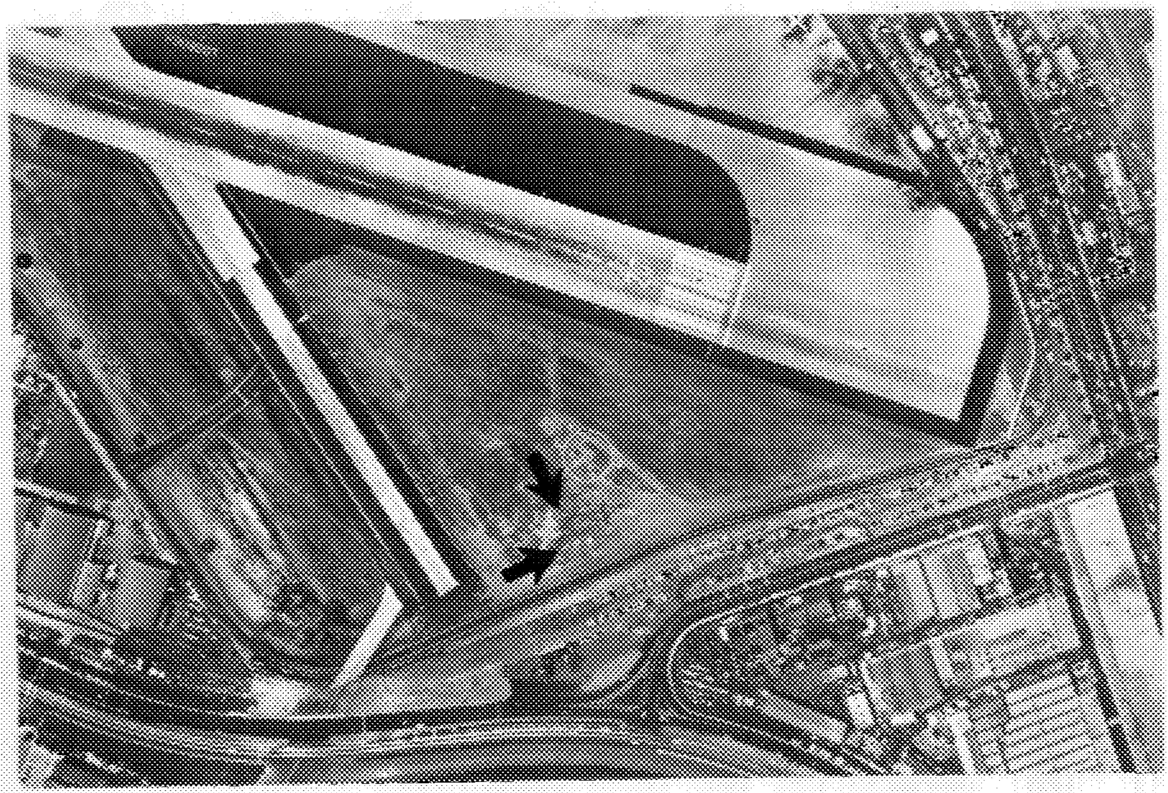


Figure II - 6 K-17C Resolution Board Location, San Diego blanket, the second upon a standard electric blanket. The first unit remained at ambient temperature for control, the second was heated to establish a thermal difference between units.

The second board type consisted of eight two-by-four foot thermal sandwiches whose cross section is pictured in Figure II-8. Two of these boards are shown in Figure II-9.

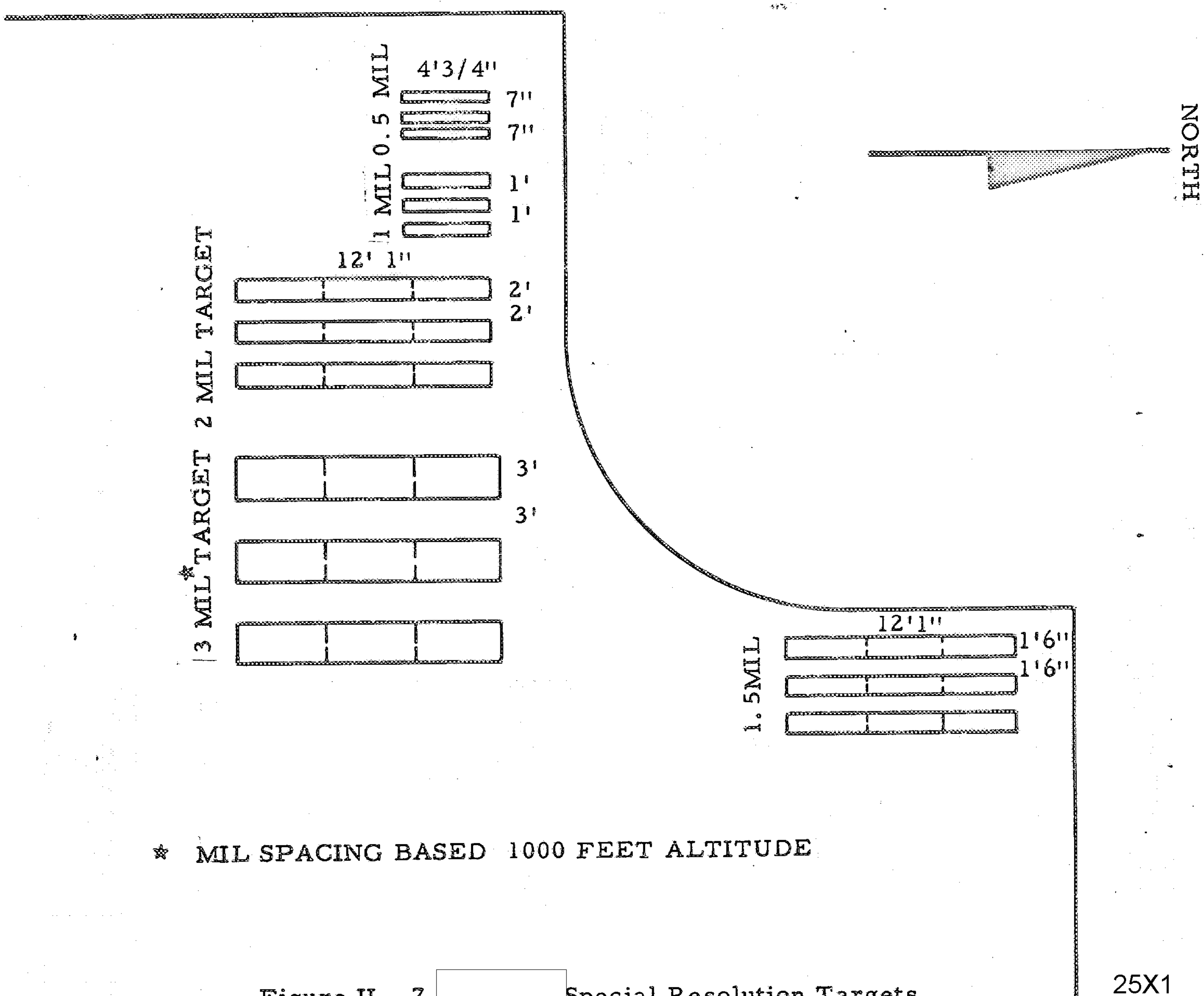
SSD/RS-7 resolution tests conducted showed the optical resolution of the RS-7 to be less than two but greater than 1.5 milliradians, i. e., it could resolve target objects less than two feet apart but not those objects 1.5 feet apart from an altitude of 1000 feet. These values were derived from the negatives of Figure II-10. Field thermal resolution, however, could not be firmly established because on the first series of Dallas tests, system peak and bias level settings resulted in over exposed film. Unfortunately, these tests could not be rerun prior to departure for San Diego. Attempts to conduct thermal resolution tests on-site were largely precluded due to other program requirements.

On-site system resolutions however can be estimated quite closely as follows:

Optical Resolution - It is assumed that the optical resolution of the system for San Diego can be related directly to that witnessed in Dallas. Therefore, on-site system optical resolution is called out as less than two but greater than 1.5 milliradians. This being an estimate can be shown from Figure II-11 flown at 1000 ft. Shown are the major lattice members of the three gasometers on the horizon north of target No. 2. These members are 9-inch and 12-inch I-beams.

Thermal Resolution - Although not "tied down" via controlled resolution boards, the field on-site thermal resolution of the SSD/RS-7 was checked by selecting and monitoring existing field targets. These "targets" were molasses storage tanks on Site No. 4 which exhibited uniform top surfaces, yet,in one instance, had a measured 1° F thermodynamic temperature difference,* the middle tank being warmer by that amount than the outside tanks. Note their appearance on Figure II-10 -- a system test strip from Flight No. 12, July 1, 1964.

*Thermodynamic temperature measured with a Simpson Thermo-o-meter whose stated midscale accuracy is ± 1° F.



25X1

Figure II - 7 Special Resolution Targets

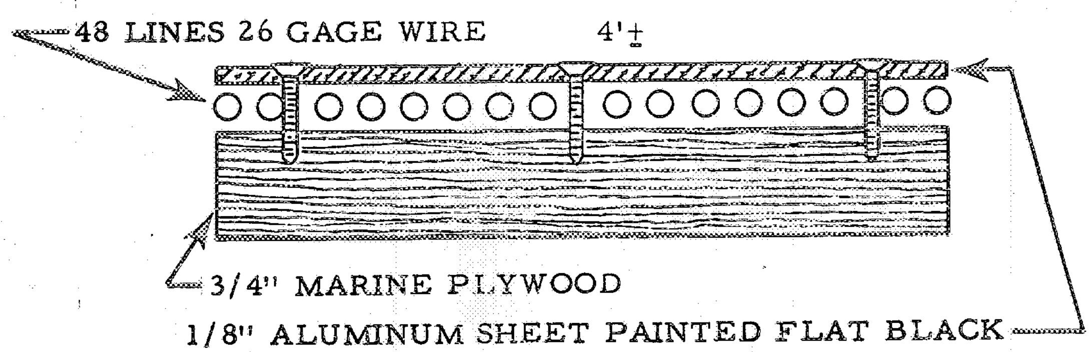


Figure II - 8 Thermal Board Cross Section

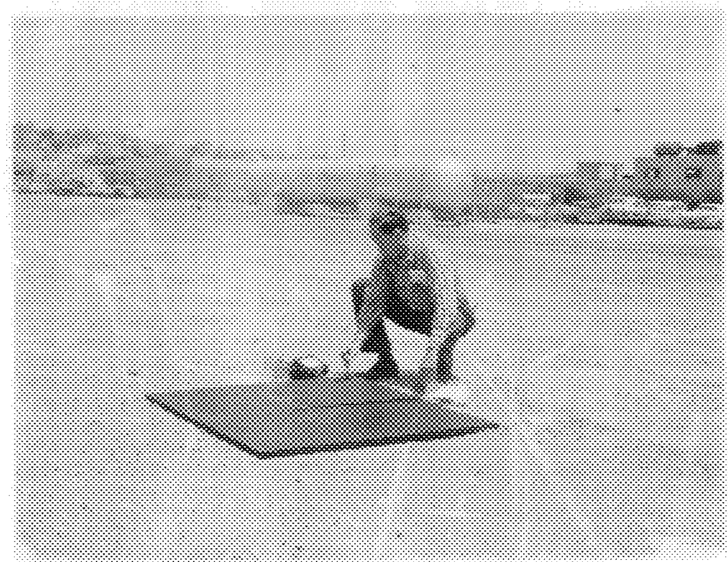


Figure II - 9 [redacted] Resolution Board
(Temperature Being Monitored with Simpson Therm-O-Meter)

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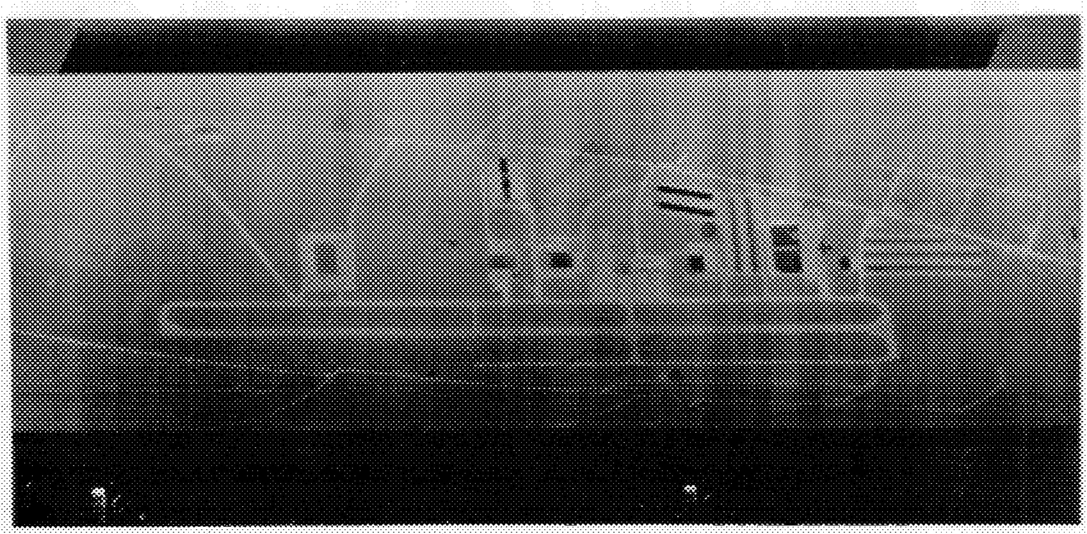

Figure II - 10 [redacted] Test Strip of Addison Airport Resolution Targets

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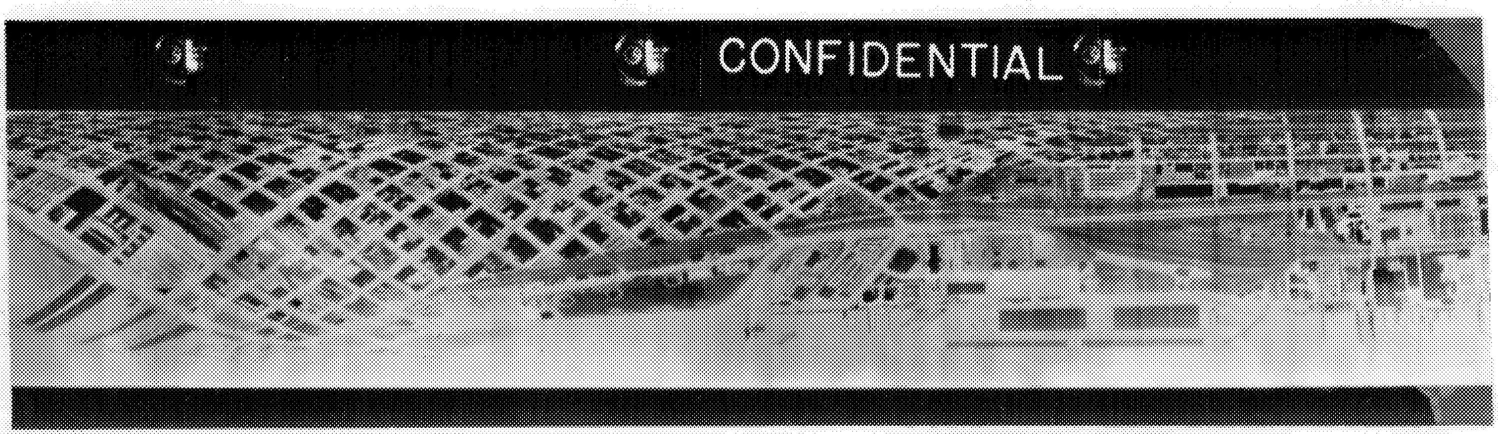

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Figure II - 11 High Gain Field Processed Test Strip, Flight No. 12

25X1

[redacted]

2. Ground Based Equipment

a. <u>Ground Truth Kits</u>* - During the initial portion of the program seven ground truth kits were assembled from "off-the-shelf" equipment (see Figure II-12). Each item was checked for proper operation then checked for consistency with other identical items prior to kit assembly. These "acceptance" tests were necessary to assure proper equipment operation and allow transfer of components from kit to kit where necessary. One kit was then assigned to each of the seven sites.

b. <u>Radiometers</u> - Original radiometric equipment selected for ground truth data collection were two [redacted] R-8D transistorized portable radiometers. These devices, though originally designed as high temperature monitoring devices, were applicable to the program because of their high sensitivity and built-in black body references. However, the supplier withdrew these systems two weeks prior to the beginning of operation, in favor of the company's R-4D units, a less sensitive device but still containing an internal reference source. The units were tested by [redacted] engineers for stability and consistency. These

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*See Section IIC for complete kit description.

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tests proved them unsatisfactory for program purposes in that they exhibited a high noise level that precluded radiometric measurements at near ambient conditions. Additionally, consistency of readings between the units could not be achieved for targets considerably above ambient.

To accomplish radiometric measurements of the selected targets and their sub-units, a [redacted] battery operated HL-4 Radiometer* (see Figure 13) was acquired through [redacted]. No preparatory tests were conducted with this instrument because of schedule restrictions. Because of this and the need for a controlled black body calibration reference which was not available, radiometric data collected were uncalibrated and acceptable only on a relative basis (see ground truth survey books).

25X1 25X1 25X1

c. On-Site Planning - On-site planning was two-fold, that derived from the preliminary visit and that directly associated with on-site operations. From the first visit necessary contacts and target selections were made. On-site planning primarily took the form of brief meetings prior to each flight. These meetings were used to inform both the ground teams and the airborne crew of the current flight plan. Because of the fog problem encountered (associated primarily with nighttime flights) these meetings took on added importance in that the flights were more on an opportunity rather than a scheduled basis.

B. AIRBORNE OPERATIONS

1. Equipment Details

25X1 a. Aircraft - The aircraft used in the San Diego airborne data collection operation was [redacted] multisensor aircraft, a converted North American B-25-J (Frontispiece). Select specifications of this aircraft are as follows:

Range:	1200 statute miles
Speed:	300 mph (max), 180 mph operational average over target
Ceiling:	25,000 ft
Communications:	LF [illegible]00 to 1750 kilocycles VHF, 118.0 to 126.9 megacycles VHF, 151, 625 megacycles (fixed frequency for ground team communications)
ILS:	108.0 and 135.9 megacycles

*See Section IIC for system details.

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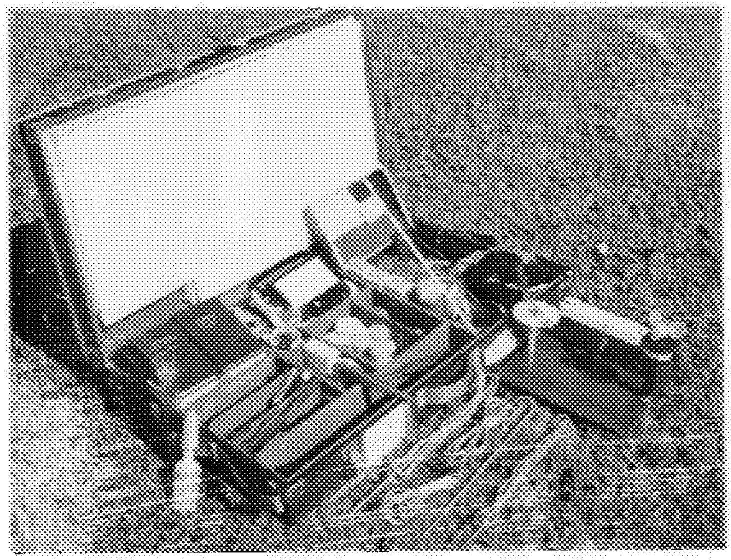

Figure II - 12 Ground Truth Kits

Figure II - 13 Stoll-Hardy Radiometer and Simpson Therm-O-Meter in Field Use

b. <u>K-17C Aerial Camera System</u> - The K-17C aerial camera's main units are the film magazine, camera body and lens cone. The camera functions as a fully automatic camera triggered by an external intervalometer. Exposures are on a 9 x 9-inch format. For this operation the film magazine was loaded with Kodak Plux X (ASA-80) film on 250 ft spools. Although the camera is adaptable to both six- and twelve-inch lens cones, only the former was used.

25X1 [redacted] K-17C installation included the A-28A Gyro-stabilized camera mount designed to accurately maintain the optical axis of the camera (see References 1 and 2).

25X1 [redacted]

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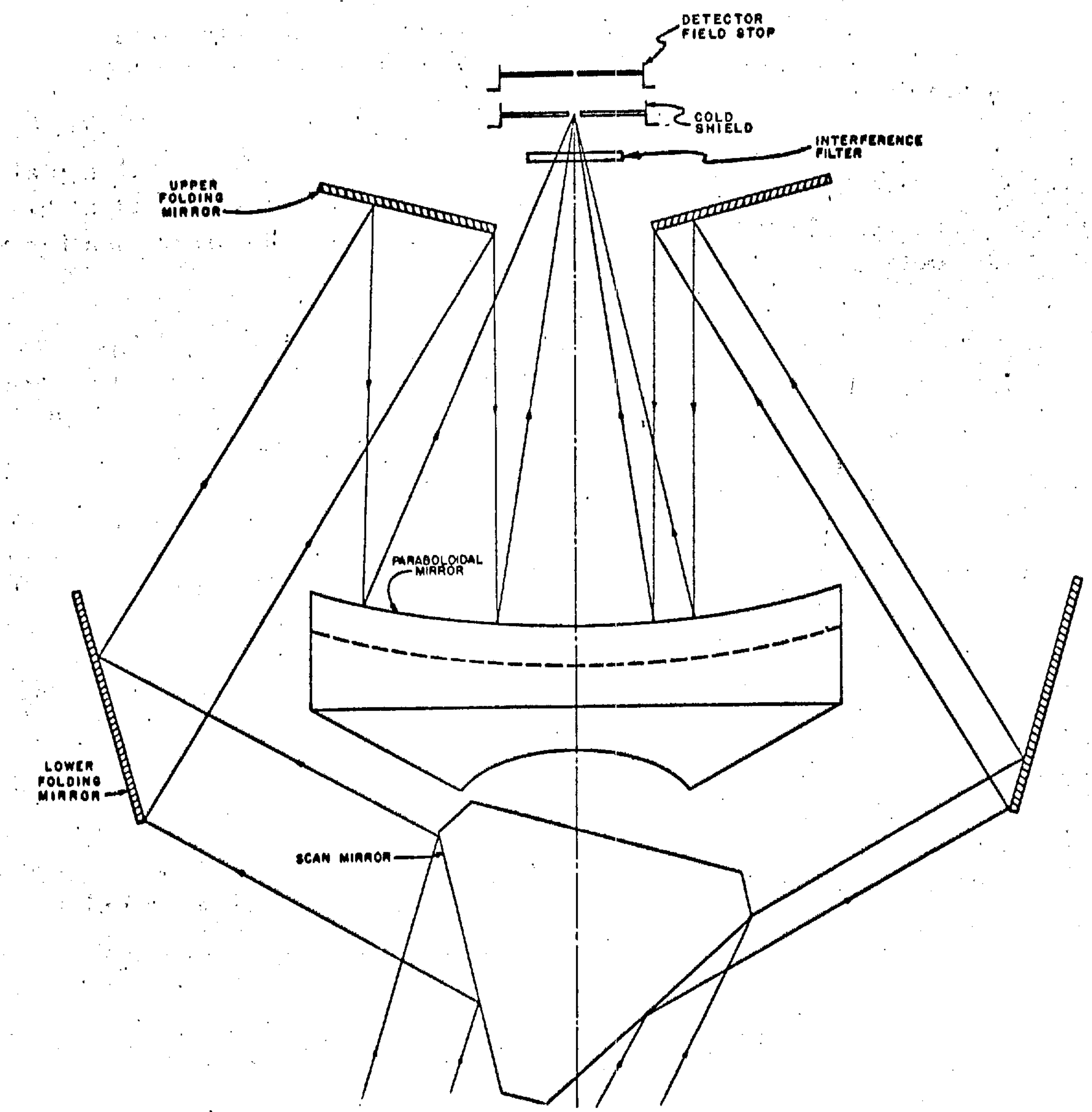

Figure II - 14 RS - 7 Scan Optics System

The optical system of the SSD/RS-7 is a split-image reflecting system (see Figure II-11). The theoretical optical resolution capability of the system is one-milliradian. Total scan angle capability is 180°, however, because little "interpretable" data can be collected near the horizons the SSD/RS-7 used on this project was field stopped to 140°. Two scan speeds are possible, 8000 rpm and 4000 rpm, with the slower scan rate being used during operations.

The detector unit was equipped with mercury-doped germanium sensitive to energies from about 2 to 14 microns. The SSD/RS-7 system is also equipped with a push-pull type filter arrangement which allows restriction of detector energies to 8 to 14 microns. This filter was employed during daytime missions to reduce the effect of reflected solar energies. A neutral density filter was used at night to allow detection of energies throughout the detector range. This filter was used rather than an open port to preclude refocusing system optics between flights.

Detector cooling is accomplished by a closed cycle, North American Phillips Model 42300MP Croyogen helium cooler. This unit has the capacity to reduce temperature of the detector element to 26°K.

The electrical signal from the detector is converted to a visible light signal by a Sylvania 6M514 glow modulator tube in the recording unit. The tube output was focused onto 70 mm Kodak Tri-X negative safety film strip by a three-faced rotating pyramidal mirror and three adjustable microscope objective lenses, all integrally mounted or directly geared to the scanning prism.

Spacing of scan lines on the film is determined by the ratio between aircraft velocity and height above terrain (V/H). To maintain proper recording speed, the film-drive speed is automatically regulated by a servomechanism controlled by the V/H signal from the main control unit. In addition, a variable density filter controls the amount of light the film receives from the glow modulator tube. The density of the filter is also controlled by the V/H signal. At maximum scan speed, the system can record continuously over a V/H range of 0.0 to 0.5 and with some discontinuity or gaps between scan lines, up to a ratio of 1.0. The V/H signal from the control unit varies from 0 to 1.0.

Several modifications to the basic SSD/RS-7 system were performed under this project. The most significant of these was the alignment of the system's scanner and recorder to extend its capabilities toward the theoretical maximum of one milliradian resolution. Additional modifications included:

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- Addition of a manual D. C. level control to the system's post amplifier for video control during large changes in terrain energies received by the system. An example of large changes in terrain energy would be contrasts between large bodies of water and land.

- Addition of 1.0 liter/second Varian Vac Ion continuous operations vacuum pump. This addition though not available during the actual mission, is designed to maintain system vacuum and preclude a vacuum on the system between flight.

- Installation of one milliradian detector and field stop.

- Modification of the system's V/H variable density filter to be compatible with one milliradian recording field stop.

2. Flight Plan and Schedule

The mission plan called for parallel east-west flight lines spaced in such a manner as to result in "blanket" coverage of the San Diego Bay area. These lines were so placed that during the daytime they would result in 20% side lap on the K-17C photographs and at night to result in overlap to a scan angle of plus or minus 45° to the nadir.

Generally, these conditions prevailed during the sixteen overflights of the area. On two occasions (Flights 6 and 14) this pattern was halted midway through the mission and on two other occasions (Flights 2 and 16) precluded altogether because of incoming fog and very low stratus clouds. In these cases northwest-southeast flight lines were flown over the primary targets. On nearly every flight, difficulty in holding prescribed flight lines existed because fog hanging just off-shore made turn arounds (hence subsequent flight alignment) extremely difficult and dangerous.

Original mission intent was to schedule daytime and nighttime flights as close to a 12-hour separation as possible yet have flights evenly spaced throughout both day and night. Efforts were made not to schedule any flights near sundown or sunup. Fog conditions in the Bay area however rendered this plan impossible, especially regarding the nighttime flights,

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Actual flight times are listed below:

Daytime		Nighttime	
Flight	Time	Flight	Time
1	1300 hrs PDT 6/26	2	0000 hrs PDT 6/27
3	1400 hrs PDT 6/27	4	2100 hrs PDT 6/27
5	1000 hrs PDT 6/28	6	2300 hrs PDT 6/28
7	1130 hrs PDT 6/29	8	2200 hrs PDT 6/29
9	1300 hrs PDT 6/30	10	0000 hrs PDT 7/1
11	1130 hrs PDT 7/1	12	2100 hrs PDT 7/1
13	1430 hrs PDT 7/2	14	0300 hrs PDT 7/3
15	1500 hrs PDT 7/3	16	2130 hrs PDT 7/3

3. Problems Encountered

Flight scheduling around harrassing fog conditions was the most difficult problem encountered during this phase of the program. The fog encroached the area in an unpredictable fashion and nearly precluded Flight No. 2, the first nighttime flight. This flight was actually flown with nearly 10/10 cloud undercast in some areas. Although efforts were made to track the incoming fog bank, this tactic was largely ineffectual on mission planning. Efforts to complete the nighttime flights while the area was clear caused early evening scheduling. As a result this also influenced daytime scheduling because of the 12-hour requirement.

Keeping the airborne sensor operable during this mission turned out to be less of a problem than anticipated. Credit is due to the flight engineers whose job it was to keep the system functioning. System malfunctions generally could be classed as normal operational problems. Exceptional system reliability was displayed during these operations with no rescheduling being required for system malfunction reasons.

Other problems related to the air operations could be classed as minor regarding their effect on program performance. Among these were loss of VHF radio transmitter, frequent interference by other aircraft operating in the area and noise abatement complaints against low flight aircraft.

4. Personnel

The aircraft crew and their assignments were as follows:

25X1 [redacted] -----------Flight manager
-----------Pilot
-----------Co-pilot

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25X1 [redacted] --------Chief engineer
------[redacted] system engineer 25X1
--------Radar system engineer

C. GROUND OPERATIONS

1. Equipment Detail

25X1 Primary ground site data were collected using equipment contained in [redacted] Ground Truth Kits (see Figure II-12). Each of the seven ground truth teams (one team to each site) was assigned a kit containing the instruments in Table II-1.

TABLE II-1

MAJOR GROUND TRUTH KIT EQUIPMENT

No.	Instrument	Application
1.	Bendix Friez Psychron (Model 566)	Wet and dry bulb temperature relative humidity, dew point
2.	Simpson Therm-O-meter	
	Pacific Transducer - 3 ea. 'stick-on' units	Target temperature
	Soiltest G-190 (2 ea.) and Science Assoc. #140 (2 ea.) soil units	Soil temperatures at depths of 1", 3", 6", and 9"
3.	Bendix-Friez Hand Annemometer (SA 444)	Wind speed
4.	[redacted] Wind Vane	Wind direction
5.	Polaroid Camera (w/film and filter) (#110B)	Data recording
6.	Ainsworth Brunton Compass	Orientation and heights of trees, structures and terrain features
7.	Sealed Beam Lamps - 2 ea.	Night orientation
8.	Chart	Cloud data
9.	Gossen Lunasix light meter	Incident and reflected light albedo
10.	Binoculars	Visual tracking of aircraft

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*Assigned to a supplemental radar program.

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In addition, each team carried a ground-to-air communication link for coordinating activities.

25X1 One [redacted] radiometer was available to the project. This is a portable battery operated field unit sensitive to radiant energies from 3 to approximately 25 microns designed for rapid measurement of surfaces having an emissivity of essentially unity. The sensitive elements of the head are two thermistors with two compensating thermistors to improve the stability of the zero. For calibration, a body of unit emissivity and known temperature must be available. Because no calibration unit was available to the project all resultant radiometric data must be considered relative and not absolute (see Ground Truth Survey books submitted earlier).

2. Plan and Schedule

25X1 [redacted] ground truth team's assigned tasks were to collect those data deemed significant to airborne data interpretations. These included micrometeorologic, photographic and site activity data. Ground teams were on-site twenty-four hours prior to the first airborne operation and remained until completion of the flight. During this period each team studied their site and selected those major target sub-units which best typify that site for continual study during the entire mission. Examples of selected sub-units included for the airport site, the main runway; for the railroad yard, tracks and box cars; and for the construction site, the main hoisting crane. These select sub-units and their immediate backgrounds were monitored for temperatures each hour during this initial 24-hour period. In addition, complete micrometeorological data was collected every six hours.

On subsequent airborne flights each team monitored the selected sub-units (temperature stations) and collected micrometeorological data before and after each overflight. Photographic records were kept on the appearance of the sub-units and any additional items related to site activity (see Section IIIB). These data are included in the Ground Truth Survey books.

3. Problems Encountered

Among the problems encountered by the ground teams were occasional equipment malfunctions, several checks by local law enforcement
25X1 agencies (to determine [redacted] personnel need to be on these sites at odd hours) and access to secure naval areas. None of the problems encountered were so serious as to preclude data collection operations.

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4. Personnel

25X1 [redacted] personnel assigned to the ground operations were:

Ground Operation Manager -------- [redacted] 25X1

Site No. 1 (airport) --------------

Site No. 2 (railroad) -------------

Site No. 3 (truck terminal) -------

Site No. 4 (port facility) ----------

Site No. 5 (rapid construction) ----

Site No. 6 (naval storage) ---------

Site No. 7 (motor pool) -----------

25X1 [redacted] were also assigned to collect radiometric data at each of the seven sites.

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SECTION III

DATA REDUCTION

All field data collected during the project were returned to
25X1 [redacted] facility for processing. Airborne collected data
25X1 were processed in the [redacted] image processing laboratory; Ground truth data reduction was accomplished by the site personnel, in the drafting and study areas.

A. AIRBORNE DATA

1. Processing

Original airborne system film negatives were processed and reproduced as follows:

a. RS-7 Negative Developing (Kodak Tri-X, SO 234 film)

1)	Developer	Kodak D-19
2)	Time	3.5 to 4.5 mins.
3)	Temperature	68° to 78° F

b. RS-7 Imagery Reproductions

1)	Paper	Xerox Varaloid Fast F
2)	Film	DuPont 228R

c. K-17C Negative Developing (Kodak Plus-X)

1)	Developer	Kodak D-19
2)	Time	6.0 to 7.5 mins.
3)	Temperature	68° to 78° F

d. K-17C Photographic Reproductions

1)	Paper	Kodak Polycontrast Rapid
2)	Film	Kodak Dektol 1:2

Negative processing was accomplished with a Morse B-5 processing unit. All reproductions, both film positives and paper prints, included in the site "Airborne Reconnaissance Data Reports" were accomplished

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with a Log Etronics unit modified for use as a contact printer. Film positives of all sixteen flights submitted were printed on a Sonne' continuous printer.

2. Image Retrieval

Techniques used to identify airborne infrared and photographic data collected during the project are described below.

25X1

b. K-17C Photography - Photographic negatives collected in San Diego are contained on fourteen rolls. In general, two rolls of film were required for each flight. Some rolls, however, contain partial data from two flights, e. g., Rolls No. 2 and 10. Identification techniques used for the K-17C data follows.

Each negative, exclusive of test and special target shots are identified by a three-unit identification. These units are (1) the flight number, (2) the flight line (for these data a lettered flight line identification is used) and (3) the photograph number. All photograph numbers are in sequence for each flight starting at one (1) and ending with the total number of San Diego Bay area shots taken during that flight.

Photograph identification example:

5 - B - 43 or 5B0043

where, 5 = Flight Number
B = Line Number
43 = Photograph Number

Contents of each of the fourteen rolls is as follows:

Roll	Flight	Lines	Photo Number
1	1	A-F	1 - 178
2	1	G-J	179 - 305
	3	A-C	1 - 88
3	3	D-J	89 - 282
4	5	A-G	1 - 201
5	5	H-J	202 - 293
		Pt. Loma, Agriculture Strip	294 - 349
6	7	A-F	1 - 178
7	7	G-J	179 - 300
		Pt. Loma Special	301 - 368
8	9	A-F	1 - 179
9	9	G-J	180 - 303
		I_S, II_S, III_S	304 - 381
10	9	General Dynamics Nuclear, Sycamore Canyon Test Site, and General Dynamics Missile Plant	382 - 421
	11	A-E	1 - 151
11	11	F-J	152 - 308
		I_S	309 - 358
12	13	S-G	1 - 215
13	13	H-J	216 - 307
	15	A-C	1 - 89
14	15	D-J	90 - 292

3. Review of Negative Quality

a. SSD/RS-7 Infrared Negatives - The SSD/RS-7 [redacted] imagery was generally of good quality. Several operational problems, e. g., fog and system malfunctions, were encountered during the sixteen flights, none so serious however, as to preclude scheduled data collection. A brief critique of the [redacted] data for each flight follows: 25X1

Flight No. 1 - Imagery appears underexposed at beginning of flight, however, system adjustments provided good quality toward the end of flight. Negatives were scratched due to errors in handling. Light fog persisted over area, heavy near coast. Altitude - 2500 ft.

Flight No. 2 - Image quality good. Undercast conditions prevailed over area varying from thin toward the south to extremely heavy near coast and toward the north. Altitude - 1500 ft.

Flight No. 3 - Image quality good. Very heavy coastal fog with some light fog over area. Some processing scratches exist. Altitude - 2500 ft.

Flight No. 4 - Image Quality fair (appears flat). "Water spotting" appears at beginning of negative roll. This is attributed to shipping undeveloped film via unpressurized commercial conveyences. Heavy coastal fog witnessed. Altitude - 1000 ft.

Flight No. 5 - Image quality fair to good. Light fog existed over area, heavy in the north and over coast. "Water spotting" is bad over entire roll. Altitude - 1000 ft.

Flight No. 6 - Image quality poor (flat). Light fog over area, heavy in the north and over coast. "Water spotting" is bad over entire roll. Altitude - 1000 ft.

Flight No. 7 - Image quality good. Heavy scratching appears over entire roll. Source of scratching indeterminable but attributed to errors in handling. Altitude - 2500 ft.

Flight No. 8 - Image quality good. Some film drive marks are encountered. Also, some system and processing scratches are present. Altitude - 1000 ft.

Flight No. 9 - Image quality fair (low contrast). Slightly hazy but no fog encountered. Again heavy scratches appear. Occasional processing streaks are apparent. Altitude - 2500 ft.

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Flight No. 10 - Image quality poor (flat). Static electricity marks appear at end of roll. V/H is apparently mis-set. Moderate fog existed over area. Altitude - 1000 ft.

Flight No. 11 - Image quality good. Light fog near coast. Altitude - 2500 ft.

Flight No. 12 - Image quality good to excellent. Heavy unexplained scratches appear over entire roll. Altitude - 1000 ft.

Flight No. 13 - Image quality good. Detector "noise" was encountered. Area is clear of any fog. Some processing scratches appear. Altitude - 2500 ft.

Flight No. 14 - Image quality good. Detector "noise" is apparent. Flight plan was changed due to heavy incoming fog. Altitude - 1000 ft.

Flight No. 15 - Image quality good. Detector "noise" is apparent. Some haze was encountered. Altitude - 2500 ft.

Flight No. 16 - Image quality excellent. Heavy scratches exist over entire roll (cause unknown). Heavy fog existed over north portion of area. Altitude - 1500 ft.

Test strips were pulled following all but one [redacted] data 25X1
collection flight. These field processed strips are included as Figures III-1 through III-15.

b. <u>K-17C Photograph Negatives</u> - General quality of the San Diego photograph negatives is good to excellent. The main degrading factor is the unsharp framing of all shots. This exists because of K-17C mounting conditions where, to obtain an unrestricted system field of view, would have required cutting certain structural members of the B-25. This tactic was ill advised because of scheduling.

4. Security

Remote reconnaissance data collected during this mission was classified and handled under the Department of Defense Industrial Security Manual, revised 31 December 1962 (attachment DD form 441). As a result, all SSD/RS-7 infrared data generated is classified CONFIDENTIAL while K-17C data is unclassified.

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Original SSD/RS-7 negatives, packaged by roll, carry the following registration numbers.

Roll Number (Flight Number)	Control Registration Number
1	1701
2	1665
3	2024
4	1702
5	1704
6	1703
7	1705
8	1706
9	1707
10	1708
11	1709
12	1710
13	1711
14	1712
15	1713
16	2025

All reproductions, exclusive of the single roll of film positives, exist within the reconnaissance data books for each of the seven sites. Their registration control numbers follow:

Site Number	Book Number	Control Registration Number
1	1	1879
2	2	1880
3	3	1881
4	4	1882
5	5	1883
6	6	1884
7	7	1885

5. Problems Encountered

Problems encountered in processing the airborne data were many and varied. Paramount among these were extremely high tap water temperatures (as high as 84° F) during the processing period. Although steps were taken to rectify this, e. g., acquisition of a water chiller, lack of processing water temperatures was serious. An additional problem involved exposing sensitometric strips on the ends of each negative roll. This was accomplished but satisfactory results were not achieved and the resultant exposed strips were removed. Reasons for this were lack of operator familiarity with the sensitometric equipment acquired for this project and lack of precise control over processing water temperatures. These served to invalidate subsequent gamma curves.

6. Data Presentation

Airborne data collected in San Diego has been presented in a series of reports containing SSD/RS-7 and K-17C coverage of the seven defined sites. All original negatives and one contact film positive of SSD/RS-7 data also have been presented. The seven airborne site report packets contain site descriptions, flight logs, flight line plots, processing notes, RS-7 [redacted] film positives and paper prints and K-17C film positives and paper prints organized by target site and flight. These image reports were submitted 21 September 1964. Original negatives were submitted 14 October 1964.

25X1

B. GROUND DATA

Reduction of ground truth information for each of the seven target sites constituted one of the major blocks of effort expended during the project. These data consisted of:

- Site identification through photography, maps and other location data
- First surface materials identification, e. g., water, soil, asphalt, concrete and metal
- Selected temperature station identification through photography
- 24-hour temperatures (diurnal cycle of temperatures for select stations)
- Micrometeorological data from the site taken before and after each flight
- Activity monitoring through photography and written descriptions
- General site photography
- Radiometric data collected at the temperature stations
- Visible spectrum reflectivity data
- U. S. Weather Bureau meteorological data at times of flights
- Miscellaneous data related to each site

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These data were compiled by site, and presented in seven separate volumes entitled "Ground Truth Survey, Site -- ." These volumes were submitted 21 September 1964.

The above data types were selected on the basis of their envisioned usefulness to an interpretation of the airborne reconnaissance data collected over each site. With these basic data the interpreter should be able to easily extrapolate from the primary target sub-units monitored to
25X1 any other sub-unit. ([redacted] believes the data collected represents an "overkill"; that is, more ground information was collected than can be effectively used at this time in a standard interpretation of the airborne data.)

The primary data reduction problem encountered, as in all programs of this scope, was reducing the collected data to a uniform format. In some instances, this was not possible because of the varying nature of the targets involved. Site No. 1 (Lindburgh Field), for example, covered a very large area relative to Site No. 5 (rapid construction). This fact dictated differences in data collection procedures which affected the final product.

Standard drafting practices were employed in constructing the site report books.

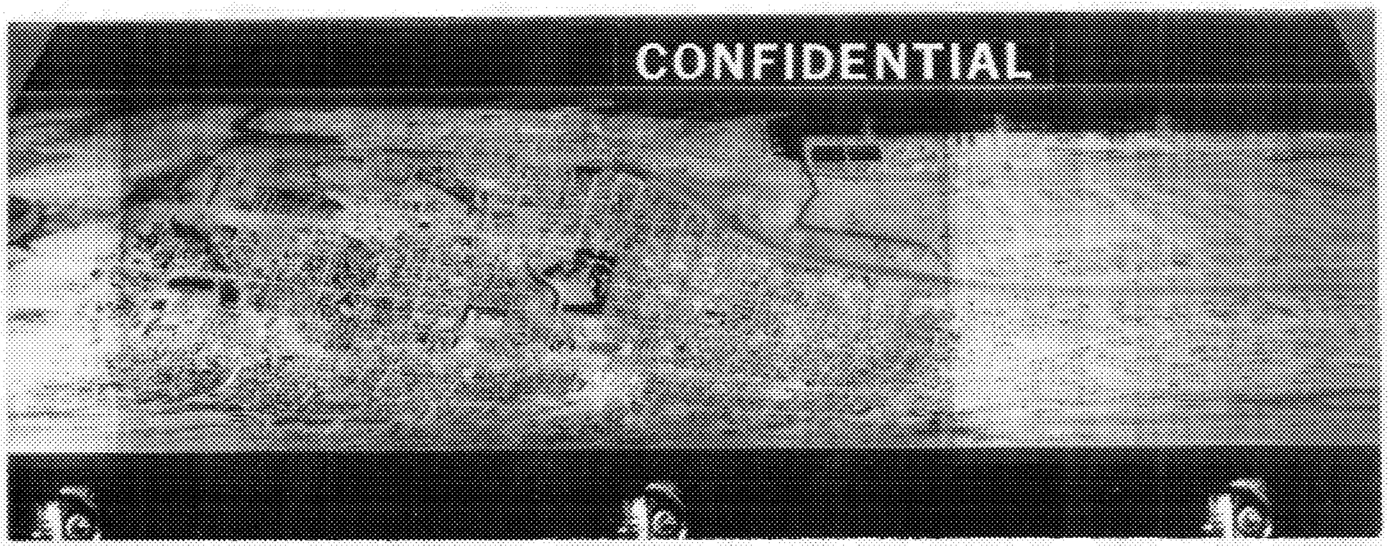

Figure III - 1 Flight No. 1. Field Processed Test Strip

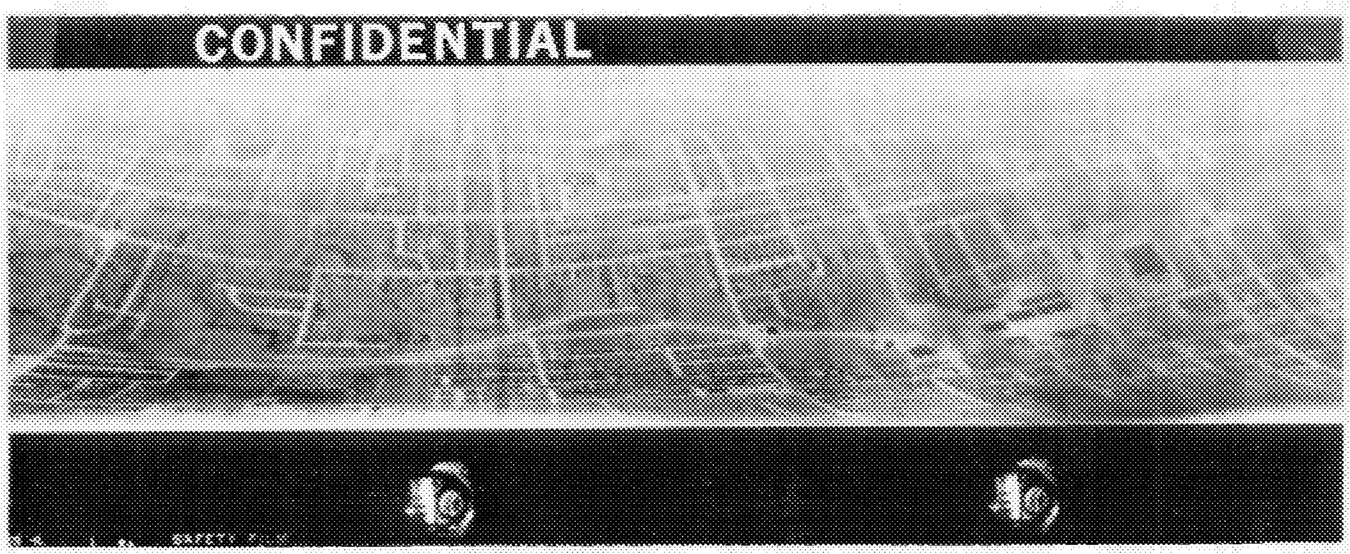

Figure III - 2 Flight No. 2. Field Processed Test Strip

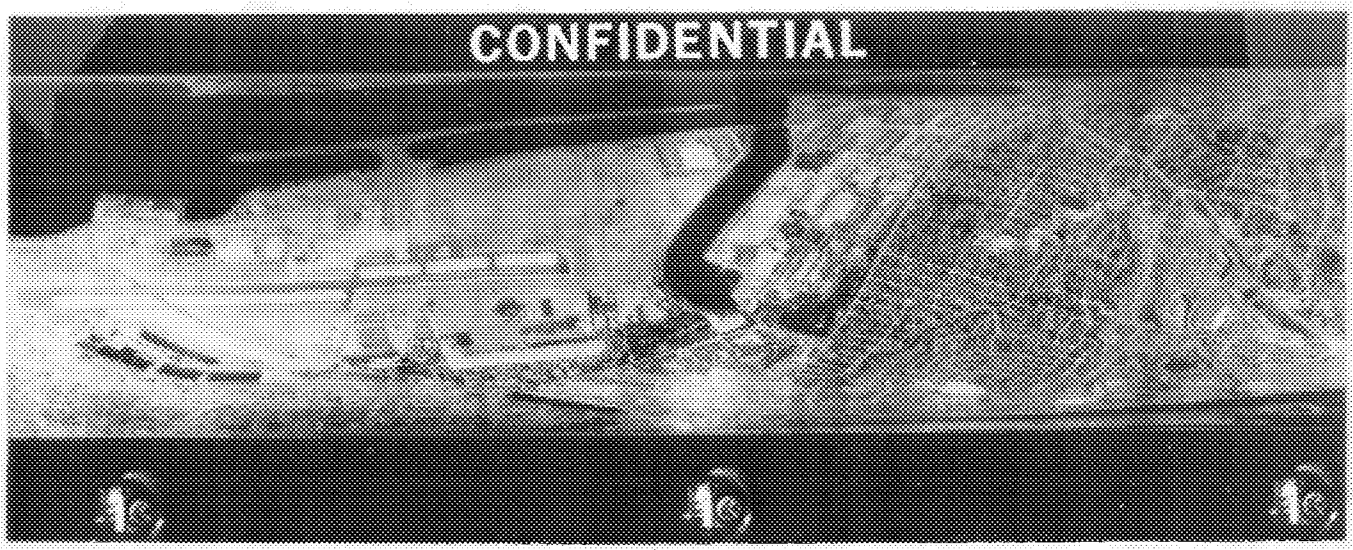

Figure III - 3 Flight No. 3. Field Processed Test Strip

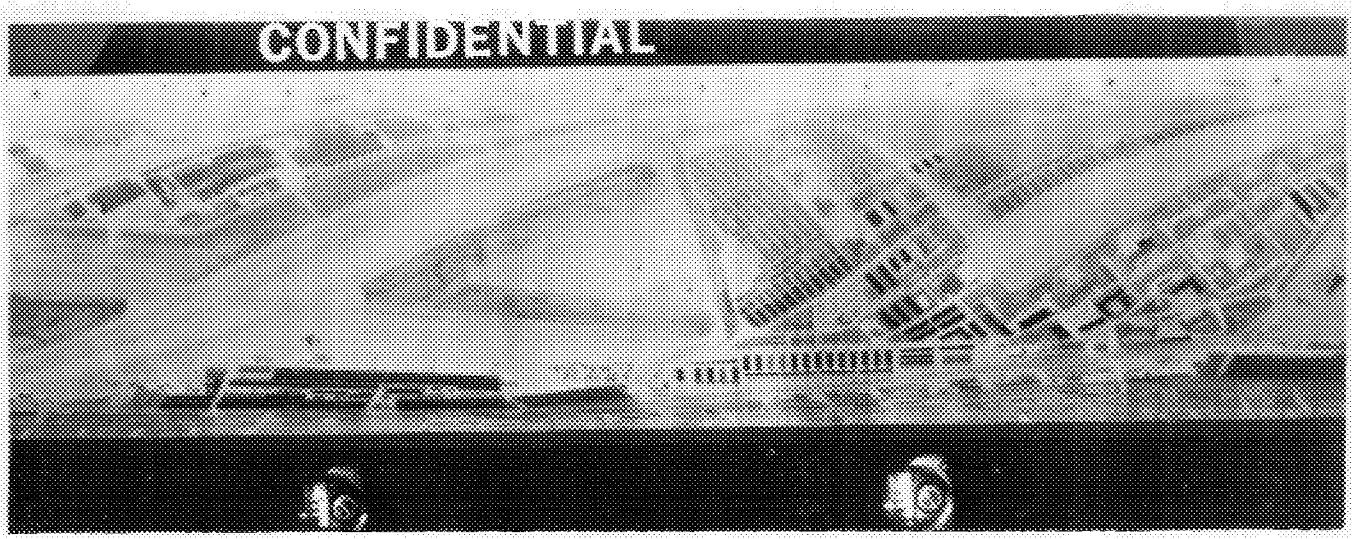

Figure III - 4 Flight No. 4. Field Processed Test Strip

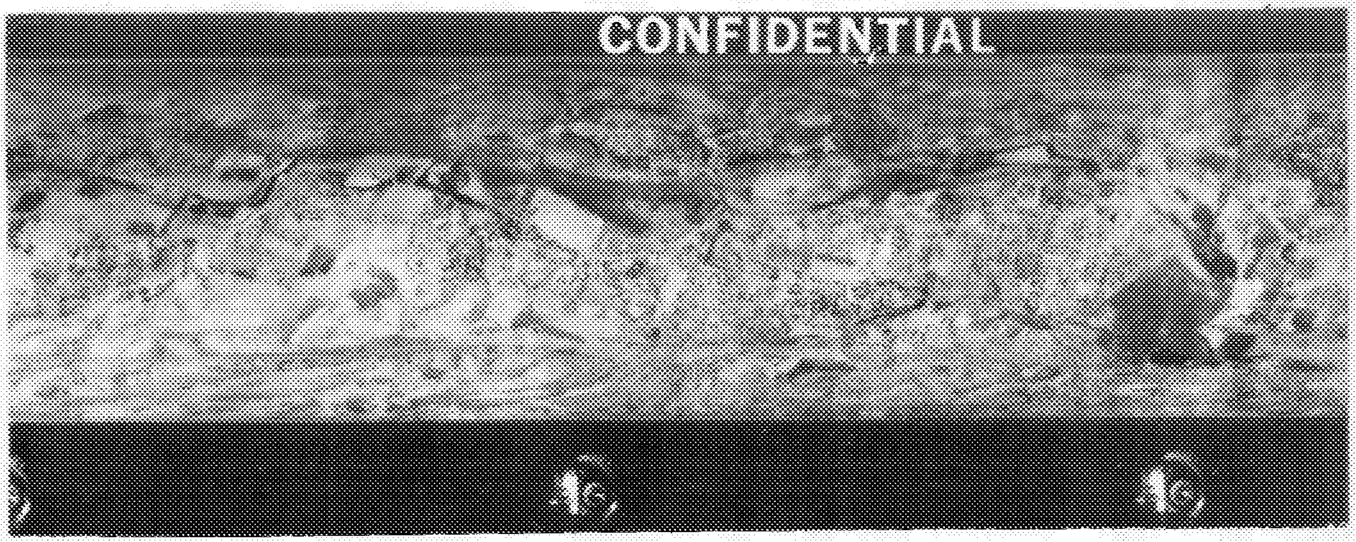

Figure III - 5 Flight No. 5. Field Processed Test Strip

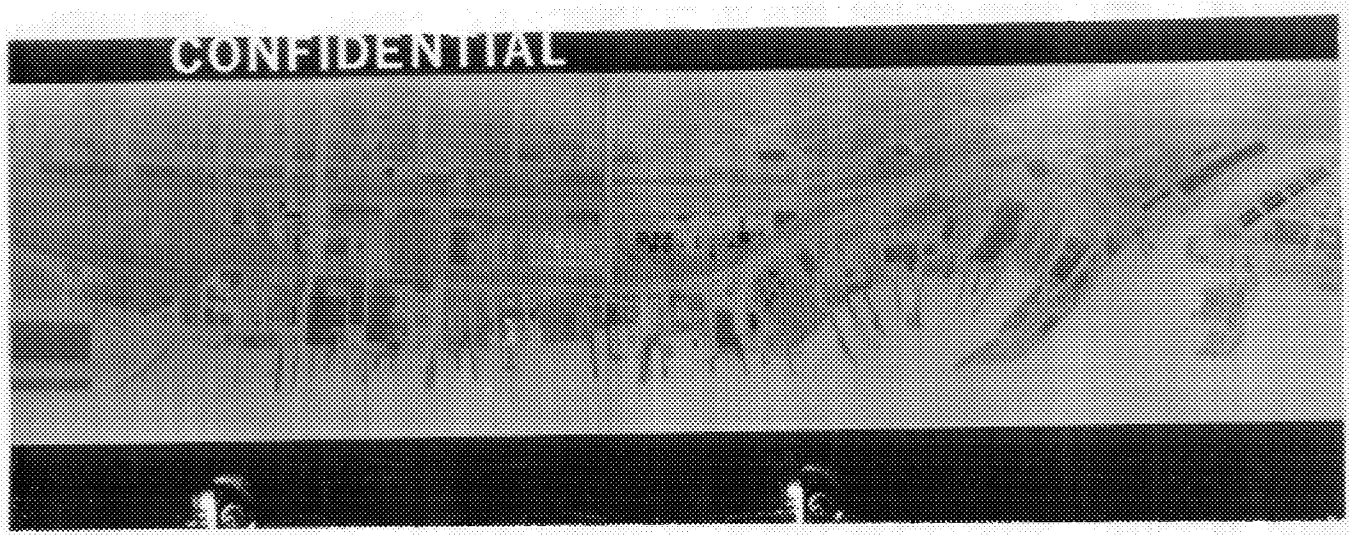

Figure III - 6 Flight No. 6. Field Processed Test Strip

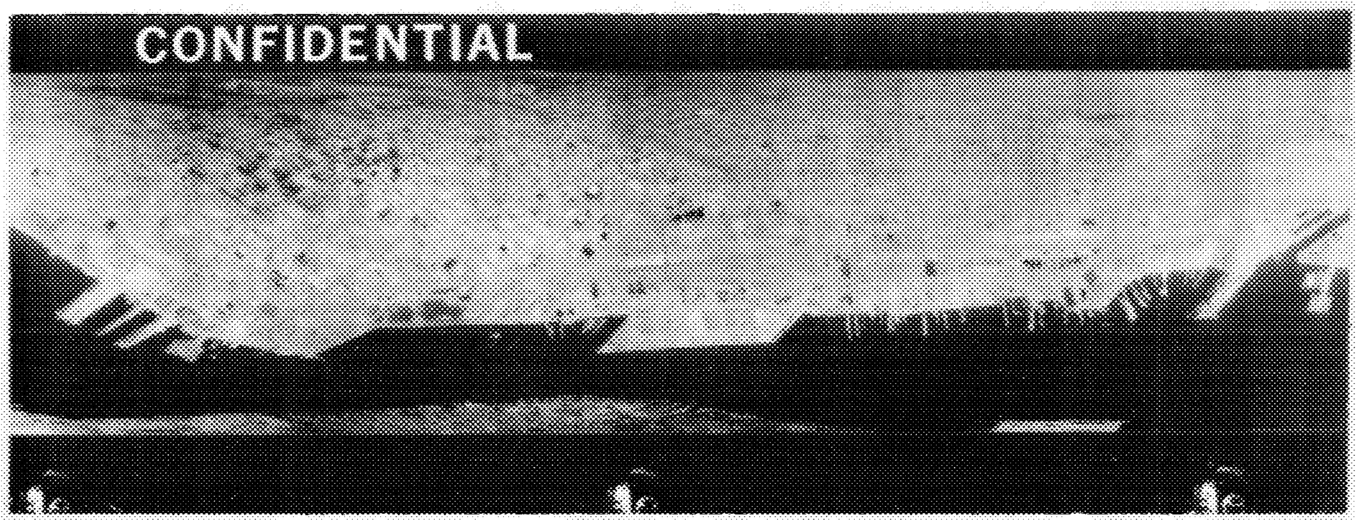

Figure III - 7 Flight No. 7. Field Processed Test Strip

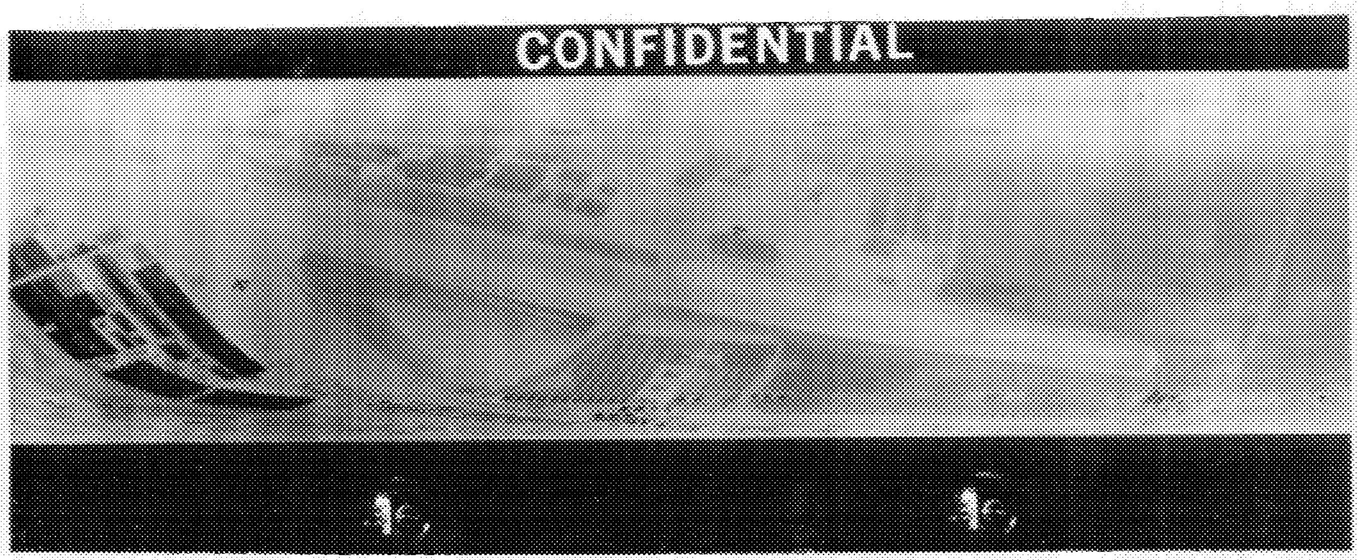

Figure III - 8 Flight No. 8. Field Processed Test Strip

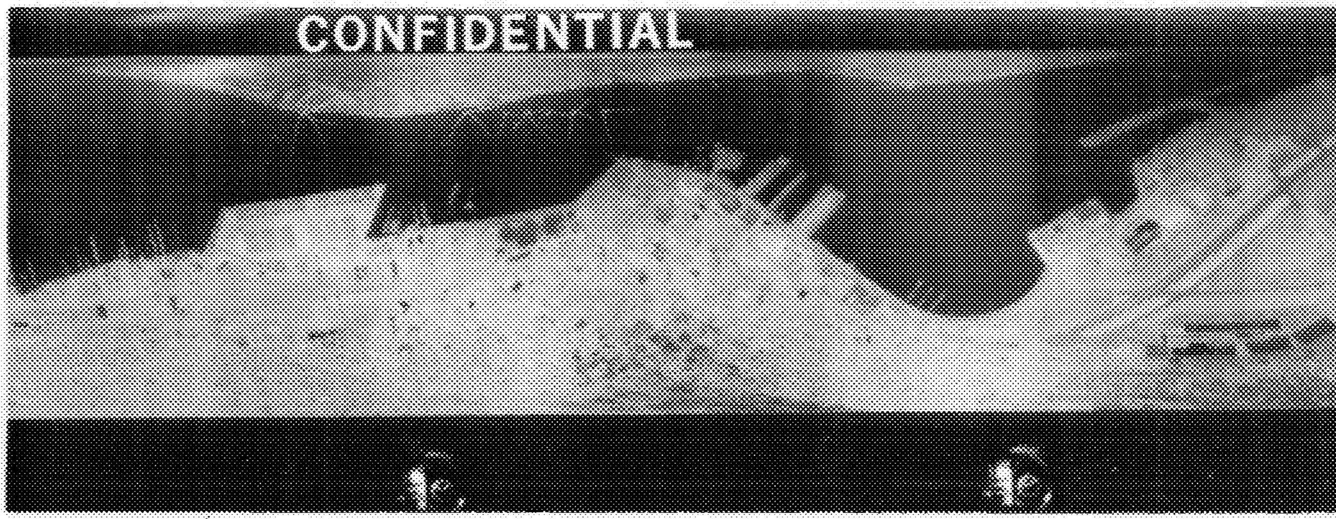

Figure III - 9 Flight No. 9. Field Processed Test Strip

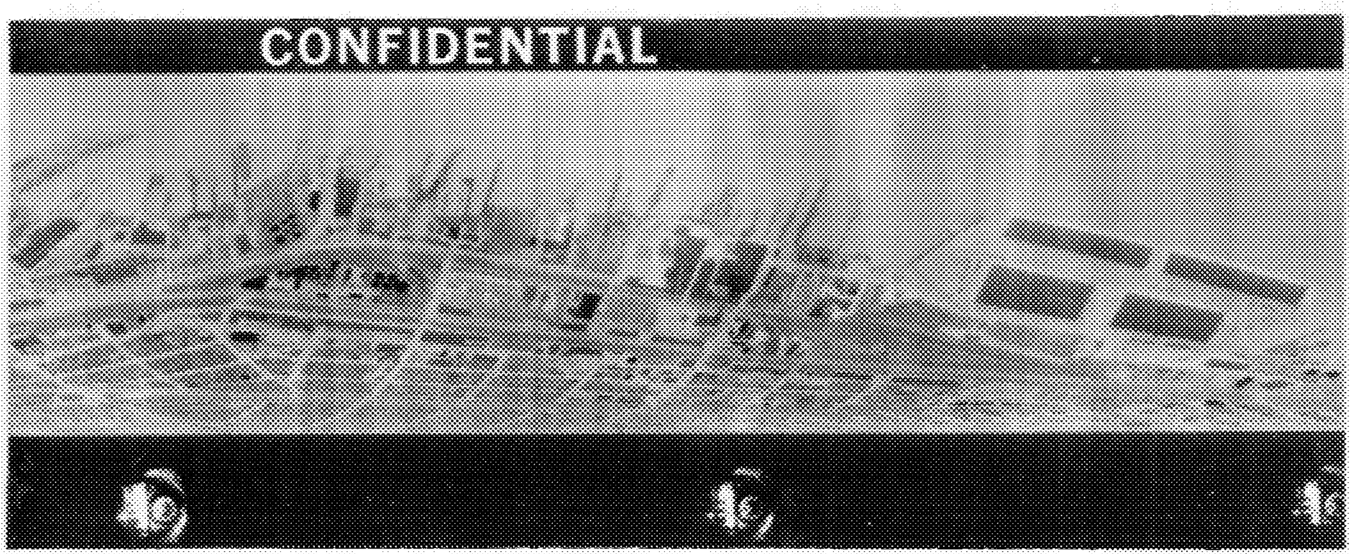

Figure III - 10 Flight No. 10. Field Processed Test Strip

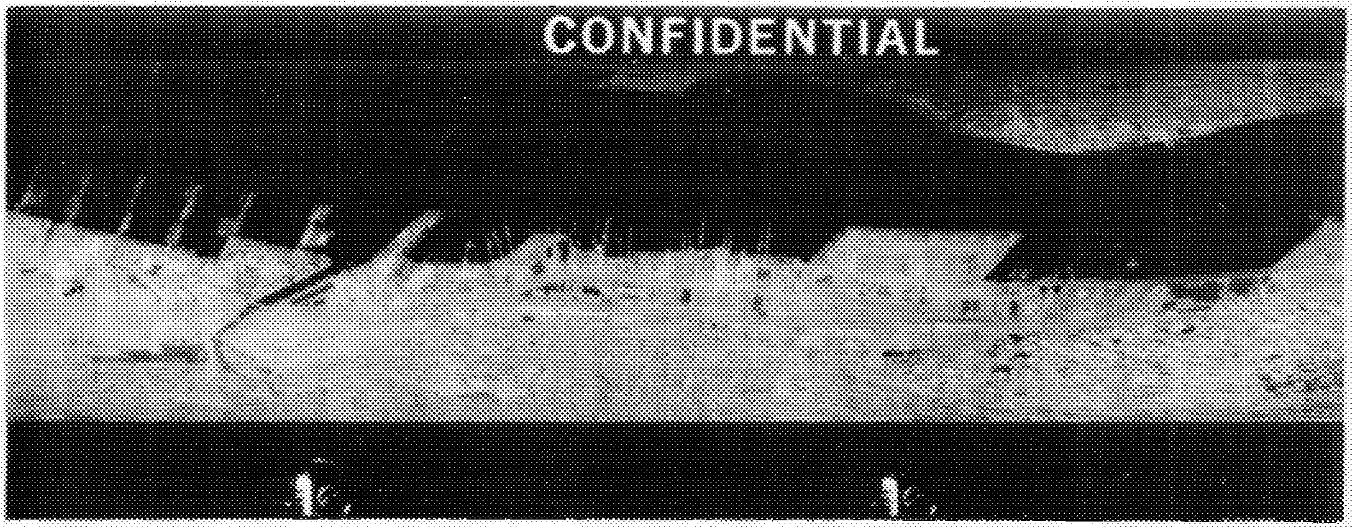

Figure III - 11 Flight No. 11. Field Processed Test Strip

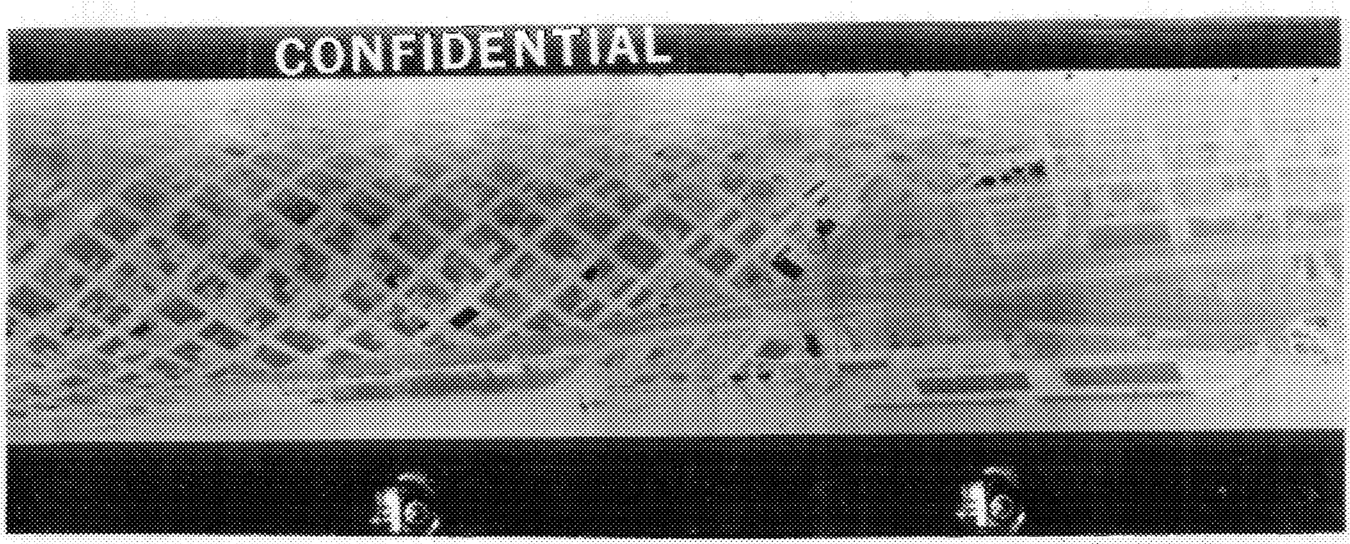

Figure III - 12 Flight No. 12. Field Processed Test Strip

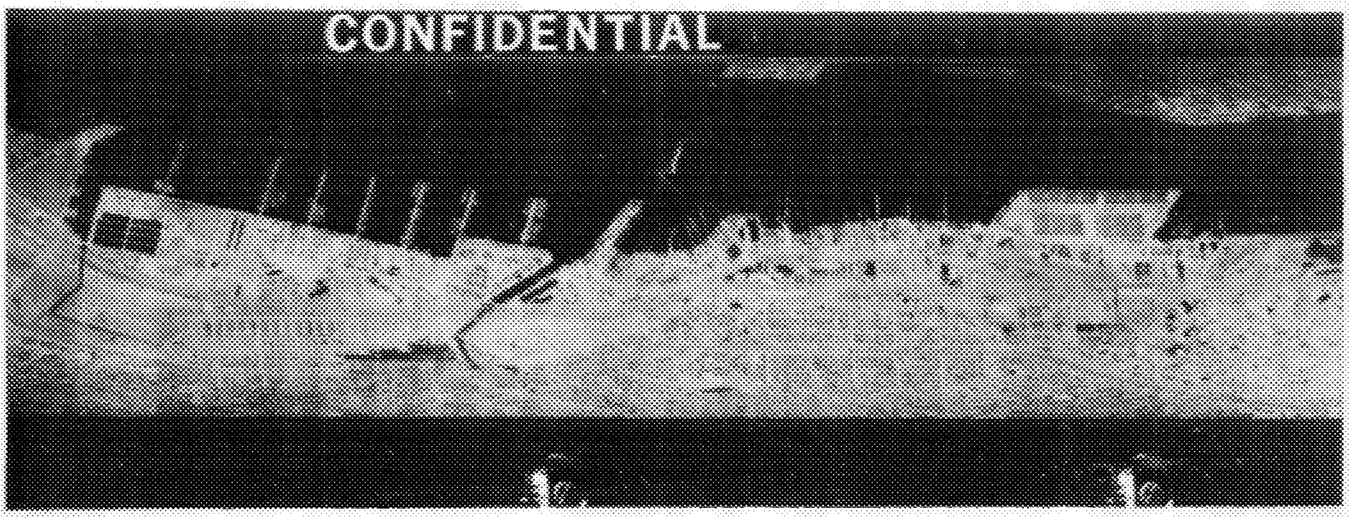

Figure III - 13 Flight No. 13. Field Processed Test Strip

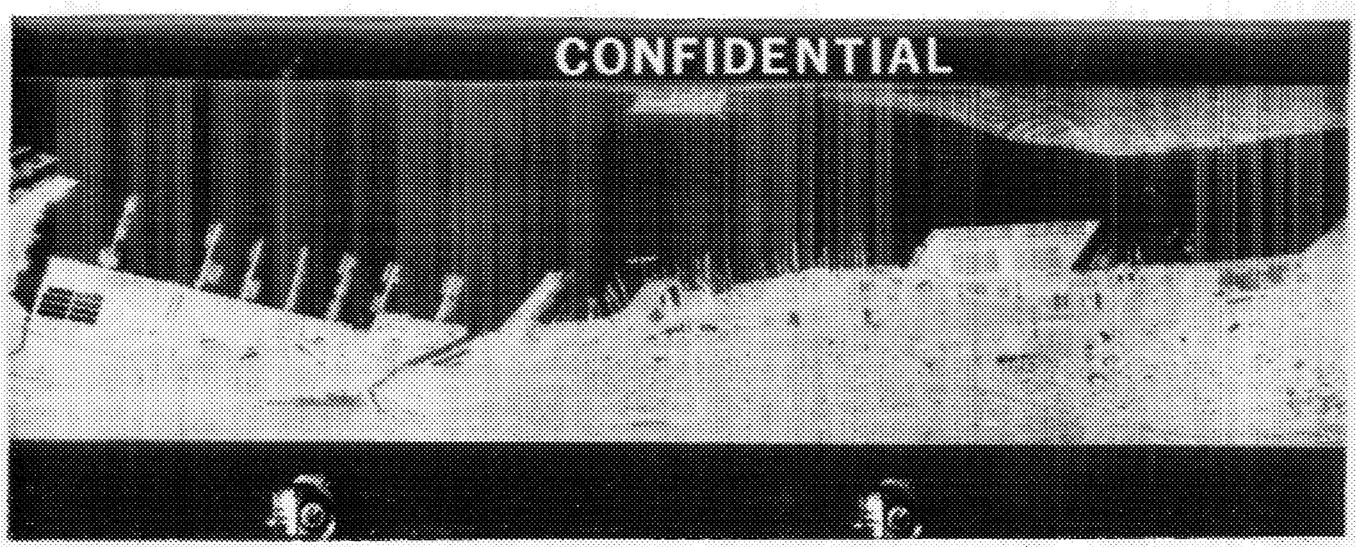

Figure III - 14 Flight No. 15. Field Processed Test Strip

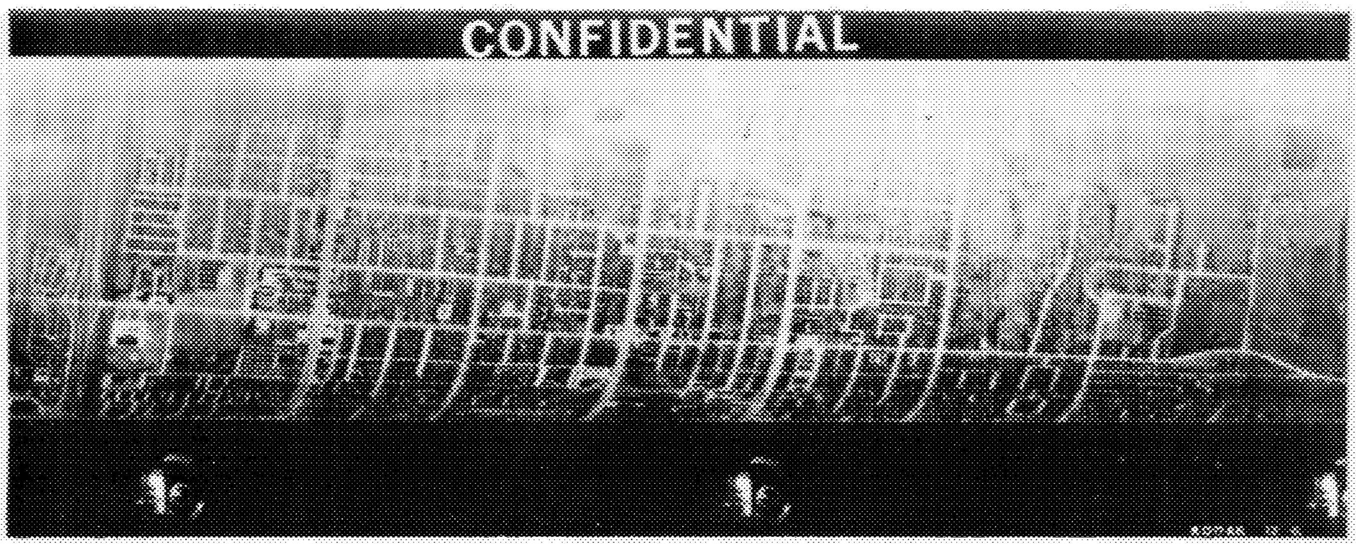

Figure III - 15 Flight No. 16. Field Processed Test Strip

SECTION IV

RESULTS AND RECOMMENDATIONS

A. RESULTS

Airborne and ground data collection efforts under [redacted] 25X1 [redacted] Project 56040 have resulted in comprehensive reconnaissance data over a wide variety of military and vivilian type targets, specifically in conjunction with seven pre-selected targets classed as indicators of military build-up. During the conduct of this program the following were demonstrated relative to [redacted] operations. 25X1

- Reliability of the SSD/RS-7 [redacted] and K-17C photographic reconnaisance systems 25X1
- Capabilities of the B-25 multisensor system*
- Capability to collect detailed ground truth data on an accelerated schedule

Significant within the program were the airborne reconnaissance and ground truth data presentations logically organized to facilitate interpretation. These formats, conceived for this project, are being generally incorporated as standard for future air and ground reconnaissance endeavors by [redacted] 25X1 In addition, viewing initial airborne imagery by the on-site ground crews resulted in the collection of additional significant ground data, e. g., photographs of anomalous appearing objects prior to departing the area.

This project also served to identify many operational problems relative to an undertaking of this nature and resulted in techniques for their solution. Among these were coping with weather problems, manpower scheduling, authorization contacts in populace area, security and the myriad of minor logistics problems.

The extent to which final results of this data collecting segment of the total program can be analyzed, however, will be greatly dependent upon the results of the next program phase, i. e., data interpretation (see Section I). Only following the interpretation phase can a true evaluation of results of this segment of the program be conducted, especially in terms of the significance of data collected.

*Radar data were also collected during San Diego operations but under a separate contract.

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B. RECOMMENDATIONS

Recommendations made from this point in the total program are necessarily limited. However, the following can be expressed.

Processing the original negatives in a controlled laboratory environment remains the recommended procedure as opposed to field processing.

No undeveloped film should be sent by commercial carrier unless shipped in pressurized containers or compartments. Film damage through moisture condensation was witnessed where the film was shipped in non-pressurized compartments (see Section III, A, 3).

A ground verification program should be instituted following the interpretation phase to confirm the interpretations of the static features of the area especially concerning the seven selected sites.

The data collected should be made available for other research and training programs following completion of the total program. These data, including the ground truth data, could constitute the most complete basic data for interpreter training yet collected.

This project has provided a format for [redacted] military 25X1
target analysis and it is recommended that it be applied to other critical strategic and tactical target types.

Further comprehensive programs similar to the one described herein should be conducted by a single contractor. That is, one group should be responsible for the total program rather than splitting it between data collection and data interpretation. This tactic would make total target site knowledge gained on-site, available to the interpreters. In so recommending,
25X1 [redacted] recognizes that a "single contractor" program is most suited where the results to be achieved center around system performance testing, evaluation and personnel training. Efforts centered on imagery interpreter's evaluation, however, may best be served by a division of labor as took place in this subject program.

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