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OPERATIONAL TEST INSTRUMENTATION GUIDE.(U)
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OPERATIONAL TEST INSTRUMENTATION GUIDE

OTEA

US ARMY OPERATIONAL TEST AND EVALUATION AGENCY
5600 COLUMBIA PIKE
FALLS CHURCH, VIRGINIA 22041

NOVEMBER 1981

THE FINDINGS IN THIS REPORT ARE NOT TO BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION UNLESS SO DESIGNATED BY OTHER AUTHORIZED DOCUMENTS.

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ABSTRACT

The Operational Test Instrumentation Guide presents the results of an operational test-oriented survey of some twenty-eight Department of Defense test/training facilities. In addition to the available instrumentation, information is provided on the landspace, airspace, data reduction, and other general support capabilities of each installation. The general support area includes such information as: (a) type, location, size, and commitments of nearby military units; (b) facility access; (c) maintenance and logistics capability; (d) climate and topography; and (e) power/communications availability.

p i

INTRODUCTION

The Operational Test Instrumentation Guide presents information on available facilities and instrumentation for potential use in the testing of new and existing systems. The guide is a collection of annexes each dealing with a specific test facility. The summary provides an overview of the annexes.

A. APPROACH

The listing of the 28 facility annexes is shown in Table 1-1. The facility abbreviation used throughout the guide is also indicated in this table. The primary criteria for facility selection were:

- o Facilities with Army operational test support capability.
- o Facilities with significant land and controlled airspace coupled with on-site instrumentation and base support.
- o Facilities with unique capabilities which satisfy a particular Army operational test need.

Detailed facility descriptions are presented in Annexes A through BB. Information in each annex is presented in a similar format to ensure consistency in coverage and ease of usage. An example of this format is outlined in Table 1-2. As can be seen from this table, only three of the six major sections of each annex address instrumentation or related hardware; Section 4 (Instrumentation), Section 5 (Threats/Targets), and Section 6 (Data Handling/processing). The first three sections address test support factors that should be considered in association with the instrumentation review.

TABLE 1-1

CONTENTS

X. Rome Air Development Center, Griffiss AFB, Rome, New York

Y. Naval Air Test Center, Patuxent River NAS, Maryland

Z. Naval Weapon Center, China Lake, California

AA. Pacific Missile Range, Point Mugu, California

BB. Fallon Naval Air Station, Nevada

Table 1-2

STANDARD ANNEX FORMAT

1. Introduction
   a. Overview
   b. Generic Systems Tested

2. General
   a. Military Units
      (1) Army Units (type, size, etc.)
      (2) Other Military Units
   b. Maintenance Capability
   c. Access (air, rail, road, sea)
   d. Logistic Support Capability
   e. Recurring Commitments (ROTC, etc.)
   f. Special Restrictions
   g. Organization
   h. Environment
   i. Topography
   j. Airspace Restrictions
   k. Power Availability
   l. Communications

3. Dimensions
   a. Landspace
      (1) Test Area Contiguity
      (2) Easements (forestry, hunting, etc.)
      (3) Impact/Live Fire Areas
   b. Airspace
      (1) Landspace/Airspace Relationship
      (2) Easements
      (3) Manned Airborne Systems
      (4) Unmanned Airborne Systems
      (5) Area Surveillance

4. Instrumentation
   a. Space Positioning and Velocity Vector
      (1) Ground elements (type, model, accuracy, frequency, mobility)
      (2) (a) Single Object
          (b) Multiple Object
          (c) Relative Positions (miss-distance)
          (d) Radar
      (2) Airborne Elements
          (a) Radar
          (b) Laser
          (c) Optical
          (d) Relative (miss-distance)
          (e) Airborne-to-ground target matching
   b. Timing
      (1) Primary
      (2) Secondary
   c. Television
   d. Photography
      (1) Motion Picture Capabilities
      (2) Still Photography

4. Instrumentation (Cont'd)
   e. Instrumentation Calibration Capabilities
   f. Other General Instrumentation
      (1) Telemetry
      (2) Meteorological
      (3) Survey
      (4) RFI/Electromagnetic Compatibility
      (5) Visibility
      (6) Sound Measurement and Analysis
      (7) Safety and Security
      (8) Soil Conditions
   g. Special Purpose Instrumentation
      (1) Ballistic Data
      (2) Environmental Chambers
      (3) Vehicle Performance
      (4) CBR Instrumentation
      (5) Other

5. Threats/Targets
   a. Ground
      (1) Electromagnetic
      (2) Weapons
          (a) Firing Realism
          (b) Scoring Capability
          (c) Destroyable/Non-Destroyable
          (d) Physical Realism
      (3) Radiological Environment
      (4) Other
   b. Airborne
      (1) Electromagnetic (number, type)
      (2) Weapons
          (a) Firing Realism
          (b) Scoring Capability
          (c) Destroyable/Non-Destroyable
          (d) Physical Realism

6. Data Handling/Processing
   a. Data Storage and Retrieval
   b. Quick-Look Capabilities
   c. Processing
      (1) System & Model
      (2) Language
      (3) Input/Output Options
      (4) Real-Time/Post-Test
   d. Distribution (Turnaround Time)
   e. Displays (plotting boards, CRTs, etc.)

7. Potential U.S. Army Test Operations for Which This Facility Appears Suitable (This section in non-Army installations only)

ANNEX A

OPERATIONAL TEST INSTRUMENTATION GUIDE

WHITE SANDS MISSILE RANGE
White Sands, New Mexico

CONTENTS - ANNEX A

LIST OF FIGURES

ANNEX A

WHITE SANDS MISSILE RANGE, NEW MEXICO

1. Introduction.

a. Overview. White Sands Missile Range (WSMR) was established in 1945 as the White Sands Proving Grounds; in 1948 the installation name was changed to White Sands Missile Range. The Department of Defense (DOD) classified WSMR as a National Range in 1961, to be equally available to all DOD users and other authorized agencies on a common basis. The Range is under the command jurisdiction of the US Army Test and Evaluation Command (TECOM).

WSMR is located in south central New Mexico (see Figure A-1). The headquarters area is situated about 50 miles north of El Paso, Texas, and about 30 miles east of Las Cruces, New Mexico. The Range proper occupies a land area about 40 miles by 100 miles, with a leased Range extension 40 miles square lying adjacent to the northern boundary. Several off-range launch and impact areas in Utah and New Mexico are used under lease agreements in support of programs requiring longer flight trajectories. The terrain at WSMR is generally flat, sandy desert with a mean elevation of 4,000 feet above sea level. Mountain ranges parallel the Range on both the east and west, crossing the Range about 75 miles north of the headquarters area.

The mission of WSMR is threefold: (1) a National Missile Range mission; (2) an Army test and evaluation mission; and (3) an installation operations mission. These three areas are more specifically defined as follows:

(1) National Range Mission.

o Provide and operate a National Range in accordance with DOD directives and in consonance with instructions and policies issued by the Commanding General, TECOM.

o Control and/or coordinate use of all electromagnetic radiation propagation devices on and adjacent to WSMR.

o Conduct research and development pertaining to Range instrumentation as directed.

(2) Army Test and Evaluation Mission.

o Plan and conduct development test II (engineering phase), development test III, and other development and developmental-type tests of rocket and guided missile systems, air defense fire distribution systems and associated equipment, and other materiel as assigned.

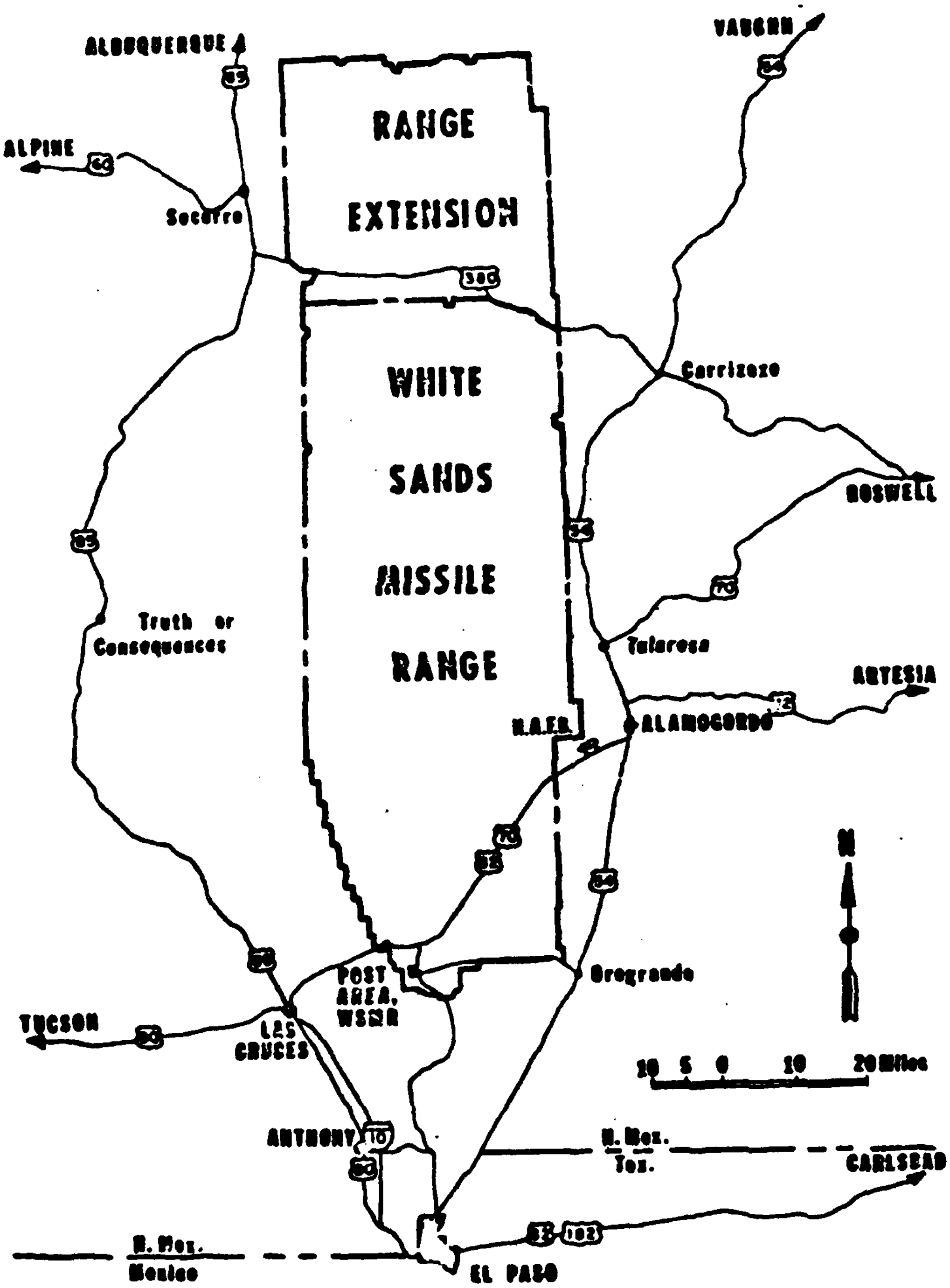


Figure A-1: White Sands Missile Range

o Operate a nuclear effects facility and conduct tests pertaining to the effects of nuclear radiation, as directed.

o Provide advice and guidance to proponent agencies and materiel developers during the development of guided missile and air defense fire distribution systems and associated equipment.

o Conduct other tests and evaluations as directed by the Commanding General, TECOM.

(3) Installation Operations Mission.

o Operate WSMR in accordance with existing regulations or as directed by the Commanding General, TECOM.

o Provide administrative and logistical support and technical advice to tenant activities and other governmental agencies.

o Perform other services as directed by the Commanding General, TECOM.

b. Generic Systems Tested. Within the scope of its various missions, a great number and a variety of programs are brought to WSMR. These programs vary in magnitude from limited one-time tests of components to continuing programs involving the development of complete weapons systems and global programs requiring the support of all the National Ranges. Test operations of more than 100 separate programs are currently supported in the areas of surface-to-surface, surface-to-air, air-to-air, and air-to-surface missiles and rockets, airborne weapons systems, space vehicle development, target missiles and rockets, reentry physics research, bomb drop tests, upper atmospheric research, and tactical missile unit training tests.

2. General.

a. Military Units and Tenants.

(1) Army Units.

Headquarters Company
A and C Companies (WSMR)
B Company (Holloman AFB)
259th MP company

(2) Other Military Units.

(a) Navy. The Deputy for the Navy to the Commander, WSMR, is the Commanding Officer of the Naval Ordnance Missile Test Facility, and serves as sponsor for all Navy test programs at WSMR as well as for NASA Goddard research rocket test programs at WSMR.

(b) Air Force. The Deputy for the Air Force to the Commander, WSMR, is the Chief of the Air Force Armament Division. He serves as sponsor for all Air Force programs testing at WSMR.

(3) WSMR Tenant Organization.

- US Army Air Defense Center, Ft Bliss, TX
- US Army Atmospheric Sciences Laboratory
- US Army TRADOC Systems Analysis Activity
- US Army CIDC, WSMR Branch Office
- Defense Mapping Agency Hydrographic/Topographic Center
- MIRADCOM Field Office, Redstone Arsenal, AL
- WSMR Field Office, 902d Military Intelligence Group
- US Army Communications Command
- District Engineer, Southwestern Area Office
- William Beaumont Army Medical Center, El Paso, TX
- GEODSS Program Office
- US Army Dental Activity
- US Air Force Armament Division, Eglin Air Force Base, FL
- US Naval Ordnance Missile Test Facility
- NASA Johnson Space Center White Sands Test Facility
- Department of Energy, Sandia Office, Albuquerque, NM
- Defense Investigative Service, White Sands Resident Agency
- US Army Office of Missile Electronic Warfare
- White Sands Meteorological Team
- DA Project TUMBLEWEED, ACSI
- ARRADCOM Field Engineering Office
- PATRIOT Project Field Office
- US Army Commissary
- US Army Office of the Test Director
- Defense Property Disposal Office Holloman AFB, NM
- ROLAND Field Office

b. Maintenance.

(1) Facilities Engineering (FE) provides maintenance of the approximately 3,000 facilities at WSMR. About 1,700 of the facilities are buildings comprising 4.5 million square feet.

(2) Maintenance centers are located on the Range at Stallion, Rhodes Canyon and the Main Post. Maintenance services are provided without cost to all Army-owned facilities. WSMR maintenance of a user's facility can be negotiated.

(3) Maintenance facilities for wheeled vehicles are available. If significant numbers of project vehicles enter the Range, additional manpower would probably be required. Maintenance for tracked vehicles is very limited but is available at Fort Bliss, which is contiguous to the Range on the south.

c. Access.

(1) Air. Commercial air transportation is available at El Paso International Airport (runway length 12,000 feet) and the Alamogordo White Sands Regional Airport (7,000 feet). A Scheduled Airlines Ticket Office (SATO) is located in the headquarters area of WSMR. Military airfields in the area consist of Biggs Field at Fort Bliss, TX (13,600 feet) and Holloman AFB located outside Alamogordo (12,200 feet). Several airfields and helicopter landing pads are located on WSMR itself, as shown in the listing below.

(a) Airfields.

- o Stallion
- o Condron Field
- o Mars Site
- o Northrup Strip

(b) Helicopter Pads.

- o JFK (Post Area)
- o Lauch Complex 32
- o Mule Peak
- o Salinas Peak
- o North Oscura Peak
- o Range Services Division (Post Area)
- o Rhodes Canyon Range Center

o PATRIOT (Launch Complex 38)

o McAfee Hospital Pad

o WSNM Headquarters

o North Ramp (Holloman AFB)

o Test Track (Holloman AFB)

(2) Water. None.

(3) Rail. WSMR is serviced by the Southern Pacific Railroad with a spur line near Orogrande, NM.

(4) Road. Interstate Highways 10 and 25 are accessible using State Highways 70 and 54. The roads serving WSMR are shown on Figure A-1. The WSMR road system is adequate for any foreseeable movement of men and materials. Tracked vehicles are allowed only on properly prepared crossovers and travel on the highway right-of-way.

d. Logistics Support.

(1) The Director of Logistics provides logistical support of all types, including supply and maintenance services, motor pool services, solid and liquid propellent storage and servicing, generators, packing and crating, commerical freight, and government passenger service.

(2) WSMR has BOQ housing for a small number of officers (15 to 20). Army units entering WSMR would have to be self-sustaining or obtain rations from Fort Bliss.

e. Recurring commitments. None.

f. Special Operation Restrictions. Activities or movement within the range must be coordinated and controlled for reasons of security, safety, and scheduling.

g. Facility Organization. The WSMR organizational chart is shown in Figure A-2.

h. Environment. WSMR does have an Installation Environmental Impact Assessment completed study.

(1) Climate. Daily temperatures, typical of the Southwest, often vary between day and night as much as 50°F. The annual temperature range maximums are 108°F to -14°F with mean values 76°-62°-46°. Annual rainfall is 9.6 inches; snowfall is 6.5 inches; relative humidity is 38 percent. Approximately 60 percent of the precipitation occurs in July, August, and September. Prevailing winds are from the west and average 7 mph with gusts to 70 mph. Winds and gusts occur mostly in the spring, with higher velocities closer to the mountains and lesser in the valley where missile flight testing is accomplished. Sand and dust can cause rapid deterioration of unprotected equipment and instruments.

Meteorlogical conditions typical of desert surroundings provide excellent year-round visibility. Good coverage by optical instrumentation is obtainable about 95 percent of the time, both day and night. The mean visibility is 36 miles while 75 to 100 miles is not uncommon.

(2) Soils. A wide variety of soil conditions exist and include lava beds in the northeast, 99 percent pure white gypsum in the south central area, and gravel, sand, and sandy clay on the desert floor. There are numerous dry lakes having high gypsum content and rocky mountains with a variety of bedrock, including granite.

(3) Vegetation. Typical southwestern vegetation covers WSMR, including native grasses, shrubs, sagebrush, creosote, mesquite, and cacti in the valley regions. Due to the arid climate, coverage is sparce, leaving wide areas open to wind erosion. In the mountains, most of the vegetation is located in sheltered areas.

i. Topography. The WSMR proper comprises an area of 2,898,778 acres. The area is traversed from north to south by the San Andres, Organ, and Oscuro Mountain ranges on the west and by the Sacramento Mountains on the east. The major portion lies within the land-locked Tularosa Basin, with valley floor elevations averaging 4,000 to 5,000 feet above sea level and mountain peak elevations up to 8,958 feet. The lower elevations are predominately in the southern areas of the Basin.

j. Restricted Airspace Areas. Airspaces over WSMR, certain adjacent areas, and off-range launch and impact areas approved for containment of tests under current programs are shown on the map from DOD Flight Information Publications (FLIP) which also provides complete geographical coordinates, effective altitudes, and usual times of use. Addition to these airspaces require 9 months' lead time. Limited airspaces are released to FAA control when not in use. All other areas are "joint use" airspaces, which means they are released when not needed for Range purposes. See Figure A-3 for WSMR air restrictions listed below.

Surface to 22,000 ft MSL	R-5107D
Surface to 24,000 ft MSL	R-5116A
Surface to Unlimited	R-5107B, R-5107C, R-5107E, R-5111A, R-5111B
24,000 ft to 43,000 ft MSL	R-5107F, R-5107G (Corridors for jet routes)
24,000 ft MSL to Unlimited	R-5109A, R-5109B

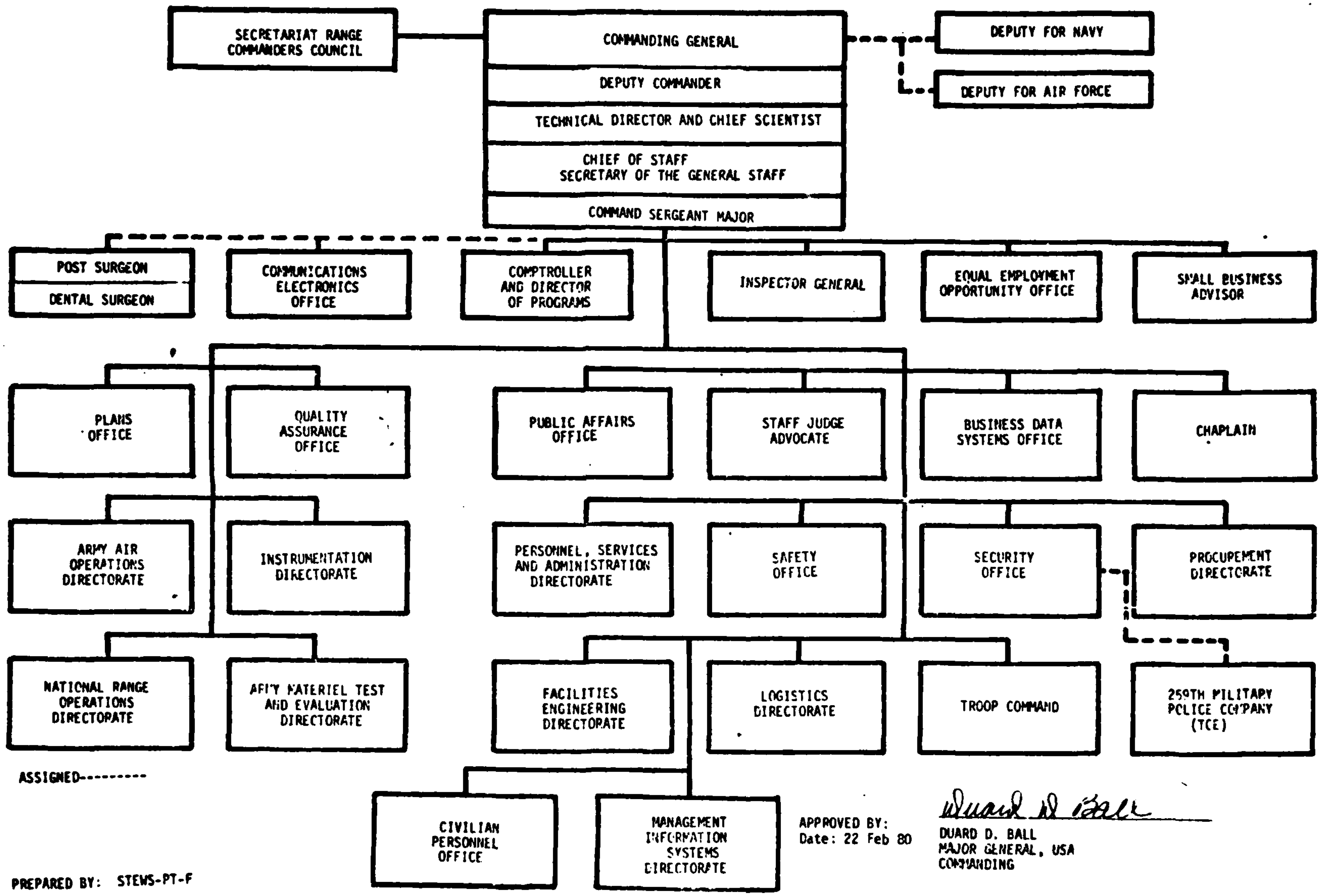
k. Power and Gas Availability (approximate).

o Electricity - Lines and Service

Overhead	2,779,596 linear feet
Underground	150,247 linear feet

Figure A-2

US ARMY WHITE SANDS MISSILE RANGE, NEW MEXICO



o Electricity - Purchased and Sold

Purchased	69,149 Mwh
Sold	1,591 Mwh

o Gas

Gas System (Distribution and Main Service)	200,934 linear feet

l. Communications. The US Army Communications Command Agency at WSMR provides communications service. This service includes planning, engineering, installing, maintaining, and operating communications equipment and facilities. The Range Communications system utilizes standard means for the transmission of voice communication, data, timing, missile guidance, destruct, and other types of signals. Communications provide the interconnecting link for information transfer between instrumentation and data centers, Range control, and Range users in support of test operations. The following list points out some of the capabilities of the Range Communications system.

(1) Real-time data are transmitted from Range Instrumentation (AN/FPS-16 radars and project radars) to a UNIVAC 1108 computer. Standard channel capability is 2,400 bits per second using data modulator/demodulator units on standard voice frequency cable pairs, open wire pairs, and microwave channels. Telemetry data is transmitted via a wideband microwave system.

(2) The ground-to-air communications system consists of 20 watt AM UHF radio transmitting-receiving sets located at key points on the Range.

(3) The open wire and cable communications plant provides data transmission and voice communications service to over 1,500 Range stations.

(4) The microwave trunking system interconnects the major Range control and instrumentation stations. This trunk line system employs three duplex radios per path. Each is capable of expansion to 960 voice frequency (VF) channels per link, or a lesser number of voice frequency channels plus data channels up to 8 MHz bandwidth. A balloon cable trunking system, utilizing multiplex equipment identical to the microwave system listed above, is used for short distances and has a capability of 420 channels maximum.

(5) Commercial communications facilities are leased for signals between WSMR and Green River, UT. Individual VF channels with E and M signaling (if required) are in use between WSMR, Fort Huachuca, PMR, and ETR for transmission of voice and data.

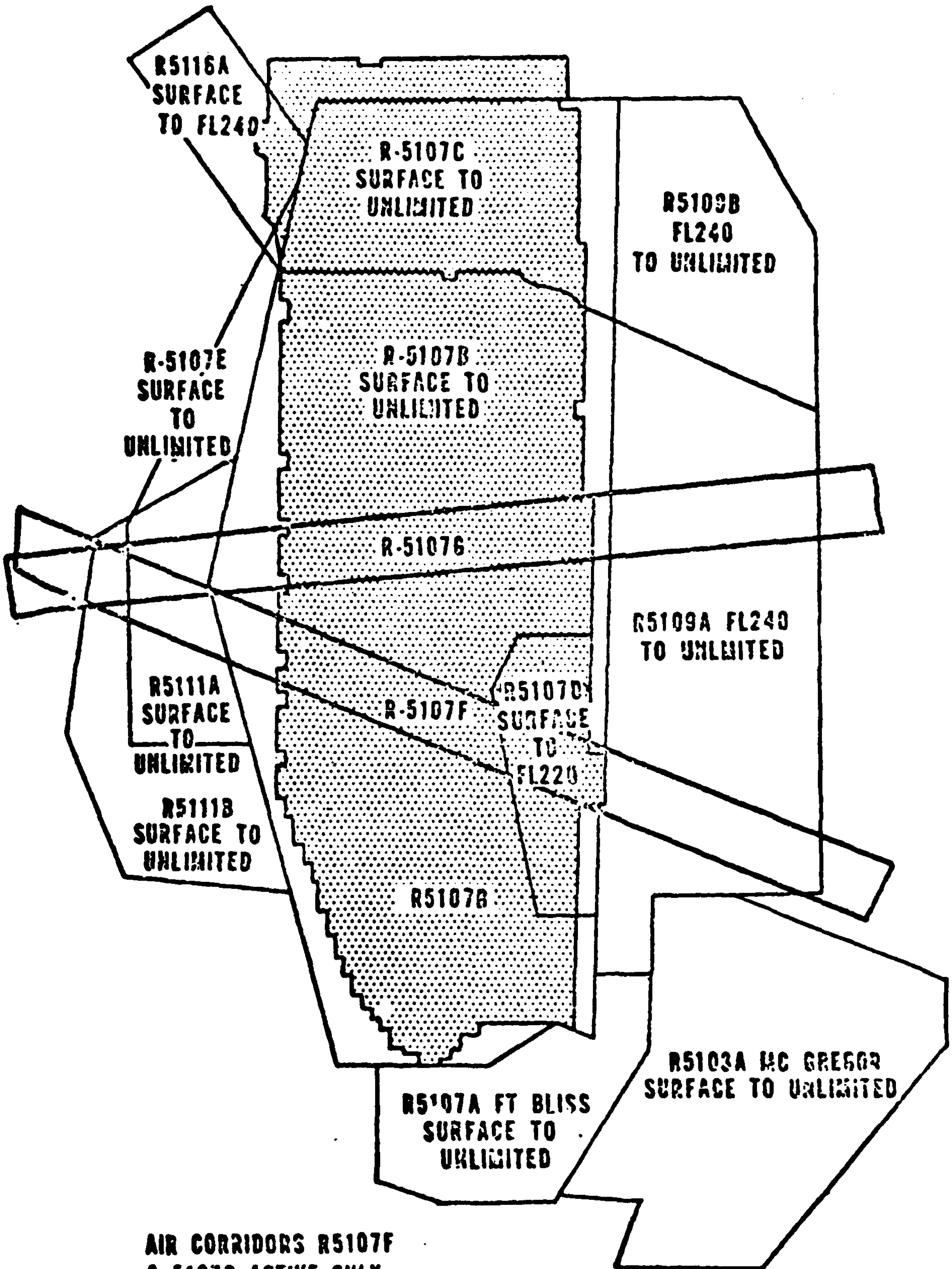
(6) Eight dial telephone central offices serve WSMR. These are located as follows:

o Green River (400-line)

o Post Signal Center (4,800-line)

Figure A-3

WSMR RESTRICTIVE AIR SPACE AREAS



NOTE: AIR CORRIDORS R5107F & 5107G ACTIVE ONLY WHEN RELEASED BY WSMR

- o Launch Complex 33 (600-line)
- o Small Missile Range (200-line)
- o Launch Complex 38 (600-line)
- o Oscuro Range Camp (100-line)
- o King 1 (1,000-line)
- o Stallion (400-line)

(7) Mobile radio systems are used extensively at WSMR for coordinating efforts of personnel in the field, for obtaining maximum utilization of vehicles and mobile instrumentation stations, and for Range user communications. There are approximately 800 mobile and 185 base stations, 54 repeaters (29 main and 25 standby) and 231 portables. This equipment is narrow-band FM, operating in the low-band VHF and UHF (400 MHz) portions of the frequency spectrum at WSMR and off-range sites.

(8) A portable radio pool is maintained for use by Range customers on short-term programs where either a communications plant is not existing or the utilization time would not justify or permit the construction of either a temporary or a permanent communications plant.

(9) A transportable public address system is maintained for use by Range customers. This system is used primarily for briefing of visiting personnel, personnel safety, and for large groups, such as Operation Understanding.

(10) A transportable communications system provides self-contained subsystems for off-range, interim, and emergency communications requirements. The system consists of the following units or subsystems:

o The basic microwave system, consisting of two end terminals, one repeater with channel dropout, and one RF repeater. Nominal range of the basic system is 150 miles. Present capacity is 48 voice frequency channels.

o Extensive intercom facilities are provided at Range user and instrumentation sites. There are approximimently 2,500 intercom units installed in single and multiple configurations.

o Three 1,000 watt radio transportable command guidance and control units, capable of transmitting the 20 standard IRIG tones, are included in the communications system.

(11) Basic technical characteristics of the communications media used at WSMR are tabulated in Table A-1.

3. Dimensions.

a. Landspace.

(1) Test Areas. The total WSMR complex consists of approximately 4,476,524 acres. This area is divided into two general groups: (a) real estate within WSMR boundaries and (b) off-range real estate areas. Figure A-4 shows the approximate acreage and location of the WSMR landscape.

(a) Real Estate within WSMR Boundaries. The area of land identified as WSMR proper is comprised generally of a portion of the former Fort Bliss Anti-Aircraft Range, California Institute of technology Ordnance Range areas, and the Alamogordo Bombing Range. Located within the WSMR boundaries is the White Sands National Monument controlled by the National Park Service. Use of this area is limited to overflights and to those roads, power lines, instrumentation stations, and telephone lines contained in special-use permits and agreements. The San Andres Wildlife Range and the Jornada Experimental Range areas are also located within the boundaries of WSMR and used as a safety buffer zone to provide security protection. The lower part of the Range is restricted area for use by the National Missile Range. This area comprises the southern end of the Range, from the headquarters area to the eastern boundary, and is bordered on the north by US Highway 70. This area is used to support the main missile launch complexes and contains special missile assembly areas, liquid and solid fuel storage areas, instrumentation sites, radar sites, airstrips, missile booster fallout areas, and some impact areas. The upper or northern part of the Range proper is also restricted area, which extends from the launch complex at its southern boundary to the north, with missile impact areas located at 30, 50, 70, and 90-mile distances. Located throughout the Range are permanent and temporary sites for instrumentation cameras, telescopes, and radar installations which support individual and/or all test programs assigned to the Range.

Land (within WSMR boundaries)	Acres	Square Miles
Owned in Fee	88,873	139
Public Domain	1,314,555	2,054
Lease	350,946	548
San Andres Wildlife Range	36,347	57
Jornada Experimental Range	60,135	94
San Andres Wildlife and Jornada Experimental Range Overlap	23,589	37
White Sands National Monument	142,639	223
TOTAL	2,017,084	3,152

(b) Off-Range Real Estate. This real estate includes the North Range Extension and other lands required to support assigned missile projects which are launched off-range and impact on-range.

TABLE A-1

CHARACTERISTICS AND CAPABILITIES
OF
WSMR COMMUNICATION SYSTEM

	WIRE	CABLE	GROUND-TO-AIR	MICROWAVE
1. Equipment Used	Standard	Standard	CM-520 AN/GRC 171	Lenkurt, GE/Collins Commercial Equipment
2. Quantity	469 miles	82,000 ckt miles	75 ground	See paragraphs 2d transmitters and 2j
3. Utilization	Control, data, timing, and intercommunications	control, data, timing, and intercommunications	Vectoring	Control, data, and intercommunications
4. Bandwidth	182 kHz (0-1) 12 kHz (WS-1)	300-3100 Hz	6 kHz	300-3400 Hz (for voice) (Variable for data)
5. Input Levels	0 to -6 dbm	0 to -6 dbm	-97 dbm	-16 dbm
6. Output Levels	-15 to -21 dbm	-15 to -21 dbm	+43 dbm	+7 dbm

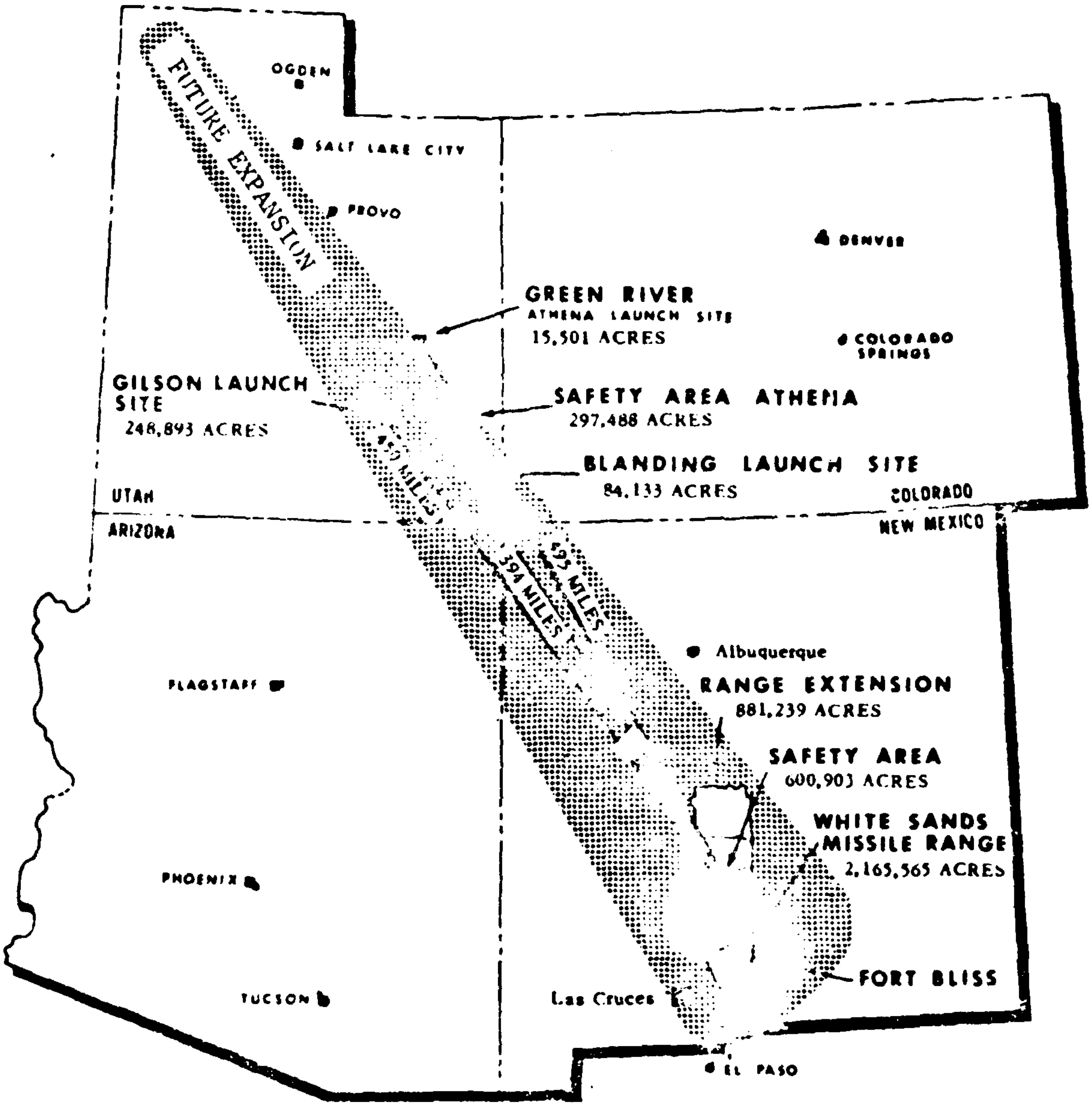
Land	Acres	Square Miles
Green River Pershing Launch Site	186,522	291
Green River ATHENA Launch Site	14,701	23
Safety Area ATHENA	309,749	484
AEROBEE 350 Area	241,263	377
Safety Areas (4A, 4A Extension)	617,603	965
Range Extension	882,045	1,378
TOTAL	2,251,883	3,518

(2) Easements/Encroachments. No major problems of encroachment have been encountered with Federal, State, county, or municipal organizations. The importance of WSMR to the defense of the United States is recognized by local community leaders and responsible State and Federal officials. Encroachment factors at the installation are considered insignificant; however, retention of the restricted airspace appears to be the growing problem of the future. The south-central New Mexico area was originally selected as a missile range because of the favorable climate and geography, and the availability of large tracts of government-owned or controlled real estate. The entire area is generally remote and sparsely populated, yet is sufficiently near major population areas to be readily accessible by air, rail, and highway. A prime consideration for the selection of this area as a test range was the relative absence of encroachment pressures by such factors as urbanization, industialization, or local political opposition. The demands inherent with the competition for use of land areas by the military and the property owners, who were displaced when WSMR was established, are as follows:

(a) Livestock Grazing. The primary industry prior to the establishment of WSMR involved livestock grazing. Pressures to co-use the Range area for livestock grazing have been resisted on the basis that continued exclusive use with a full and flexible schedule of Range tests is required in order to effectively accomplish the Range mission.

(b) Mining Operations. Of the 209 privately-owned mining claims within the Range, only three were operated commercially prior to establishment of WSMR. The principal minerals that have been discovered in these mining claims are fluorspar, barite, galena, silver, talc, tungsten, and copper. a major mining consultant firm employed by the Army to survey the minerals within the Range determined that none of these minerals occur in sufficient quantities to warrant mining.

(c) Civilian Economic Development and Area Urbanization. Currently, due to the low population in this area, there is little pressure caused by such factors as urbanization and industrialization; however, a



WHITE SANDS MISSILE RANGE
NEW MEXICO

Figure A-4

study has been initiated by the Department of the Interior to develop and put to beneficial use vast amounts of brackish ground water in the Tularosa Basin. A large portion of the Tularosa Basin is located within WSMR.

(d) Hunting. Large areas of the Range have been opened once a year for public hunting on a controlled, noninterference basis. WSMR has a cooperative game management plan for the propagation of native and exotic wildlife.

(3) Impact/Live Firing Areas. Because of the large land area both on and off range, and through the use of mobile instrumentation and control systems, a wide variety of launch areas, trajectories, and impact areas can be supported, subject to ground and flight safety constraints. Special areas are designated for testing short range missiles, hazardous testing, and live impact areas. Through selected use of off-range and adjacent areas, lone-range overland trajectories can be accommodated.

b. Airspace.

(1) Landspace/Airspace Relationship. Landspace/airspace relationship at WSMR is totally controlled by the range on a mission basis. Special non-operatioal areas do not exist.

(2) Easements. See subparagraph 2f.

(3) Manned Airborne Systems. The Air Force Development and Test Center (ADTC) provides high-performance cargo and rotary wing aircraft support as a National Range service for authorized program testing at WSMR. ADTC headquarters is at Eglin AFB, and support of this type may be staged from Kirtland or Holloman AFB, NM. The New Mexico Air National Guard may provide limited high performance aircraft support if compatible with training flight schedules. The Army Air Operations Directorate provides Army aircraft aviation support to WSMR in the area of recovery operations.

WSMR Army Aircraft

Quantity	Aircraft
1	U-8F Seminole
1	U-21A Ute
5	UH-1H Huey
10	OH-58A Kiowa

(4) Unmanned Airborne Support. WSMR does not provide any unmanned airborne targets, but does support target missions with drone control systems, such as the Drone Formation Control System (DFCS), the Vega Command and Control System, and radio command guidance transmitter systems.

(5) Area Surveillance.

(a) Airspace. Surveillance radars are located on and off range to ensure aircraft safety and to detect unauthorized penetrations of the restricted airspace. The surveillance functions is performed by three AN/TPS-48 3D radars, and tow mobile NIKE-AJAX radars. The three AN/TPS-48 radars are located at fixed on-range sites. One is located in the southeast corner of the Range (Ruth Site), the second in the northwest corner of the Range in the Stallion area (Search Site), and the third is located in the Holloman AFB area (Rita Site). The data from these radars are received, processed, and displayed in real time by the use of modified AN/GSA-51 (BUIC III) equipment. Mobile radars are used for local surveillance coverage on an interim basis at Moab and Green River, Utah.

Radar Skin Tracking

Maximum range for one square meter target	50 nm
Accuracy, range	±1,000 yds
Azimuth angle accuracy	±0.5°
Height information	±2,000 ft
Altitude coverage	1,000-96,000 ft
MTI 1 (clutter rejection)	20 db

Beacon Tracking (IFF)

Maximum range	250 nm
Altitude coverage (above terrain)	1,000-96,000 ft
Beacon coder (number of targets)	80
Beacon adaptability	AN/UPX-14

(b) Ground Space. Roadblocks are controlled by the Director of National Range Operations and manned by personnel of the Provost Marshall. On and off range, roadblocks are required to control traffic and provide protection during certain tests and live firing operations. Locations and manning times of roadblocks are specified in the applicable Operations Directive document of the Universal Documentation System.

4. Instrumentation.

a. Space Positioning and Velocity Vector.

(1) Ground Elements. None.

(2) Airborne Elements.

(a) Angle Measuring equipment (AME).

1 Description. The AME is a short baseline CW phase comparison system which uses interferometer techniques to measure the difference in phase of a VHF or S-band carrier received on pairs of precisely spaced antennas. Two direction cosines are determined at each AME station. Space position can be found by combining data from two AME stations. Each station is composed of a crossed baseline antenna field, an RF section with amplifiers, mixers, a tunable oscillator, phasemeters, a data processor, and a data handling unit.

2 Existing Capabilities. The system range is limited by the airborne signal source and can track any CW source in the frequency range 215-277 MHz or S-band.

- o Portability: fixed
- o Number: two AME stations
- o Trajectory measurements (two targets)
- o Real-time capability
- o Instrument accuracy: 0.2 to 0.3 milliradian
- o Sample rates: 1, 2, 5, 10, 20, 50, 100 per second
- o Recording medium: magnetic tape
- o Utilization: safety, quick-look, measurement analysis
- o Support requirements: communications and timing

3 System Features and Limitations.

a Features.

- o Does not require acquisition information
- o System operational reliability is better than 85 percent.
- o VHF to S-band conversion is possible in approximately 30 days.

b Limitations.

- o Large data errors at elevation angles below 3 degrees.

o Loss of resolution at elevation angles above 85 degrees.

(b) Cineteodolites.

1 Description. The cinetheodolite is an optical tracking instrument designed to permit angular position recording of the pointing axis from the instrument to the target. The vehicle image is recorded on photographic film with azimuth and elevation angular data. Simultaneous operation of two or more cinetheodolites permits the derivation of position, velocity, acceleration, and attitude data.

Cinetheodolite film is chemically processed the day it is exposed. Film quality control reviews each station's record to establish data coverage and to evaluate the station's electronic, optical, and mechanical equipment performance.

Range data reduction facilities edit, time correlate, and collect cinetheodolite film, utilizing film readers, data comparators, station data banks, and data processing equipment. Upon completion of the processing and analysis, the reduced data is sent to the Range user in report form.

2 Exising Capabilities. (see Table A-2). Precision of cinetheodolite position data varies with target size, slant range, elevation angle, and tracking acceleration rates. The Contraves system is capable of recording position data to 100,000 feet altitude and providing attitude data with an accuracy of one to five degrees. Four Contraves are being installed in mobile cinetheodolite mounts (MCM) to increase Range operational flexibility.

Twenty Askanias are incorporated into mobile cinetheodolite mounts. Mobilization of the Askanias permits maximum flexibility in geographical coverage at minimum capital investment.

3 System Features. The accuracy of reduced data is high. Relatively long trajectory segments can be accurately and permanently recorded from a single station. The cinetheodolite system does not require vehicle-borne acquisition aids. Cinetheodolites can be employed on most daytime operations with acceptable atmospheric conditions. Average instrument operational reliability is 87 percent.

(c) Electronic Sky Screen Equipment (ELSSE) System.

1 Description. The ELSSE system utilizes an interferometer technique to obtain real-time trajectory deviation and/or X, Y, Z data during the launch phase for missile flight safety control. A CW signal source is required on the missile and is usually provided by the RF telemetry transmitter. Each ELSSE system consists of a single baseline unit with a dual channel receiver, error sensing unit, a mechanical servo, and a strip chart recorder, a crossed baseline unit with associated dual channel receivers, error sensing units, mechanical servos, and elevation angle correcting analog computer circuitry. The system furnishes direction cosine information from which trajectory information is derived.

Table A-2

CINETHEODOLITE CHARACTERISTICS

Characteristics	KTH53 (Askania)	Contraves *
Number in Use	21	42
Frames/sec	5, 10, 20	5, 10, 20, 30
Film size (mm)	35	35
Frame size (width x height in inches	1.45 x .93	.93 x .60
Magazine (ft of film	170	500
Coded timing type	WSMR Askania	IRIG B
Instruments with aided tracking	20	42
Focal length (inches)	40-90	60-120
Tracking Rates (degrees/sec)		
Manual		
Aided	30 az & el	45 az & el

2 System Capabilities. ELSSE will operate with any stable radio frequency in the telemetry S-band; WSMR has two ELSSE systems.

3 System Features and Limitations.

a Features. This system is capable of displaying flight motion of a missile in real-time; hence, it is very valuable for the support of Range safety requirements.

b Limitations. ELSSE data is available only to the Range Safety Officer. The vehicle to be tracked must provide a stable radiation source in the S-band frequencies.

4 Planned System Improvement. No major system modernization is planned.

(d) Miss-Distance Indicator (MIDI) Radar.

1 Description. The MIDI Radar and Scoring System is a miss-distance measurement instrument which can score a wide class of surface-to-air weapons. The MIDI system provides a near real-time vector miss-distance measurement, including both distance and direction to the point of closest approach by individual missiles fired at aerial targets. Miss-distance measurement is obtained by use of a simple concept: The target is acquired and tracked by the radar and two additional gates are generated in close proximity to the tracking gate in order to detect a projectile or missile crossing the radar beam in the vicinity of the target. Target and missile off-boresight monopulse measurements, antenna encoder and readings, and tracking gate range from each detected projectile are recorded on magnetic tape. Upon conclusion of the firing test, the raw recorded data is processed by an independent program in the SPC-16/70 computer in order to derive scoring results for each firing test. Data from one test can be processed and listed in approximately six minutes.

2 Characteristics and Capabilities.

- Type - Instrumentation Pulse

- Operating Frequency - 9.6 to 9.9 GHz

- Transmitter
  - Peak Power - 750 kw
  - Pulse Repetition Frequency - 640/1280/2560 Hz
  - Pulse Width (nanoseconds) -30

- Receiver
  - Bandwidth - 40 MHz
  - Noise Figure - 8 db
  - Dynamic Range (linear) - 70 db

- Antenna
  - Gain (small dish)/Beam Width - 36 db/2.5°
  - Gain (large dish)/Beam Width - 42 db/1.25°
  - Polarization - Linear-Vertical

- o Tracking range on one square meter
  - Minimum - 200 meters
  - Maximum - 20 km

- o Tracking Accuracy Corrected
  - Angle Data - 1 mil
  - Range - 5 meters

- o Scoring capability on 0.3 square meter missile

  500-meter target range - 0.8 meter RMS
  1000-meter target range - 1.3 meter RMS
  2000-meter target range - 2.5 meter RMS
  4000-meter target range - 5.2 meter RMS
  6000-meter target range - 10.8 meter RMS
  9000-meter target range - 24.0 meter RMS

- o There is one MIDI radar in inventory.

(e) Radar Instrumentation (AN/FPS-16, AN/MPS-25, and AN/MPS-36. Description. WSMR tracking systems are high-precision, C-band pulse radars, operating in either skin or transponder tracking modes. WSMR has 11 AN/FPS-16, one AN/MPS-25, and six new AN/MPS-36 radars. These radars are the primary WSMR real-time instruments and provide the following information to the Range and its users:

- o Real-time and post-flight trajectory data

- o Special measurement data

- o Acquisition data to other data collection systems

Instrumentation radar locations are shown on Figure A-8. Two AN/FPS-16 sites are located at the Green river, Utah, launch facility (R-218, R-219). The one mobile AN/MPS-25 is used to support launch operations at Blanding, Utah, and other locations as required.

(f) Radar - Secondary Support

1 Description. There are three S-band radars used for either beacon or skin tracking. Primary use of these radars is to provide low accuracy measurements to Range users and acquisition data for FPS-16 radars and optical instruments. Associated with these radars (and the FPS-16 radars) is a radar chain system that receives, converts position coordinates, and distributes acquisition data.

2 Existing Capabilities. Characteristics and capabilities of these radars are shown in Table A-3.

Table A-3

CHARACTERISTICS AND CAPABILITIES OF SECONDARY SUPPORT RADARS

	MPS-19
Number	3
Transmitter power (kilowatts)	750
Frequency band	S
Antenna diameter (feet)	8
Antenna gain (dB)	35
Antenna feed	Mutating
Number operational	3
Age (years)	25 to 28
Accuracy	
Range (yards)	±25
Angle (mils)	±1
Coverage	
Range (miles)	200
Azimuth (mils)	6,400
Elevation (mils)	-20 to +1,580
Tracking rates	2,000 to
Range (yards/sec)	3,000
Azimuth (degrees/sec)	60
Elevation (degrees/sec)	30

3 System Features and Limitations. These radars provide low accuracy data and are difficult to maintain; however, they do aid in reducing the workload of the instrumentation radars on missions which have less severe tracking requirements. Older, less serviceable units are used for targets. These radars will be phased out of service when the AN/MPS-36 radars are operational.

(g) Velocimeter.

1 Description. The Velocimeter system consists of a microwave continuous wave transmitter and receiver. A transmitter, normally located directly behind the missile launcher, illuminates the missile. The reflected signal is compared to the transitted carrier, and the Doppler frequency is extracted at the receiver. Radial velocity of the target is then determined from the Doppler frequency.

Instrument Characteristics are:

Transmitter frequency	X-band
Transmitter power (maximum)	200 watts to 2 kW
Antenna beamwidth	1.8 deg (5 systems)
	9 to 15 deg (2 systems)
Receiver bandwidth	80 kHz (2 systems)
Receiver bandwidth	30 kHz (2 systems)
	300 kHz (3 systems)

The Range has two X-band velocimeters which are five years old.

2 Existing Capabilities. The existing velocimeters are located in the launch areas and provide the following information:

Velocity precision	±2 ft/sec
Angle precision (az & el)	±5 mils
Maximum velocity	15,000 ft/sec (3 systems)
	4,000 ft/sec (2 systems)
	1,500 ft/sec (2 systems)

b. Timing.

(1) Primary. The WSMR Timing System makes use of two reference sources: the U.S. Naval Observatory for reference to a point in time, and the National Bureau of Standards for frequency calibration of frequency standards.

The time reference maintained by the U.S. Naval Observatory is designated as Universal Time Coordinated (UTC) and it is to this standard that timing at WSMR is referenced. WSMR access to the time reference of the U.S. Naval Observatory is obtained through RF receiving equipment operating on the 100 kHz frequency of the Loran-C (LOng RAnge Navigation) system operated by the U.S. Coast Guard and controlled by the Observatory. The Loran-C system radiates a pulsed signal at a specific rate and at precise times with respect to UTC. The transmissions, controlled by a cesium beam oscillator, are highly accurate and stable, and are easily received at WSMR, thereby making this system the primary source for time synchronization.

The standard frequency broadcasts from the Natinal Bureau of Standards radio station, WWVL, at Fort Collins, Colorado, provide accurate and stable frequency standards upon which the WSMR timing system is dependent for time interval (frequency) accuracy and stability. The WWVL frequency is normally stable to better than two parts in 10" with day-to-day variations of less than one part in 10". The accuracy is controlled by the atomic frequency standards maintained by the Bureau, and the frequency offset is correlated with UTC as maintained by the Naval Observatory.

(a) WSMR Time Code Generators. Several types of time code generators and time code translator/generators are installed or otherwise at WSMR to provide range time signals. Considerations in the choice of a generator to meet requirements of a given situation include: reliability, accuracy, and stability; type and number of output signals desires; and size, weight, operating environment, and input power.

1 Master Time Code Generator. The time code generator (TCG) used at Uncle-2, the master station of the WSMR timing system, is an Astrodata Model 6600. For optimum reliability, the unit at Uncle-2 consists of three time code generators, all operated simultaneously, but with outputs in use from only one of the generators at a given time. If a failure should occur with the primary unit, automatic switching is provided for selection of the outputs of the second unit and manual selection of the third unit is available in case of further failure. Constant comparison of the outputs of the three units provides assurance of accuracy and stability.

2 Secondary Time Code Generators. Three WSMR timing stations, in addition to the master station, are currently classed as generating stations (using TCG's or time code translator/generator - TCT/G's - independent of a synchronizing input signal from Uncle-2). These stations are Uncle-36. at Green River, Utah, and two mobile timing vans: Uncle-38 and Uncle-39 used in remote areas, normally beyond the broadcast range of signals from Uncle-2. When located within the range of Uncle-2's signals, however, the TCT/G's in these vans may be synchronized by an input signal from Uncle-2. All three of these stations have RF receiving equipment for Loran-C and /or NBS broadcasts for correlation of signals generated independently of Uncle-2.

3 Secondary Timing Translators. A number of the timing stations (and many user stations) are equipped with time code translator/generators whose normal mode of operation is with a synchronizing input, either wire line or radio signal, from Uncle-2. At the present time, the timing stations considered to be in this classification are as follows:

Uncle-3	Uncle-35
Uncle-4	Uncle-44
Uncle-6	Uncle-45
Uncle-25	Uncle-46
Uncle-32	Uncle-51

The time code generators and time code translator/generators used in the above stations (as well as in the three stations in paragraph 2 above) consist of several different models manufactured by Astrodata and Datum.

Most user stations sending or receiving "real-time" pointing data are furnished an Astrodata 7555-112 Basic timing unit (BTU) and an ancillary time code translator/generator to provide the timing formats necessary for correlation of the pointing data, and in these cases, the BTU is provided with a synchronizing input signal from the timing system.

4 Airborne Time Code Generators. To satisfy the timing requirements of instrumentation carried in aircraft (or other airborne vehicles), an airborne time code generator service is operated by personnel of the WSMR timing system. This service, which is provided to aircraft operating from Holloman AFB, includes providing time code generators synchronized with the WSMR timing systems or, if the time code generator is provided by the user, providing synchronizing service.

Depending upon individual timing requirements, available power, and installation space in the vehicle, either an Astrodata Model 6190 or a time code generator manufactured by Electronic Company especially for airborne use (Model ZA 39200 or ZA 36750) is provided when the user requires an airborne time code generator.

Due to the fact that the controlling oscillators in the airborne TCG's are not as stable, comparatively, as the oscillators used in the ground-based system, small errors in time synchronization (drift) can thus be detected and, if necessary, interpolated to specific "event" times for data reduction purposes. The Uncle-60 van is equipped with its own time code translator/generator for use in synchronizing users, and to provde users with direct-writing oscillograph records. Radio receivers are also available for use in synchronizing with WSMR timing while away from home base.

(b) Generated timing formats. With the exception of one special-purpose time code (Askania timing) and certain minor deviations in modulation frequencies due to equipment considerations explained below, all time code formats generated and distributed by the WSMR timing systems are in conformance with IRIG Standard Time Formats contained in RCC/TCWG Document 104-70. IRIG formats available are: A, B, D, E, and H.

(2) Secondary. The timing signals distributed for use at WSMR are produced by two different categories of electronic "pulse generators." The first type consists of an ultra-stable oscillator (frequency standard) which drives a series of frequency dividers and binary or binary-coded-decimal coders which produce, respectively, uniformly repetitive pulse trains at various rates (at or below the oscillator frequency), and coded format pulse trains which yield standard time-of-day (STOD information).

The second category of "pulse generator" used by WSMR operates in the same general manner as a time code generator, and produces output signals in (approximate) synchronism with the phasing of the input signal. In case of loss of the input signal or failure of the output to compare in coded time information of phase with the input, an alarm sounds to alert the operator and the unit continues to operate from an internal oscillator until the input synchronizing signal is restored. When the input signal is restored, internal circuitry corrects for the accumulated time error. (This type of "pulse generator" which uses one input signal and "translates" to a variety of outputs is called a time code translator/generator (TCT/G) and, in some cases, can provide parallel outputs for use with computer systems.) The TCT/G may be used as a TCG by replacing the internal oscillator with an external frequency standard.

All instrumentation timing signals at WSMR originate with one of the two categories of generators: time code generators, or time code translators/generators.

c. Television.

(1) Description. Closed-circuit television (CCTV) system provide remote surveillance, instrument readout under hazardous conditions, and instrument aids. The majority of the systems are permanently installed in climatic chambers, propellant mixing areas, test stands, launch and impact areas. These facilities are provided and maintained by WSMR and operated by the Range users.

(2) Existing Capabilities.

(a) Eleven closed-circuit TV subsystems are boresight-mounted on the Range AN/FPS-16 radars.

(b) Seventy-four independent CCTV systems are maintained by NR-DO-TV for instrumentation support; 45 at fixed locations and 29 portable.

(c) Four mobile television vans, equipped with three camera systems, microwave receiver-transmitter units, and communications and switching equipment are available for range operation. These mobile units are completely independent for on-range, all-weather operations.

(d) A majority of the permanent television camera positions are equipped with pan, tilt, and zoom controls.

(3) System Features. These systems are generally reliable and require a low maintenance effort. Most of the obsolete equipment is being used in areas where picture quality is not critical.

(4) Planned System Improvements. Modernization of the television system will be limited to the periodic replacement of obsolete equipment with an emphasis on new equipment-mobility.

d. Photography.

(1) Motion Pictures.

(a) Telescope.

1 Description. A tracking telescope is a long focal length optical recording instrument. The telescope tube assembly, with photographic recording camera, is mounted to rotate about the elevation axis. Elevation axis support is facilitated by standards (up-rights) that are part of the telescope mount. The telescope mount permits azimuth rotation about and on the telescope base. An instrument pedestal supports the telescope base.

The tracking telescope system's primary purpose is to record attitude, event, intercept, and miss-distance data. In addition, this system supplements other range photographic instrumentation by providing engineering sequential and documentary data. Portions of the WSMR tracking telescope system are mobile providing greater flexibility in complying to operational requirements on and off the Range proper. Fifty-eight tracking telescopes with focal lengths ranging from 24 to 500 inches and capable of recording with 35mm and 70mm cameras are available. Fiducial mark references and range time are recorded on the film to provide data correlation.

Tracking telescope film (both color and black and white) is developed by WSMR film processing laboratories. Film is then delivered to Quality Control for evaluation and verification of instrument operation and data coverage provided.

Tracking telescope data is particularly valuable for diagnostic analysis of vehicle malfunctions. Project personnel utilize the film for sequential information and engineering analysis since it is time correlated and thus provides a very accurate history of the flight, detailing any difficulties encountered.

2 Existing Capabilities. The four types of telescopes with the number of each and average age are shown in Table A-5, Telescope Characteristics and Capabilities.

3 System Features and Limitations.

a Features. The WSMR tracking telescope system provides a permanent reusable record of attitude, miss-distance, event, and engineering sequential data. This being a passive range instrumentation system, a vehicle-borne tracking or acquisition aid is not required. Average instrument reliability is 0.84.

b Limitations. Relatively small field of coverage and lack of angular pointing acquisition information for the fixed telescope instruments.

4 Planned System Improvements. The major modernization effort planned for the telescope system is the replacement of the Intercept Ground Optical Recording (IGOR) system instruments by the DOAMS. This effort will improve the operational capability to support Range user requirements for attitude, event, and miss-distance information. New instrumentation will include optical systems with better light transmission characteristics, improved focusing and stability with longer usable focal length, improved tracking systems for one-man operation, and complete compatibility with the Range Digital Acquisition System.

(b) Fixed Cameras.

1 Description. Fixed cameras are utilized to photograph portions of a missile flight without tracking the vehicles. Data are recorded by point using firmly fixed camera axes so that the field of coverage will include trajectory segments of interest during operation. Target arrays placed in the field of coverage permit metric data reduction. In launch

phases, data such as angular velocity and acceleration in roll, pitch, and yaw planes, and the orientation and attitude of the vehicle are recorded. In addition, the action of the vehicle on the launcher and the reaction of the launcher and its effects on the vehicle performance are obtained. Engineering sequential information is vital when mission malfunctions occur during launch phases. Fixed cameras provide this information.

2 Existing Capabilities. The WSMR fixed camera system is employed at launch complexes, impact areas, and at strategic points along the vehicle's trajectory. The cameras are pre-oriented. Various cameras are used whose characteristics include framing and streak, pin-registered, fixed or projected fiducials with illuminated or available light exposures, selectable and/or variable frame rates, and a variety of interchangeable lenses. A summary of the characteristics and capabilities of fixed cameras is presented in Table A-6.

The accuracy of the WSMR fixed camera system is a function of the number and kind of cameras used, their location with respect to each other, and missile angular rates through the field-of-view.

Table A-5

TELESCOPE CHARACTERISTICS AND CAPABILITIES

DESCRIPTION	TETRA	MELMT	TRACKING MOUNT		VERSATILE SEXTANT	CINE
Optical System	Folded Baker Reflector Corrector	Modified Baker	Catadioptric	and Refractor	Refractor	
Diameter (in)	18	16	12-18			
Focal Length (inches)	82	115, 192, 350	50, 100, 180		48-100	
Camera Film Size (mm)	70	35, 70	35, 70	35, 70		
Frames/sec	0-60	10-200	5 to 2500	5 to 2500		
Tracking Rate (deg/sec)	20	30	90	90		
Type	Mobile	Mobile	Mobile	Mobile		
Number Operational	2	4	20	5		
Age (years)	11	5	6-9	11		

Table A-6

CHARACTERISTICS AND CAPABILITIES OF FIXED CAMERAS

DESCRIPTION	PIN REGISTERED (16mm)	ROTATING PRISM (16mm)	ROTATING PRISM (35mm)	ROTATING PRISM (70mm)	CONTINUOUS FLOW STREAK (35mm)	PIN REGISTERED (70mm)	PIN REGISTERED (35mm)
Number in use	10	25	84	74	9	71	96
Sample Rate (Frame/Sec)	5 to 400	150 to 11,000	250 to 2,500	90 to 360	Continuous up to 175	5 to 60	5 to 90
Focal Length (mm)	25 to 360	25 to 375	50 to 375	150 to 400		80 to 250	25 to 600
Average Age (years)	27	13	Up to 14	4	14	9	5

NOTE: The above does not include instruments at the high speed test track.

3 System Features and Limitations.

a Features. Average instrument reliability is 89 percent. A fixed camera system is passive and does not require on-board equipment. Most fixed cameras are portable requiring minimum time for positioning. A variety of cameras and lenses permits recording mission phases from several areas on and off the Range.

b Limitations. Accurately located target arrays are required to obtain metric data from film. Present turn-around time for film processing and reading is about 30 days.

4 Planned System Improvements. Modernization plans for the fixed camera system assume the successful development of a new instrumentation scheme to reduce the fixed camera support requirements in the near launch region of missile flight. Replacement of the older instruments is planned on a one-for-three basis over the next few years.

(2) Fixed Camera.

(a) General. Fixed camera instrumentation is used in the following areas of vehicle flight test:

- Trajectory Data - position, velocity, and acceleration (impact and ground target miss-distance).
- Attitude Data - yaw, pitch, roll, and roll rate.
- Engineering Event - single or multiple time correlated occurrences.

(b) Flight Segments Instrumented.

- Launch
- Boost
- Terminal
- Impact

(c) Length of Trajectory Coverage.

- Nominal - 0-300 feet slant range
- Extended - 0-1000 feet slant range
- Special - 0-5000 feet slant range

(d) Present System Capabilities. Operational reliability: 95-100 percent. This is the most reliable system at WSMR.

1 Data Accuracies Provided.

- o Trajectory - position data = ±0.1 to 1.0 ft
  velocity data = ±2.0 to 10 ft/sec
  acceleration = ±4.0 to 20 ft/sec

- o Attitude - pitch, yaw data = ±0.3 to 1 degree
  roll data = ±10 degrees
  roll rate data = ±30 degrees/sec

- o Events - single item = 0.0005 sec
  multiple item = 0.0001 sec

2 Additional Metric Support Items.

- o Image Motion Compensation Recording
- o Radar Antenna Boresight Recording
- o Radar PPI&A Scope Data Recording
- o Rocket Engine Plume IR Recording

(3) Attitude and Event Measurement (Optical).

(a) Distant Object Attitude Measurement System (DOAMS).

1 Description. DOAMS is a dual tracking telescope with focal lenghs of 2.5 and 5 meters equipped with photographic recording high speed 70mm cameras mounted to rotate about the elevation axis. The telescope mount permits azimuth rotation about the vertical axis of the telescope base and supports the operator's seat, console, and guide scope to permit manual and automatic tracking of moving targets. An instrument pedestal supports the base. The telescope's primary purpose is to record attitude, event, intercept and miss-distance data. In addition, this system supplements other range photographic instrumentation by providing engineering sequential and documentary data. In addition to the target, image time, azimuth and elevation angles, housekeeping data are recorded on film. The DOAMS replaces the outmoded, obsolete IGOR with an improved telescope system that provides shorter exposures and more precise event and miss-distance data.

2 Capabilites (Estimate).

a It is estimated that v-angle accuracies of ±5 degrees can be realized from medium-sized vehicles at a slant range of 150,000 feet.

b System data error estimates:

- o Pitch .8 - 4 degrees
- o Yaw .5 - 3 degrees
- o Roll 5 - 90 degrees

c Predicted system reliability. 90 percent.

d Estimated data delivery is 15 days.

3 Features and Limitations.

a Features. The DOAMS tracking and optical focusing system is slaved to the radar net. During a missile tracking mission, each of the camera systems is automatically turned on and off by a camera sequencer which also displays the range countdown.

b Limitations. Although DOAMS is not mobile, it is considered to be transportable and requiring only eight hours to prepare it from, or for, transportation.

4 Planned Improvement. Modernization plans for the DOAMS anticipate that film reading techniques and reading equipment will be improved in order to fully utilize the additional image information which the DOAMS will make available.

(b) Trajectory Measurements (Optical) Aided Laser Tracking System (ALTS).

1 Description. ALTS utilizes a Neodinium doped Yttrium Aluminate Garnet (YAG) laser-mounted above a van trailer and is capable of positioning any suitable augmented target within 65,000 feet. One system provides azimuth, elevation, and range data at sample rates up to 100 per second. A television camera on the tracking pedestal provides the operator with visual information. The operator, the control and recording equipment are housed in the van.

2 Capabilities (Estimate). a It is estimated that ALTS will have the following accuracies:

- Azimuth and elevation - ±0.1 MRAD

- Range - ±0.5 feet for ranges 700 to 5,000 feet; ±1.0 feet for ranges 5,000 to 30,000 feet; ±2.0 feet for ranges 30,000 to 65,000 feet.

b The ALTS records data on nine-track IBM compatible tape format. Two plotting boards are available for plotting data either in real-time or post mission. The video display may also be recorded.

3 Features and Limitations

a Features. The ALTS is capable of receiving and transmitting Precision Acquisition System data to Range Control Center. The ALTS is also capable of receiving radar XYZ data. The ALTS pedestal has a capability of mounting a light-weight camera system on the elevation trunion. The ALTS can operate alone at any prepared site, utilizing generator power and radio communications and timing.

b Limitations. The ALTS requires a prepared site consisting of a concrete pad for the instrument pedestal and a surveyed calibration target array.

(4) Still and Motion Picture Documentary Photography.

(a) WSMR maintains a complete still and motion picture photographic laboratory. The laboratory performs all photo-processing, prepares documentary and training films, reproduction work, and illustration services as required in documentary preparation.

(b) Photographic Processing. WSMR operates a film processing laboratory consisting of automatic and manual machines which process and reproduce film to raw output in black-and-white and color. The processing laboratory can process any black-and-white film, but only processes Eastman Kodak color film products using the E-4 an E-6 process. WSMR can process the following:

- 16mm, 35mm, and 70mm
- 5-1/2 inch up to 12 inch black-and-white film
- 16mm, 35mm, and 70mm color reversal film
- All sizes of ballistic camera plates
- Reproduce motion picture film in 16mm, 35mm, and 70mm sizes
- Reproduce and enlarge or reduce motion picture film from 16mm to 70mm

e. Instrumentation Calibration Capabilities. The Calibration Division at WSMR is part of the Quality Assurance Office (QA). This division has designed a calibration program to provide a single source of test and measuring instrument calibration, assuring that all test and measuring equipment will be maintained within prescribed specifications and tolerances. Quality assurance services are provided for all test and measuring instruments in use at WSMR and all associated and auxiliary testing laboratories. Primary and secondary standards are maintained for certification of test and measurement instruments. A calibration schedule has been established to periodically calibrate all instruments at optimum intervals to assure validity and integrity of WSMR test data. The WSMR calibration program also provides primary calibration services to Dugway, Fort Huachuca, Yuma Test Station, and NASA's Pueblo Depot on a reimbursible basis. The Calibration Laboratory establishes, maintains, derives, and disseminates parameters of national and international units of measure from standard instruments by reproducing natural constants or by use of derivation techniques in a wide range of parameters, values, and accuracies. The major categories of measurement capability required and available for temperature, mass, force, torque, pressure vibration, acceleration, acoustic, length, hardness, roughness, flatness, angle, luminuous and radiant intensity, spectral radiance, magnetism, electrical parameters (voltage, current, power, resistance capacitance, and inductance), dissipation factor, radio and microwave parameters (modulation, attenuation, phase, power, and impedance), and time and frequency.

f. General Instrumentation.

(1) Telemetry

(a) Introduction. The Whit Sands Missile Range Telemetry System is a complex of fixed and mobile or transportable telemetry facilities located strategically throughout the missile range proper and in certain off-range locations selected for optimum mission support.

The fixed station complex consists of the Telemetry Data Center (TDC), telemetry acquisition stations, data relay stations, recording stations, and data display facilities. In varying degrees, many of the stations provide combinations of these functions.

Mobile or transportable stations provide the functions of ground telemetry checkout, signal acquisiton, signal relay, and recording in varying degrees of functional combinations for each unit. These vans are relocated and operated as dictated by misison requirements.

Off-range telemetry support is provided by a chain of fixed data relay stations, extending from Green River, Utah, southward through parts of Colorado and New Mexico to WSMR. Mobile stations may be utilized in certain areas to supplement the off-range data relay chain, if required.

The WSMR-TMS is oriented towards complete support of systems conforming to standards contained in the Range Commander's Council Document,

Telemetry Standards; however, some equipment limitations will prevail until all procurement funding limitations are resolved.

The WSMR overall telemetry capabilites are listed in Table A-7.

(b) Telemetry Systems.

1 Telemetry Acquisition System. The Telemetry Acquisition system (TAS) is an L- and S-band RF signal Acquisition system and consists of a 24-foot parabolic reflector mounted on a tracking pedestal, preamplifiers, down-converters, and multicouplers. The antenna is fed by a 5-element, single-channel monopulse feed system. Right and left-hand circular polarization may be selected simultaneously. Various modes of operation are provided, including slaved, manual rate, and manual position. A sector scan mode with automatic transfer to automatic tracking is provided to simplify acquisition. A rate memory mode is available as back-up to maintain track under signal fade conditions.

Two telemetry stations on the range are equipped with the TAS. One station is located on the northern end of the range at Atom Peak in the Oscura Mountains (Jig-10). The other is located southeast of Alamogordo at Alamo Peak in the Sacramento Mountains (Jig-67).

2 Transportable Telemetry Acquisition System. The Transportable Telemetry Acquisition System (TTAS) is an L- and S-band RF signal acquisition system mounted on a 30-foot semi-trailer which may be moved to locations both on and off range in order to be in the most advantageous

tracking position to acquire a particular data phase; i.e., lift-off, mid-flight, or impact. It contains an on-board 60-kw diesel-driven generator, an operator enclosure with multi-rack console, and an 8-foot parabolic reflector with broad-band psuedo monopulse automatic tracking feed. Pre-amplifiers and multicouplers are included in the station equipment.

TTAS provides data acquisition simultaneously in both bands. Both right and left-hand circular polarization may be selected simultaneously. Operating modes include manual, stores memory, spiral scan, digital slave, synchro slave, optical slave, and automatic tracking with frequency and polarity diversity.

A TTAS unit is normally operated adjacent to, and in connection with, a TTARS mobile van which relays the received data to a fixed telemetry station, or may be used with a telemetry mobile ground station van which is equipped with recording and data read-out facilities. Seven TTAS units are presently in operation and additional units are under procurement.

3 Transportable Automatic Tracking System (TEL TRAC). TEL TRAC is a trailer-mounted automatic tracking system manufactured by Canoga Corporation. The system operated in the L- and S-bands and has a relatively with beamwidth to enable semi-automatic acquistion of a target over a wide region in space. Target vehicles may be tracked from launch at angular acceleration rates in excess of 40 degrees per second^2. TEL TRAC consists of a 6-foot parabolic antenna with manual, automatic, and slave control modes; S- and L-band preamplifiers; S- and P-band down-converter; and telemetry receiver. This system outputs the received signal to a fixed station, TMV, TSPV, or TTARS in an adjacent location for further distributin.

4 Telemetry Acquisition and Relay System. Telemetry Acquisition and Relay System (TARS), a major subsystem of the WSMR-TMS, is a high-reliability frequency diversity microwave system used for relaying telemetry data. The TARS provides facilities for accepting data from receiving subsystems, multiplexing the data into a microwave baseband, and relaying the data either to demultiplex and recording stations or to the Telemetry Data Center by means of the microwave RF system. The system is configured so that either manual or automatic selection of any of up to eight acquisitions sources may be made.

The main TARS complex, located in the New Mexico portion of the missile range, consists of three fixed acquisition/relay stations (Jig-10, Jig-56, and Jig-67), plus the Telemetry Data Center. TTARS augments the system by relaying data from any area of the range to the fixed stations for insertion into the TARS.

The TARS consists not only of microwave and multiplex equipment for relaying of telemetry data, but also includes subsystems for the remote control of telemetry equipment (from Jig-56) in the remote stations, and equipment for processing and recording telemetry data, such as commutators, decommutators, voltage-controlled oscillators, data discriminators, and direct write and magnetic tape recorders.

Table A-7
WSMR TELEMETRY CAPABILITIES

Frequency Coverage	
P-band	215-260 MHz
L-band	1,435-1,540 MHz
S-band	2,200-2,300 MHz
Demultiplexing and Decommunication Formats	
Frequency Fivision	FM proportional bandwidth FM constant bandwidth
Time Division	PAM PDM PCM
Combinations	PAM/FM, PAM/FM/FM PDM/FM, PDM/FM/FM PCM/FM, PCM/FM/FM
Recording Capabilities	
Pre-detection magnetic tape recording	Center frequencies: 225, 450, and 900 MHz
Analog magnetic tape recording	Single or multiple station flight coverage
Digital magnetic tape recording	Packing density: 556-1, 600 bits/inch
Quick-look records	Direct write and oscillograph recorders
Real-time display	Analog meters Digital Lights Printers
Processing	
Data is edited, normalized and scaled	Rate: up to 50 K samples/sec linearized,
Date is time tagged	Resolution: 10^{-4} sec
Tapes formatted	7-track and 9-track tapes
Special processing	Rate: commensurate with number of samples and processing required
Standard data product outputs	Refer to Appendix

5 Transportable Telemetry Acquisition and Relay System (TTARS). This system is a subsystem of the TARS and consists of five mobile units used in conjunction with the n-range, fixed TARS stations (Jig-10, Jig-56 and Jig-67). Once the units are positioned in the locations selected for optimum mission support and the microwave paths established with the fixed TARS station, the TTARS stations become a working part of the TARS.

Each TTARS has identical mission support capabilities and can receive telemetry data in the L- and S-bands. Each unit can relay up to eight 500-kHz data channels or five 1.5 MHz data channels.

6 Telemetry Mobile Ground Station Vans (TMV). The Telemetry Mobile Ground Station Van system currently consists of five transportable semi-vans (Jig-26, Jig-27, Jig-29, Jig-30, and Jig-66) which may be moved to runways, launch areas, buildings, taxi-ways, or wherever they may be required for telemetry ground tests or flight support. The telemetry test may be conducted as "closed-loop" tests, using co-axial cable for minimum radiation, or they may be radiated tests. These vans are equipped with a low-gain (11 dB) antenna for use when tracking is not required, allowing the TMV to operate independently of other systems.

Ground stations and recording equipment varies in the vans but, in general, the vans are equipped with complete FM/FM ground stations and PAM/PDM and PCM decommutation systems. PAM and PDM capacity is 10K pps and all NRZ codes of PCM are provided to one megabit per second. Digital outputs, as well as analog, are available. PAM/FM, PDM/FM, and PCM/FM recording on magnetic tape is accomplished with predetection conversion at frequencies of 225, 450, and 900 kHz.

Any one of the TMV's may be used in connection with a data display facility providing up to 48 channels of data for display.

7 Special Purpose Systems. Three special purpose systems, making up portions of the overall WSMR telemetry system, are described below.

a Data Display Facilities. In addition to the main Telemetry Data Center data display facilities located in the WSMR Range Control Center, two other data display facilities are available. One (Oboe-56) is located in the central range area at the King-1 radar building.

Although the capacity and complexity of these two data display facilities are not the same, each serves the purpose of providing the user with a visual display (meters, lights, and/or analog recorders) of telemetered data parameters in real-time. Oboe-56 is currently supplied data via the DCDP Microwave System from Jig-67, or by two TMV's which can be located outside the northwest area of the King-1 building. Oboe-61 at Green River is operated in connection with Jig-68.

b Telemetry Special Purpose Van (TSPV). Two Telemetry Special Purpose Vans (Jig-23 and Jig-38) are currently in service to provide data coverage from remote areas, both on and off range. Each is a self-propelled van, equipped for signal acquisition in the P-band. When used in conjunction with a TTAS or with a TMTS, each can also support missions in L- and S-bands.

c Transportable Manual Tracking System (TMTS). The Transportable Manual Tracking System (TMTS) is an L- and S-band antenna system that can be transported to a fixed or mobile station, set up, and operated in connection with the station's receivers to provide L- and S-band signal acquisition. Seven of these units are in use. Each unit is similar and consists of a manually operated antenna mount with L- and S-band antennas, preamplifier, and multicoupler. Where performance specifications vary slightly between two different commercial suppliers of these systems, both have been included below.

(c) Telemetry Stations - Fixed.

1 Station: Telemetry Data Center (TDC) at Range Control Center, WSMR Building 300. This facility is a high-speed information conditioning and processing station consisting of components, assemblies, and subsystems providing the general functions and capabilities to condition, demultiplex, digitize, identify, and time-tag telemetry data in a real-time and deferred-time environment. The TDC can convert frequency and time multiplexed telemetry data to formats suitable for digital processing and recording, analog display and recording, and transmission to remote processing facilities.

All converted data, time-tagged to a resolution 10^{-4} seconds, may be recorded on magnetic tape while selected data is also routed for display and/or computer processing. The capabilities of the TDC permit telemetry data to be normalized, edited, scaled, linearized, and formatted at a maximum aggregate data rate of 50,000 samples per second.

2 Station: Jig 10, Acquisition, Relay and Recording Station at Atom Peak. Direct signal-receiving capability is P-band, L-band, and S-band. Relayed signals are recieved via microwave from a TTARS or via 600 MHz relay from Jig-61 at Mt. Taylor. The received RF signals can be relayed via the TARS microwve to Jig-56. This station can also receive and record on tape or relay to Fig-56/TDC command-control transmissions.

Composite telemetry data can be recorded on magnetic tape in analog form with a maximum of two MHz frequency response. Predetection recording is available at 225 kHz, or 900 kHz.

3 Station: Jig-56, Acquisition, Relay, and Recording Station at Dry Site (Elevation 4,099 ft). Direct signal receiving capability is P-, L-, and S-bands. Relayed signals are received via TARS microwave from Jig-10 and Jig-67, and/or from TTARS. A maximum of eight channels at 500 kHz bandwidth, or five channels at 1500 kHz, or a combination of above channels can be received from both Jig-10 and Jig-67. A maximum of 16 channels at 500 kHz bandwidth, of 10 channels at 1500 kHz can be relayed to the Telemetry Data Center. Jig-56 can receive and decode and/or record on tape.

Composite telemetry data can be recorded on magnetic tape in analog form with a maximum of 2 MHz frequency response. Predetetion recording is available at 225, 450, or 900 kHz. Signal strength from the fixed TARS stations and TTARS vans can be recorded on magnetic tape and/or direct write recorders.

4 Station: Jig-67, Acquisition, Relay, and recording at Station Alamo Peak. Direct signal receiving capability is P-band, L-band, and S-band. Relayed signals are received via TARS microwave from Jig-10 at Atom Peak and/or from TTARS. Either direct or relayed signals can be transmitted via the DCDP microwave link to Oboe-56 in the King-1 building for display and/or via the TARS to Jig-56/TDC.

Composite telemetry data can be recorded on magnetic tape in analog form with a maximum of 2 MHz frequency response. Predetection is available at 225, 450, or 900 kHz.

5 Station: Obeo-56, Data Display Facility at Rooms 113 and 115, and Plotting Room Floor in King-1 Radar Building, Central Range Area. Input data is received from Jig-67 via the DCDP microwave link, and/or by means of 96 data wire lines from one or two TMV's outside the King-1 building. Data received can be displayed and recorded on direct write recorders and oscillograph recorders or can be displayed on meters and/or lights.

TDC real-time data can be remotely displayed on Oboe-56 via the RDDA system as required by range users and/or range safety personnel.

(d) Telemetry Stations - Mobile

1 Station: Transportable Telemetry Acquisition and Relay System (TTARS) Unit. Receiving capability in S- and L-band when used in conjunction with a TTAS or TMTS. The telemetry data received are relayed to a fixed TARS station (Jig-10, Jig-56, or Jig-67) for further distribution.

2 Station: Jig-23, Telemetry Special Purpose Van. Direct signal receiving capability is P-band, only. S- and L-bands can be acquired from TTAS or TMTS. Composite telemetry data can be recorded on magnetic tape in analog form with a maximum frequency response of 100 kHz. The composite FM/FM telemetry data can be separated and displayed in real-time on direct write recorders and/or oscillograph recorder. This station may be used for missile checkouts or telemetry ground checks.

3 Station: Jig-26, Jig-27, Jig-29, Jig-30, J-66 (TMV), Mobile Acquisition and Recording Van. Direct signal receiving capability is P-, L-, and S-bands. Composite telemetry data received can be recorded on magnetic tape in analog form with a frequency response of 1.5 MHz. This station has predetection capabilites of 225, 450, and 900 kHz. The composite PAM/PDM, PCM/FM, and/or FM/FM data can be separated and displayed in real-time on direct write recorders and oscillograph recorders and/or displayed in a data display facility. This station may be used for missile checkout or telemetry ground checks.

4 Station: Jig-28, Telemetry Special Purpose Van. Direct signal receiving capability is P-band, only. S- and L-band can be acquired from TTAS or TMTS. Composite telemetry signal received can be recorded on magnetic tape with a maximum frequency response of 100 kHz. The composite PAM/PDM/FM and/or FM/FM telemetry data can be separated and displayed in real-time at a data display facility. This station may be used for missile telemetry checkout or telemetry ground checks.

(2) Meteorological Systems Support. Although not a part of the WSMR program as outlined in DA Project 1-U-265302-D-240, meteorological support is absolutely essential in both Range test activities and considerations for Range modernization.

Meteorological data, consisting of both surface and upper air observations of existing atmospheric conditions, are provided at places and times as required by using agencies. Meteorological satellite photographic data is also available. A network of 11 major permanent observational sites and numerous special-use sites are maintained on-Range to ensure that the optimum timely support may be provided. In addition, a major surface and upper air observational facility is maintained at the WSMR Test Complex, Green River, Utah, in support of the ABRES-ATHENA Program. Three mobile units are available, each capable of providing full-scale meteorological observations at such off-Range locations as may be required. These mobile units have provided data from such diverse locations as Del Rio, Texas; Amarillo, Texas; Carlsbad, New Mexico; Fort Wingate, New Mexico; and Blanding, Utah.

Conventional upper air observational methods are normally restricted to the levels from the surface of the earth to about 125,000 feet above sea level due to inherent limitations of ballons used for this purpose. In order to provide meteorological data from about 125,000 feet MSL to about 250,000 MSL, meteorological rockets are utilized. These rockets are fired from three areas on WSMR (at Small Missile Range, Zurf Site, and the Army Blockhouse) and Green River, Utah.

(a) Atmospheric Sciences Laboratory. The Atmospheric Sciences Laboratory (ASL), an element of the Electronics Command, has the responsibility for providing meteorological support services and Sonic Observation of Trajectory and Impact of Missiles (SOTIM) data for Department of Defense, NASA, DNA, and other activities in all geographic areas of WSMR operations.

The Atmospheric Sciences Laboratory also has the responsibility of providing the necessary research and development in order to assure that its meteorological service technical area provides the most precise and accurate meteorological support possible consistent with requirements.

(b) Other. All forecasting, impact predictions, and climatological activities are performed or supervised by highly trained experienced professional civilian meteorologists. Data collection is performed by highly trained and experienced military, civil service, and contractor personnel.

1 Forecasting. A complete forecasting facility is maintained at WSMR that provides routine general service forecasts, upper air forecasts, special forecasts as required by Range users, and severe weather warnings of conditions potentially hazardous to life, property, or to Range missions. A special forecast office is maintained at Holloman Air Development Center to provide liaison with Air Force projects and to provide a highly specialized

trajectory forecast service in support of the Air Force Cambridge Research Laboratory's Balloon Branch. A forecasting facility is maintained at Green River Launch Site, Green River, Utah, to provide full-scale forecasting service to the ABRES-ATHENA program.

2 Impact Prediction. An impact prediction service utilizes the aerodynamic characteristics of various types of missiles and the atmospheric conditions existing prior to launch to determine launching elevation and azimuth angles required to attain missile and booster trajectories, space points, vector velocities, and impacts in desired locations. This service, performed by ballistic meteorologists highly trained for this specialized function, is provided at launch locations as required to assure safe impact of missiles and boosters and successful accomplishment of research missile flights. Ballistic meteorologists are also assigned to Green River Launch Site, Green River, Utah, in support of the ABRES-ATHENA program. In addition to the manual impact prediction techniques, Automatic Rocket Impact Predictors (ARIP) real-time computer techniques to assist in providing the optimum accuracy of impact prediction.

3 Climatology. The many years of meteorological records for WSMR are utilized in the preparation of comprehensive climatological studies of atmospheric conditions over the Range. These units are tailored to the specific requirements of the Range users and provide a reliable base for long-range planning of Range activities.

(3) The Geodetic System at the White Sands Missile Range. The Geodetic System at White Sands Missile Range consists of many subsystems composed of Control Networks, Instrumentation Location and Orientation Surveys, Coordinate Systems and Survey Datums. The Geodetic System locates and orients Range launch points, impact points and instrumentation sites/stations with respect to the reference spheroid and local coordinate systems. The present overall system has evolved over a period of years during which the mission of the Range has changed and expanded. The WSMR geodetic function was assigned in 1964 to the U.S. Department of Commerce, Environmental Science Services Administration, Coast and Geodetic Survey (USC&GS), and was reassigned to the U.S. Army Topographic Command (TOPOCOM), Corps of Engineers in March 1969. On 1 July 1972, this agency became the Defense Mapping Agency, Topographic Center (DMATC).

(a) Geodetic Control Network. Since 1969, the DMATC geodetic personnel have observed 42 new baselines and have reobserved 24 old geodimeter baselines (most of them with the laser-type geodimeter), the majority of these lines being part of the precise geodimeter traverses. Some previously observed horizontal angles and astronomic azimuths were reobserved. A readjustment of 155 primary geodetic control stations, incorporating 151 geodimeter baselines and 45 astronomically observed azimuths, has been executed yielding an accuracy of about one part in 1,000,000 for these primary stations. The origin for this adjustment is the NAD 1927 position of station ED-50. The new datum is called White Sands Datum 1973, abbreviated WSD-73 (NAD). In 1972, the Green River and Blanding, Utah, launch complexes were connected with the White Sands Missile Range Control system through a precise geodimeter traverse.

(b) Geoid Height Adjustment. The number of stations adjusted simultaneously was 339, with one station (using for it an interpolated value from the NOS geoid map of New Mexico) held fixed. The standard error of the adjustment (one sigma) is ± 0.012 meter. The average one sigma error for an adjusted station is ± 0.016 meter. The remaining 74 stations were adjusted by holding geoid heights of the main adjustment fixed.

(4) Frequency Management.

(a) Description. The Frequency Management Activity is a division of the U.S. Army Communications Command and is composed of frequency surveillance, evaluation, and radiation analysis facilities. This activity controls the use of all radio frequencies utilized at WSMR and all radio frequencies assigned to WSMR for use by WSMR based projects. Frequency assignments are made through the Frequency Management Activity and the DOD Area Frequency Coordinator. Frequency scheduling is performed on a daily basis at Range Operations. All frequencies used in connection with missile or static firing missions are monitored, and the spectrum utilization of transmitters, receivers, antennas, and other electromagnetic propagation phenomena are analyzed.

1 Control. Processes allocation and assignment requests. Performs susceptibility and spectrum conservation studies on new or planned systems. Compiles and maintains frequency records and listings.

2 Analysis. Establishes and develops interference tolerances; interference prevention or reduction programs; identifies distances from emitters at which radiation hazards exist.

3 Surveillance. Provides fixed and mobile frequency surveillance, throughout the entire state of New Mexico, all other U.S. territory within a 150-mile radium of Headquarters, WSMR, and portions of Colorado and Utah. Furnishes operational electronics countermeasures control and resolution of interference problems.

(b) Existing Capabilities

o Fixed and mobile frequency surveillance stations

o Recording media - magnetic tape, paper tape strip chart, X-Y plotter and oscillograph camera

o Frequency range of antenna analysis and pattern range - 200 MHz - 40 GHz

o Laboratory test facilities for complete MIL STD EMC analysis of communications-electronics equipment

(c) System Features

o Multiple signal frequency control and analysis capability is achieved by use of wide-band and narrow-band receivers; systems scan automatically, have memory, and provide readouts.

o Dispersion and mobility of frequency surveillance stations make use of space diversity and also provide rapid location of interference signals.

o Laboratory MIL STD tests permit EMC analysis and the determination of equipment spectrum utilization before approval for use at WSMR.

o Antenna analysis facilities provide pattern and gain data for range user equipment (as required), instrumentation, and frequency surveillance antennas.

(5) Visibility. The standard weather visibility observations are available from the ASC Met Team.

(6) Sound Measurement and Analysis. None.

(7) Missile Flight Surveillance. The requirements for a Flight Termination System (FTS) depend upon vehicle size, performance, flight pattern and, foremost, if it has the capability to exceed WSMR range boundaries from the launcher point. In general, vehicles that hve no capability to leave the range boundaries can be tested at WSMR without an FTS. However, specific test objectives (data gathering, test operations) may dictate that evacuations and roadblocks are not adequate to protect Range facilities and/or personnel in which case an FTS, be it range limiting via timer or uplink, may be required.

(8) Soil Conditions. None.

g. Special Purpose Instrumentation

(1) Ballistic Data

(a) Description. Ballistic cameras are rigidly mounted, wide-field, fixed-plate cameras used to obtain quantitative data for the computation of ballistic trajectories, calibration of other measuring systems, and for meeting stringent position measurement requirements that cannot be met by other measurement systems.

Position data are derived from measurement of star and target position on camera plates form two or more stations. Ballistic camera characteristics are shown in Table A-9.

(b) System Features and Limitations. The ballistic camera system is the most accuratew position measuring system available. Individual ballistic camera mission turnaround time is three minutes.

(2) Vega Command Control System.

(a) Description. The Vega Command control System at WSMR is presently used to command and control QF-86E, QF-1C2, and PQM-102 target drones. The system consists of a Fixed Ground Station (FGS) controlled from the King 1 complex, and a mobile ground station for runway use. The Fixed Ground Station is designed to use existing instrumentation radars to provide the command and data link between the FGS control console and the target drones. The transmission of commands to the target is accomplished by generating commands (pulses) at the console, which are transmitted to and combined with the normal interrogation pulses of the radar. The information is encoded in a pulse-position-coded (PPC) format where pulse spacing conveys command information. The FGS commands are transmitted in the frequency band assigned to the Range AN/FPS-16 and MPS-36 radars. The radars presently used with the WSMR system are R-122/123 for mid-Range support and R-114/395 for south Range support.

The mobile command control facility is utilized for drone take-off and landing operations. The mobile system will hand off control or assume control of the drone from instrumentatin radars when the drone is airborne and visible to both.

(b) Capabilities. The WSMR Vega Target Command Control System is presently used to command, control, and gather data (telemetry and range) from QF-86E, QF-102, and PQM-102 drones. The system is capable of encoding, transmitting, and decoding both proportional and discrete commands. In response to the proper command, a range reply and data are returned to the instrumentation radar. The range reply pulse is generated by the transponder independently of the encoder and will always be generated even when the encoder fails. The system's range, azimuth, and elevation data are limited only by the accuracy of the radar used for mission support.

(c) Features and Limitations.

1 Features. The control console utilized with the FGS has two controller positions and is capable of commanding any two of four radars assigned to it. One control position is designated as the primary control position while the second position serves as a backup. By utilizing the two control positions, it is possible to fly two drones simultaneously without a backup capability.

2 Limitations. The number, location, and accuracy of instrumentation radars used to interface with the Vega system, coupled with the availability of communications facilities, will determine the system usefulness.

(d) Planned Improvements. Modernization plans for the Vega Command Control System include:

1 Addition of a sub-scale drone control console for installation in Building 300. The proposed sub-scale console will control BQM-34A, MQM-34D&F, and MQM-107 drones and will interface with existing instrumentation radars at R-114/395 and R-122/123.

2 The sub-scale control console will be made to interface with the four radars in 4A and will be modified to provide for flying any two of the drones simultaneously.

3 North Range (R-127/128) and south Range (2 ea., AN/MPS-36) radars will be provided Vega system radar interface kits.

4 The sub-scale control console will be adapted to QF-86E control.

Table A-9

BALLISTIC CAMERA CHARACTERISTICS AND CAPABILITIES

CHARACTERISTICS & CAPABILITIES	BC-4	ASTRO MK II
Format size (inches)	7-1/4 x 7-1/4	8 x 10
Lens focal length	115mm (2 infrared, 2 visible light)	7-12 inches
	210mm (2 infrared, 2 visible light)	
Samples/sec	2-20 or dependent on beacon rate	Depends on light source
Portability	8 Fixed, 4 Portable	Portable
Number	17	6
Age (years)	15	17

(3) Drone Formation Control System (DFCS).

(a) Description. The DFCS provides close formation or independent guidance, control, and navigation for up to six drones and tracking capability for up to four additional aircraft. The system utilizes a network of ground stations and drone airborne equipment to provide position location by combining DME trilateration techniques with altimeter data. A single RF frequency is used in a time share sequence to transmit command and control data to the drones, receive drone telemetry data, and accomplish the DME function. A large central computer is used to derive position, generate control commands, and service the displays and manual flight control consoles. Flight control is manual by pilots at the consoles or automatic by the central computer using a control law to derive along track, cross track, and altitude correction commands to maintain flight along the required preprogrammed pattern.

(b) Capabilities.

1 The DFCS can control up to six drones in close formations, multiple formations on independent patterns, or nonformation independent flight patterns over WSMR. Flight control is manual from the DFCS consoles or automatically controlled by the DFCS computer for launch, rendezvous, formation assembly, formation flight and recovery. The DFCS is operational for the BQM-34 and the QF/PQM-102 drones. For the QF/PQM-102 drones, both the DFCS and the Vega Control System (VCS) are used. DFCS is the primary flight control system for formation assembly and flight and the VCS is used for take-off/landing phases.

2 System performance estimates are based on typical drone presentation corridors for the BQM-34 and QF/PQM-102 drones.

RMS Tracking Accuracy	25 ft, XY
	50 ft, Z
Control Accuracy	50 ft, XYZ
Altitude AGL	200 ft to 60,000 ft
Coverage XY	Lower 2/3 of WSMR
Formation Slant Range Spacing	-200 ft to 3 miles

(c) Features and Limitations.

1 Features. DFCS is an integrated tracking, command, and telemetry system and operates essentially independent from other WSMR systems, drone escape maneuvers and automatic collision avoidance capabilities are included. Console displays include fixed map background, moving map background, two dimensional split screen, and drone flight data. A simulator is included for system testing and flight planning.

2 Limitations. Tracking accuracy is a function of geometry and quality of altimeter calibration. Control accuracy is a function of weather conditions, drone capability, control law accuracy, and tracking data. A two-drone simultaneous flight capability is available for QF/PQM-102, six drone for BQM-34S, or any combination of two QF/PQM-102 and up to four BQM-34S drones. DFCS airborne equipment is not dual redundant on the QF/PQM-102 drones and no take-off/landing capability is included; therfore,

the Vega Control System is used in conjunction with DFCS.

(d) Planned Improvements. Only nine airborne subsystems were procured with the system and unit cost is unacceptable.

The system will be modified for QF-86 and VSTT flight control when user forecasts dictate a firm requirement.

(4) Environmental Test Facilities.

(a) Environmental (Climatic). The following chambers of equipment are available for use.

o 10 high-temperature chambers varying in size up to 70' x 20' x 20' and providing temperatures up to 250°F.

o Six low-temperature chambers varying in size up to 69' x 23' x 16' and providing temperatures down to -100°F.

o One 4' x 4' x 4' dust chamber, +70° to 170°F, 200 to 1,750 fpm wind.

o Five humidity chambers varying in size up to 70' x 20' x 20' and providing relative humidities from 35°F dewpoint to 100 percent relative humidity.

o Three solt fog chambers varying in size up to 70' x 20' x 20'.

o One altitude chamber 6' x 6' x 6' providing altitude equivalents to 200,000 feet.

o Solar radiation banks (20' x 4' x 8' max speciman size) yielding 100 to 370 BTU/ft^2/hr.

o Two rain chambers varying in size upt o 70' x 20' x 20' with rain rates up to 27"/hr.

o Two freezing rain chambers, 25' x 10' x 10' and 11' x 10' x 8', with rain rates of 1"/hr and 2"/hr, respectively. Several of the above conditions may be impsed simultaneously.

o Two portable wind machines, velocities from 25 mph to 60 mph 25 feet from propeller.

o Four portable temperature conditioning shrouds varying in size up to 60 x 16 x 16. Used with portable mechanical field conditioning units.

o Five portable mechanical field conditioning units on semi-trailers provides up to 15-ton refrigeration at -65°F air temperature and 1750 BTU/min heating for portable temperature conditioning shroads.

(b) Environmental (Dynamic). The following equipment is available for use.

o Vibration exciters of both electrodynamic and hydraulic types offering peak forces of from 50 pounds to 60,000 pounds at frequencies from 5 Hz to 3 kHz.

o Shock test machines accepting items up to 4,500 pounds with one dimension less thant 5' and providing up to 10,000 G's for a 50-pound package and up to 200 G's for a 4,500-pound test speciman.

o One centrifuge, 100-inch, is available for acceleration tests, the larger providing two 300-pound item with 100 G's.

o A high intensity noise facility equipped with a reverberant noise chamber provides a maximum of 164 db with the range of 75 to 9 kHz.

o Static and aerodynamic loading and heating equipment producing up to 5,000 pounds of force and 400°F temperature.

(5) Vehicle Performance. None.

(6) Chemical, Microbiological, Metallurgical, and Electromagnetic.

(a) Chemical. The chemistry test facility has an extensive instrumentation including gas chromotographs, spectro-photometers, emission spectrograph, polarograph, X-ray defraction, X-ray spectrograph, mass spectrometer, neutron activation analysis. The facility also includes a clean room and ultrasonic cleaning capabilities.

(b) Biological. ARMTE has developed a well-equipped microbiology laboratory to evaluate biodeterioration of missiles and associated equipment. The test facilities include the largets microbiological chamber in the United States, 30-feet long, 20-feet wide, and 15-feet high, and can simulate the three major tropical environments.

A tropical greenhouse, 20-feet long, 12-feet wide, and 8-feet high, is employed for tropical exposure and test methodology studies.

Test facilities for component testing include a fungus chamber, 3' x 2' x 2' and fungus chamber 3' x 3' x 6', used to test live missiles and hazardous test items.

(c) Metallurgy Laboratory. The instrumentation and capabilities of the metallurgy laboratory cover a broad spectrum of metallurgy. Areas of primary capability include nondestructive testing, metallography, corrosion analysis and corrosion control, heat treating and material failure analysis.

Nondestructive testing equipment consists of fixed and portable industrial radiographic machines, up to 300 KVP, Cobalt-60 radiographic isotope, ultrasonic flow detector, magnetic particle inspection unit and eddy current inspection unit.

Metallographic equipment consists of two metallurgical microscopes, one with photographic capabilities, and a transmission electron microscope.

Support equipment includes hardness testers, fixed and portable, a macrophotographic unit, heat treatment furnace, photgraphic dark room with automatic industrial X-ray processor, stereo-microscope and metallographic specimen preparation equipment.

(d) Electromagnetic.

1 The Electromagnetic Radiation Effects (EMRE) facility includes at present five testing areas, seven transmitter shelters, and space for attendant labs and offices. Testing must be done outdoors, exposed to the weather. The following items are installed and available for ranges shown.

o (ET-1) 3 MHz-30 MHz. Continental-Electronics Model 617B. Power output is available to 50,000 watts. This transmitter is used with a single vertical antenna with a matching unit on a ground plane. Field intensities vary from 10 V/m at 330 feet (1 wave length at 3 MHz) to 100 V/m at 50 feet.

o 100 kHz-4 MHz. General Electric EMRT-1. Power output up to 50 kw is available. Field intensities in excess of 100 V/m can be generated.

o 100 MHz-500 MHz. General electric Model EMRT-2. The power output is 20,000 watts. Field intensities of 100 V/m have been obtained at 50 feet.

o 1 GHz-2.7 GHz. Field intensity of 10 MW/square centimeter.

o 1 GHz-18 GHz. The power output of this transmitter is on the order of 100 watts.

o 30 Kilovolt, 5 milliamperes. Power supply. This equipment is capable, with ancillary equipment, of simulating the electrostatic charge on a human being.

o 380 MHz-10.4 GHz. WSMR-built magnetron with power varying from 165 to 400 watts. Field size varies from 8 to 16 feet in diameter with effective field intensities (at various distances) from 30 V/m to more than 100 V/m.

o 10 kHz-220 MHz. Sewwp generators, 1 kw output, effective field 20 V/m at 1m from antenna.

o 0.5 GHz-1 GHz. 4 kw output transmitter developing field intensities of 200 V/m at 50 feet from the antenna.

o Helicopter electrostatic simulator. 500,000 volts across 1,800 picofarad capacitance, simulates discharge of electrostatic energy which may be developed on a helicopter.

2 Nuclear Effects. The following list describes the facilities with associated capabilities for test of nuclear effects on missile systems and related materiel.

a Fast Burst Reactor (FBR). The Fast Burst Reactor produces a fission spectrum of combined neutrons and gammas and simulates the initial radiation of nuclear weapon environments. Table A-10 shows the burst and steady-state performance characteristics of the FBR. The neutron spectrum of the FBR is a slightly degraded fission spectrum. The ratio of the neutron tissue dose to gamma tissue does is about nine to one. With proper shielding arrangements the neutron to gamma dose ratio may be varied over a wide range. The reactor pulsewidth may also be varied from about 40 usec to greater than 1 msec. The fast burst reactor is located in a 50-foot square by 20-foot high concrete shielded exposure cell. The fast burst reactor can be operated at an outdoor site, thereby enabling the testing of very large items of equipment and the reduction of neutron room scattering. There are no features such as trees, hills, etc., of the surrounding terrain that limit the utility of the outdoor site.

b Linear Electron Accelerator (LINAC). The Gamma LINAC is a 48 meV linear electron accelerator which is used to simulate the gamma radiation from a nuclear explosion. It provides a source of single intense pulses of high-energy electromagnetic radiation of short time durations. Bremsstrahlung radiation (high-energy photons of electromagnetic radiation) is produced by the electron beam bombardment of an external target made of high-density material; i.e., platinum. The Gamma LINAC provides electromagnetic pulses variable in width from 10 nanoseconds to 10 microseconds. The LINAC may be single pulsed or pulsed at a rate of 10, 20, 30, 60, or 120 per second. See Table A-11.

c Steady-State Neutron Generator. The Steady-State Neutron Generator (SNG) can be used to produce monenergetic neutrons of either 14 or 2.6 MeV by use of tritium of deuterium targets. Facilities are available to allow use of thermal neutron irradiations. The reactions involved are the same as described for PNG. Characteristics of the SNG are listed below.

Steady State Mode

	14 MeV Neutrons	2.6 MeV Neutrons
High voltage	150 KeV	150 KeV
Beam current	1.5 ma	1.5 ma
Isotropic	2.0×10^{11}	8×10^{8} n/sec
Max Flux	n/cm^{2}sec $\times 10^{10}$	6.0×10^{7} n/cm^{2}/sec

Minimum target-to-sample seperation is 1/4 inch. Multiple (5-target) assembly allows rapid swithcing to new target and switching between 2.6 and 14 MeV meutrons. Typical target half-lives are:

Beam Current (mA)	Half-Life (hr)
1.5	+2.0
1.0	3.5
0.5	7

Pulsed Mode

Pulse width (continuously variable)	1 to 10^{4}
Rep rate (continuously variable)	10 to 10^{5} pps

Residual beam	$6 \times 10^{-4}\%$ of peak pulse current
Beam current	0 to 1 ma
Output at 1 ma	10^{11} n/sec
Max usable flux (14 MeV neutrons)	2×10^{10} n/cm^2/sec
Max usable flux (2.6 MeV neutrons)	6.4×10^6 to 6.0×10^7 n/cm^2/sec

Table A-10

FBR CHARACTERISTICS

Burst yield, fissions max	12×10^{17}
Pulse repetition rate per 8-hour day	7
Integrate neutron flux 1 inch from reactor surface, neutrons/cm^2 (10 KeV)	6×10^{13}
Total leakage neutrons (10 KeV)	1.7×10^{17}
Peak instantaneous gamma-ray dose rate, rads/sec	3×10^{8}
Initial reactor period,	13
Burst half-width, 1/2	39
Maximum temperature rise, °C	360°
Average temperature rise, °C	180°
Cooling time (forces air), minutes	45
Maximum steady-state power, watts	10,000

Table A-11

CHARACTERISTICS OF GAMMA LINAC

Electron energy	1 to 48 MeV (variable)
Peak beam current	0 to 1.25 ampere (variable)
Beam pulse width (variable)	10 nanoseconds in 10-nanosecond increments to 100 nanoseconds continuously variable from 100 nanoseconds to 10 microseconds
RF peak power	30 megawatts
Frequency	2,855 megacycles (S-band)
Repetition rate	Single pulse of 10, 20, 30 60 or 120 pulses per second
Peak dose rate	10"r/sec
Pulse width	10 mamo sec to 10 micro sec
Bremsstrahlund radiation Max average energy	25 MeV

The SNG can be used for radiation effects testing neutron radiograph, or as part of a complete activation analysis system, including pneumatic transfer systems, 400-channel analyzer, single-channel analyzers, and a radio chemical laboratory. The Gamma LINAC, which was described previously, can also be used for activation analysis and is connected to the analyzers by a sample transfer system.

d Dosimetry Analysis System. The dosimetry facility provides the means of evaluating nuclear damage data obtained from all simulation devices and permits extrapolation of such data to weapon systems and real nuclear environment condition. The system consists of a thermoluminescent dosimetry reader, neutron activation counters, and multi-channel spectrum analysis system.

The system is capable of measuring gamma radiation from 10 to 10^6 neutrons/cm-sec. Neutron energy thresholds from thermal to 14 MeV are measurable within the ± percent accuracy.

e Electromagnetic Pulse Facility. The antenna array consists of modular wave radiators that radiate an electromagnetic wave having a propagation characteristic of a horizontal plan polarized electromagnetic wave. The working volume is 22 feet high by 44 feet long by 44 feet wide. The intensity is variable between 1 and 60 KV/mile. The rise time is 7 to 10 nanoseconds. The pulse rate is 1 pulse per five minutes.

f Gamma Radiation Facility. The Gamma Radiation Facility exposure cell is 40 feet by 20 feet. The sources are pneumatically transferred from a storage plg to the exposure head. The exposure head is 12 inches in diameter and 18 inches long. The exposure area is that area around and in front of the head. The output intensity varies as the inverse square of a the distance between the head and the test item.

- Intensity: 10 to 2.5×10^6 roentgens per hour at one centimeter.
- Duration: 0.1 seconds to 7 days.
- Energy: 0.66 MeV or 1.17 MeV and 1.33 MeV.

g The Thermal Effects Facility. The Thermal Effects Facility (Solar Furnace) is a solar furnace of the focusing type which utilizes an effective aperture to focal length ratio of less than one. The maximum flux at the center of the image of the sun at the focal plane is 80 cal. cm^{-2} sec^{-1}. Minimum pulse width is 0.1 sec. Maximum dimension of test item along the focal plane is 4 feet. Test area is 5.8 inches in diameter.

(7) Other.

(a) Warheads and Explosive Testing.

1 Detonation Tests. A capability exists in the detonation test area to conduct detonation tests of missile warheads, motors, and/or other explosive devices up to 10,000 pounds TNT equivalent, without interference with other range activities. The detonation test area is approximately three square miles in area and is located about nine miles from WSMR

Headquarters. Tests are normally conducted in a graded area of about 1,000 feet square in which blast gage arrays and/or fragmentation arenas can be conducted to meet specific test requirements.

2 Operational Hazards Test. A capability exists to subject warheads, rocket motors, assembled missiles, and other explosive devices to simulated operational hazards such as exposure to conflaguration, gunfire, detonation, slow heating, or severe rough handling (40-foot drop) in the detonation test area with the explosive limits and supporting facilities, equipment, and instrumentation shown above. An up-range site (Blast Test Facility) has been set aside for subjecting Army missile systems or other material to the blast effects of up to 1,000,000 pounds (500 tons or 1/2 KT). Future plans for this site include installation of firm power, a fixed control bunker with equipment programming and time distribution equipment, portable instrument shelters, and a non-portable water well for dust control.

3 Warhead Effectiveness Testing. A capability exists to obtain missile warhead effectiveness and lethality data against personnel or materiel targets by impacting the warheads in special areas.

4 Explosive Train Testing. A capability exists at the Special Weapons Assembly Facility No. 4 (SWAB 5) to determine sensitivity and reliability of small electroexplosive devices (EED) (up to 10 grains) by subjecting them to constant current (40 amp max) or voltage (800v max) pulses of known length in an EMR-free environment. Future plans include updating the present equipment and addition of equipment to determine the sensitivity of EED's to electrostatic charges and to precondition and subject them to repetitive pulses.

5 Warheads Inspection and Assembly. A capability exists also at SWAB-5 to perform inspections, assembly, disassembly, or modifications on warheads and adaption kits or components thereof. Five large high-ceilinged explosive assembly bays (explosive limit 1,000 lb/bay) furnished with an interconnected overhead monorail hoist system are available.

6 Warhead Balancing. A capability exists also at SWAB-5 to statically and dynamically balance explosive-loaded missile warheads up to the size of the PERSHING warhead and to determine center-or-gravity, concentricity, and compliance to other design criteria.

7 Warhead and Related Component Storage. Facilities are located at SWAB-4 to store missile warheads and components under 24-hour armed surveillance. Two storage igloos with a 30,000-lb explosive limit and a deontator storage building with a 1,000-lb explosive limit in addition to the assembly bays described under Warheads Inspection and Assembly are available.

8 Hazardous Component Retrieval and Disassembly. WSMR is not presently equipped to safely retrieve and disassemble malfunctioned hazardous items after static or flight tests. They are destroyed in place. Future plans include remotely operated equipment to perform this task to determine causes of malfunction.

(b) Detection and Guidance - Missileborne Guidance Test Facility.

1 Simulation Table. The Micro-Gee Products, Inc. Model 100 simulation table is a portable table which simulates rocking motions. It can be used to test and calibrate sensors and gyros. Input control indicates the table angular position at any instant up to a frequency of 0.2 cycle per second and a tilt amplitude of 10 degrees either side of horizontal. Recorder terminals may be connected to a recorder or oscilloscope for indicating or recording table position at any frequency.

2 Linear Acceleration Table. The Micro-Gee Product, Inc. Model 702L15 linear acceleration table is a high-displacement, low-frequency, recti-linear oscillating platform used primarily for determining the frequency response of linear accelerometers and suitable for determining the acceleration or velocity sensitivity of gyros, velocity pickoff, and similar sensor. The mounting surface is 3-7/16 by 12 inches. Maximum displacement is one inch, with rates of 35 inches per second possible. Accelerations up to 6.5 g between 12 and 45 hertz decrease at 4 decibles per octave to a maximum 1.5 g at 500 hertz. Frequency response is flat to ±1 decible between 2 and 100 hertz.

3 Gyro Test Table. The Ideal-Aerosmith, Inc. Model 9790VS gyro test table provides roll, pitch, and yaw motion for testing gyroscopic instrument, guidance platforms, etc. The 24-inch wide by 30-inch long table, mounted on a vertical drive shaft, has an adjustable tilt angle between 0 and 15 degrees. Rotation rates between 0 and 60 revolutions per miute can be continuous or can be automatically reversed at one minute intervals.

4 Rate of Turn Table. The Genisco Technology Corp, Model C-181 rate-of-turn table applies a constant rotational rate to stable platforms, accelerometers, rate gyros, and other component parts of guided missiles for calibration of functional testing. Maximum load capacity is 100 pounds. Rates between 0.01 and 1200 degrees per second with a maximum rate change of 100 degrees per second are available. Sixteen slip rings for instrumentation purposes have electrical noise below 1 millivolt. Accuracy is within one percent with repeatability of 0.2 percent in a given direction and 0.5 percent in the opposite direction. Angular velocity is constant to within 0.1 percent, including yaw and drift. Accelerations due to vibration do not exceed 0.15 g in any axis or plane.

5 Indexing Table. The Optical Measuring Tools Ltd, Model STT 21 indexing table has a 12-inch rotary platen mounted on a tilting base and attached to a fixed base by a common pivot shaft. Rotary and tilting motions are controlled through their respective handwheels and worm drives. The rotary and inclinable sections are each equipped with optical micrometers providing position readout to one arc second. The table is approximately 20 by 38 inches with 360 degrees rotation and 0 to 90 degrees inclination.

6 Angular Oscillating Table. The Micro-Gee Product, Inc. Model 610A angular oscillating table is a flexure-mounted, electrodynamically driven platform for subjecting angular devices such as rate gyros and angular accelerometers to sinusodial angular rates and accelerations. The 10-inch diameter platform can accept a maximum load of 100 pounds. A maximum displacement of two degrees with an oscillating range between 0 and

100 hertz and a maximum acceleration of 100,000 degrees per second are possible. Minimum displacement is less than one second of arc, with a minimum frequency of 0.001 degree per second. Distortion is less than one percent for displacements under one second.

7 Sidereal Gyro Test System. The J. W. Fecker Co. Model 052 Mk 33 sidereal gyro test system can be positioned parallel to the earth's polar axis or at any position ±95 degrees from the vertical by means of a trunnion axis tilt mechanism and readout assembly. The readout assembly is a dualhead W. and L. E. gurley-Unisec micrometer with an accuracy of ±2 arc seconds and a resolution of one arc second. The table is machined to a flatness with 0.001 inch total indicator reading and will support a load up to 500 pounds in the horizontal position with less than 15 arc seconds deflection. Table command rates available are 1X, 2X, 4X, 5X. 8X, 10X, 20X, 25X. 40X, 50X, 100X, and 200X earth sidereal rate. A three-bay console is used to house equipment required to excite, monitor, and control the instrument being tested and provides a testing system which will evaluate the operating charcteristics of single of 2-degree-of-freedom gyros or pendulous accelerometers under condition identical to those encountered in actual use.

8 Precision Rate Table. The precision rate table is used to perform open-loop guidance section tests. Performance characteristics and limits of capability are measured under controlled simulated flight conditions. Adaption of the table for laser-seeking guidance sections requires a simple change from black-body to laser source simulators. The table can handle a maximum load of 600 pounds with a maximum Of 300-foot pounds of bending force in the turning axis. Constant angular velocities of 1, 2, 5, 8, 10, 15, and 20 degrees per second can be selected. In addition, manual controls allow selecting variable angular rates between 0.02 and 100 degrees per second. Fixed angular accelerations of 1, 2, 3, 4, 5, 10, and 20 degrees per second are also available. All rates above 1 degree per second are accurate to ±0.002 degree per second. All acceleration rates are accurate to ±5 percent. Auxiliary equipment includes environmental shrouds for temperature conditioning, black-body sources to simulate infrared targets, and an optical beam splitter for multiple target simulations.

(c) Electro-Optical Test Facility.

1 Thermal Measurement System. The thermal measurement system is capable of obtaining spatially scanned infrared data at wavelengths between 2 and 5.5 microns. The data are presented in real-time on a black and white television display and recorded on a video tape recorder along with timing for late analysis on the image analysis system and the mobile infrared data acquisition system. The system normally scans a 10-degree field, but with a special lens, the field of view can be reduced to 2 degrees. Scanning rate is 16 frames per second with a thermal sensitivity of 0.2°C. The system can be aimed by using a tripod, the mobile infrared tracker, or the airborne relative tracking system.

2 Rapid-Scan Infrared Spectrometer. The rapid-scan infrared spectrometer is a rugged, mobile instrument capable of measuring infrared spectral irradiance at wavelenghts between 1.5 and 14.7 microns at the rate of 10 scans per second. It employs a circular variable filter for spectral

scanning, permitting high resolution and real-time data reduction. The cassegrain optical system primary mirror is 12 inches in diameter and has a 0.8 milliradian field of view. A television camera using the same optics as the spectrometer permits monitoring of pointing direction. Data are presented in real-time on the same television display as the one used for the camera and are recorded along with the television image and timing on a video tape recorder. The mount provides for 360 degrees azimuth and up to 45 degrees elevation tracking.

3 Spectrophotometer. A Beckman Instrument, Inc. Model IR 4 spectrophotometer is available for transmissivity, reflectivity, and responsibity measurements. The spectrometer operates over a wavelength range of 1 to 15 microns with a resolution of 0.01 micron and an accuracy of 0.015 micron. Responsibity of radiometers, infrared seekers, or other infrared receivers can be measured by using a seeker or other infrared receivers can be measured by using a 4 by 4 by 10-foot sealed, dry nitrogen purged chamber, a collimating mirror, and other optics for directing a controlled infrared beam at the test specimen.

4 Airborne Tracking System. The airborne relative tracking system is used to simultaneously point two data gathering systems and to record their relative pointing directions. It consists of two remotely controlled tracking mounts, two joy sticks with associated servo controls, circuitry for calculating the relative pointing directions of the two mounts, and a television display. In use, a television camera is attached to one of the mounts and its output is presented on the television display. Another instrument, such as the thermal measurement system or laser spot scanner, is attached to the other mount. The pointing direction of the second instrument relative to that of the television, timing data, and other annotations are presented on the television display camera and recorded on a video tape recorder for later analysis. The two tracking mounts can be operated independently, slaved together so that one will follow that pointing direction of the other, or slaved so that one maintains an angular bias relative to the pointing direction of the other. The system is used for measurements of the infrared signatures and infrared or laser energy distribution measurements.

5 Laser Spot Scanner. The laser spot scanner is an image-intensified vidicon with a spectral response between 0.35 and 1.1 microns. It is equipped with a 50-angstrom bandpass filter centered at 1.06 microns so that it will reject light outside the wavelength of neodymium doped lasers. Other filters can be substituted for other laser wavelengths within the vidicon's spectral response. A zoom lens can be used to vary focal length from 15 to 150 millimeters. It uses a standard television monitor for real-time data display and a video tape recorder to record data for later analysis. In one mode, it operates continuously, providing the spatial distribution of light within the wavelength region of the filter. In a second mode, it is gated to match the pulse repetition interval of the laser which is illuminating the target, thus operating only when the laser is radiating.

6 Image Analysis System. The image analysis system is used for editing and general analysis of data recorded on video tape. A color television display can be used to present normal color television recordings

or to generate pseudo color presentations of black and white television recordings. In this case, the colors represent different shades of grey in the black and white presentation, permitting greater definition of gradations and more accurate determination of the boundaries of these gradations. A second television display provides a presentation which appears to be three-dimensional. The image can be rotated to any apparent aspect angle so that it can be viewed from the most advantageous angle. Either of the television displays can be photographed. A third display presents a number which represents the brightness value associated with any point on the color television display. The coordinates of the point are selected by moving vertical and horizontal cursor lines on the television screen. Associated with the image analysis system is an analog memory disc, analog-to-digital conversion equipment, a digital formatter, and two digital tape recorders permitting digitizing of selected data from the video inputs in a format compatible with the Univac 1108 computers.

7 Video Recording System. The video recording system includes a light table television camera and video monitor. The light table consists of a frosted-glass surface for displaying transparencies of still photographs or individual frames from motion picture film. A television camera with a zoom lens is vertically mounted above the light table so that it views the transparency. The video output from the television camera can then be viewed on a television monitor or introduced as data to the image analysis system. The light table permits expanding the applications of the image analysis system to include photographic images.

(d) Microwave Test Facility. Susceptibility and vulnerability to electronic countermeasures can be a severe limitation of weapons systems and components. Microwave and computer simulation techniques are used to evaluate the effect of electronic countermeasures on systems and components performance. A screen room is available in which a variety of microwave signals can be produced for test purposes. The power to the screen room is three phase with provision for power ground monitoring to determine phase balance. The facility includes two spectrum analyzers, coaxial frequency meters, and microwave power meters. It has a variety of microwave variable frequency oscillators, a microwave sweep generator, a 4 to 8-gigahertz noise source, and four traveling wave tube amplifiers.

(e) Laser Facility. The laser facility is used for safe, highly controlled tests of lasers. Testing is controlled remotely from an adjacent room. A remote-controlled closed-loop television system monitors events within the laboratory. There is a variety of optical benches and fixtures, lenses, mirrors, and other optical devices. Instrumentation includes a large visible light spectrometer, various optical sensors, and several types of recorders. Lasers available include a neodymium doped YAG laser which radiates 200 millijoules of energy in 75 microsecond pulses at 1.06 microns wavelength with beam divergense less thatn 3 milliradians. Pulse repetition frequency is selectable at 1, 5, 10, or 20 pulses per second. Also available is a helium-neon continuous-wave laser with power output of 5 milliwatts at a 0.6328-micron wavelength and beam divergence of 1.7 milliradians. In addition, there are two small helium-neon lasers. An argon-ion pulsed laser with variable pulse rate to a maximum of 60 pulses per second, maximum peak power of 2.2 watts with minimum average power of 3 milliwatts can be used for laboratory alignment and holographic experiments. Six discrete lines are output at 0.4579, 0.4765, 0.4880. 0.4765. 0.5017. and 0.5145 microns. Nominal pulse width is 50 microseconds. For Gamma Scientific, Inc. sensor and readout units comprise and low-light-level monitoring system. Filtered to have the same spectral response as the human eye, they function between 10^{-5} and 10^{-2} foot-candles. All units are completely portable and operate from battery packs. Data may be monitored or recorded on general-purpose recorders. Three radiometric light measurement units operting in the 0.35 to 1.1 micron region are avialable for measurement of light (pulses and continuous) in intermediate illumination ranges.

5. Threats/Targets.

a. Ground.

(1) Electromagnetic. None.

(2) Weapons. None.

(3) Radiological Environment. See paragraph 4.g.(4).

b. Airborne. None.

6. Data Processing and Handling.

a. Data Storage and Retrieval Capabilities. Received telemetry data are relayed to the data handling station for demodulation, demultiplexing, and recording. The Telemetry Data Center (TDC) has the capability for demodulation, demultiplexing, predetection, and post detection magnetic tape recording, digitizing, error correcting, data processing, formatting, and data display. The TDC is intefaced to the Central Processing Facility (CPF) to input telemetry in real-time or deferred-time as required. The TDC displays telemetry data at remote locations via a telemetry microwave data link.

b. Quick-Look Capabilities. Test data which require additional production effort after the test are referred to as post-test data. Post-test data processed, formatted, and copied after test completion with the primary WSMR effort directed towards rapid delivery being referred to as Quick-Look Data (QL). Restrictions on output include the following:

- Limited number of parameters
- Limited number of copies
- Bound report
- Low data rates
- Little format flexibility

These data are provided in a preliminary report.

c. Processing. Test data, which are assessed and processed after test completion to optimize quality and determine the quality level, are referred to as validated data (VD). These data are usually provided in the final data report. The Analysis and Computation Division is responsible for the preparation of this finalized data.

(1) System and Model.

(a) Description. The data processing facility accepts raw data recorded on film and magnetic tape from Range instrumentation and prepares data reports for Range users. Large-scale computing systems and complex data conversion equipment (see Table A-12) are utilized to perform the data processing functions. Data processed in real-time are utilized to perform the data processing functions. Data processed in real-time are utilized to support in-flight command and control of test vehicles, range, safety, and the generation of real-time data reports.

(b) Background. During FY-66, 12 of the 18 computers were replaced by two direct-coupled systems (DCS). In FY 67, a third DC (7090-7040) provided essential expansion of overall capacity. These computer systems were phased out as TEAM-UP computers were installed and operational systems implemented during FY 71 and FY 72. DCS-3 was released in the first quarter FY 70 as a result of the installation of the TEAM-UP Part A Business Computer. DSC-1 was released in the third quarter of FY 71, and DCS-2, in the second quarter FY 73.

(c) System Configuration. Part A. The system installed for installation management business applications is an IBM 360/65 which became operational early in FY 70.

Part C. The Part C computing system consists of five UNIVAC 1108 processors configured to accomplish the functions of real-time processing, remote terminal processing, and batch or post-flight data processing.

System A consists of two 1108 processors interconnected with one Input/Output Controller (IOC) and is called a two-by-one system. Subsystem B is a two-by-one system, and Subsystem C is a one-by-zero system. Subsystem a is the primary real-time data processor. Subsystem B is a remote terminal support and batch processor but also serves as a backup system for real-time processing. In addition, expanding real-time requirements demanded the development of a combined A and B mode for large missions. This mode became operational in FY 76. Subsystem C is devoted to batch processing of classified data thereby minimizing security problems and additional costs of security treatment for all remote terminals.

The system currently services five U-9300 terminals, one U-9200, one DCT-2000, five DCT-1000s, five U-1021s, 37 U-100s, and one UTS-400. A wide variety of other terminals can access the system through a dial-up facility.

(d) Planned System Improvements. TEAM-UP, Part A, is not responsive to the needs of top and middle management. Detailed reports designed primarily for line item accounting do not provide summarized or exception reports. A remote inquiry capability and an on-line data base are planned to provide management access to current, meaningful information.

(e) TEAM-UP, Part C, Augmentation. A long range plan has been developed for the replacement and upgrade of the 1108 systems during FY 78-82 time period. This plan is described in reference 22 in the Bibliography.

An uninterruptible power supply will be installed in FY 77 to minimize the effect of power failure.

Optical data conversion equipment; WSMR processes large quantities of optical data. The processing of optical data is time-consuming and involves numerous operations of a manual nature. A variety of precision reduction equipment is required to prepare optical data for analysis. This is summarized in Table A-13.

(2) Language. FORTRAN, COBOL, and ASSEMBLY languages are used. Other terminal oriented languages are also used.

(3) Input/Output Options. Data are available to the user in the form of plots, listings, photographs, strip charts, and magnetic tapes.

(4) Real-Time/Deferred-Time.

(a) Real-Time. Historically, WSMR real-time data processing developed along evolutionary lines to support various tests conducted in relation to both weapons systems and research projects. As projects became more complex the data processing capabilities increased proportionaly. Rapid technological advances in computer hardware enabled WSMR to phase out obsolete computer systems with modern ones. The real-time computer system progression started with the IBM 7044 (stand-alone) in the early sixties, followed by the IBM 7044/7094 (direct-couple) in the late sixties. The UNIVAC 1108 systems have been utilized during the seventies. A system on mini-computers is planned for the eighties.

Real-time data processing is integrated with instrumentation and communication hardware to collectively form the WSMR real-time data system (RTDS). Figure A-16 gives the data flow for the RTDS. The RDTS performs pre-flight diagnostic analysis of the instrumentation, communication links, and computer interface equipment which will be utilized for mission support. Pre-flight wind data is available from the meteorological systems. An NR-A computer program collects the data and builds a wind profile. Missile launch angles can then be computed by applying the atmospheric effects to a simulated trajectory.

Numerous experiments are performed at WSMR which require in-flight real-time data. The data processing functions are usually the result of project test objective requirements or restraints due to safety. Some of the notable historical applications are illustrated in the following examples: guidance commands were calculated from radar data to orient the ATHENA missile during reently; commands are initiated from thereal-time computer to detonate the LITTLE JOHN and LANCE warheads at a precise altitude; computer displays a-low a drone to maneuver just seconds before

Table A-12

WSMR COMPUTERS

Equipment Identification	No. of Units	Location	Use or Purpose
IBM 360/65	1	Bldg 1512	Business (TEAM-UP, Part A)
IBM 360-65	1	TDC, Bldg 300	TM Processing
IBM 360/75	1	DFCS Bldg 300	Drone Control
UNIVAC 1108 (2x1)	2	Bldg 300	Scientific and Engineering (TEAM-UP, Part C)
UNIVAC 1108 (1x0)	1	Bldg 1526	Scientific and Engineering (TEAM-UP, Part C)
UNIVAC 1108	1	Bldg 1401	TRASANA

intercept with HAWK and PATRIOT missiles; computer generated pointing data (PAS - Precise Acquisition System) orients the CHAPARRAL launcher towards the target prior to launch; and specially formatted PAS data is sent to the Navy Desert Ship for SM-2 guidance.

Generally, projects require PAS data to weapon systems sites and to their own data gathering instrumenation. Project guidance and control requirements use commands directly from the RTDS computer (NR-A) or use manual commands transmitted on the basis of real-time displays. Real-time displays are used by projects to evaluate inflight performance and monitor mission progess.

Requirements for real-time data come from within WSMR inself as well as from WSMR projects. Missile Flight Surveillance Division (NR-M) uses real-time displays to make decisions for terminating unsafe flights via manual intervention or relies upon computer auto-destruct commands if test condition preclude human reaction time. Flight Safety may also use the on-line meteorological support before launch to ensure test objectives can be reached safely. Range Conrol (NR-R) uses real-time displays for vectoring manned aircraft along prescribed flight patterns as well as controlling and coordinating real-time missions. Range Conrol also interprets prelaunch diagnostics to confirm the operational readiness of the RTDS. Data Collection (NR-D) uses PAS data for instrumentation sites that need tracking assistance.

Post-flight generation of quick-look information is performed by NR-A personnel for mission analysis. This post-flight processing is expedited through the use of consolidated data tapes which are logged in real-time.

Table A-13

OPTICAL DATA CONVERSION EQUIPMENT

Item	Quantity	Nomenclature	Manufacturer	Model
1	3	Comparator, Coordinate, Ballistic Plate	Gaetner	1231
2	2	Comparator, Film Reader, Modified	Mann	4220
3	2	Comparator, Film Reader, Modified	Mann	829A
4	3	Comparator, Coordinate, Film Reader	Gaetner	1231
5	9	Telereadex, Modified	Whittaker	29A
6	3	Telereadex, Modified	Whittaker	29E
7	1	Micro Densitometer	Jarrell-Ash	500
8	1	Micro Densitometer	Jarrell-Ash	23-500
9	3	Light Table, Film Editing	Hardy	N/A
10	1	Light Table, Film Editing	Cinema Arts	N/A
11	6	Data Conversion Editing Table, Film, W/Frame Counter	SDC/Integrated Systems Support, Inc.	1086
12	3	Dial Reader, Cine-theodolite, Modified	Parabam	ADR 1
13	1	Programmable Film Reader, A - Scope	Information International, Inc	PFR-3
14	1	Tape Combiner	Computing & Software, Inc	N/A
15	10	Serial Interface Packages, W/Tape Units	Computing & Software, Inc	N/A
16	1	Data Reducer, Strip Chart	Data Instruments, Inc	099

17	2	Cineotheodolite Film Reader, Contraves, Model F, W/Mag. Tape Unit.	Contraves	AFB 2
18	1	Cinetheodolite Film Reader, Contraves Model F, W/Card Punch Unit	Contraves	AFB 2
19	1	Automatic Programmable Film Reader, Cinetheodolite	Singer-Link	N/A
20	1	Dataplotter	Calcomp	835

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ANNEX B

TRADOC COMBINED ARMS TEST ACTIVITY (TCATA)

FORT HOOD, TEXAS

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ANNEX B

TRADOC COMBINED ARMS TEST ACTIVITY (TCATA)
Fort Hood, Texas

1. Introduction.

a. Overview. Fort Hood is located just west of Killeen, in central Texas, along US Highway 190. The post is 65 miles north of Austin, and 60 miles south of Waco. Fort Hood is the home of the III Corps, the 1st Cavalry Division, the 2d Armored Division, the 13th COSCOM, 6th Cavalry Brigade (AC), and Headquarters TRADOC Combined Arms Test Activity (TCATA).

The mission of Fort Hood is to control, train, and provide administrative and logistical support for all units assigned or attached.

The mission of TCATA is to plan and conduct operational and force development tests and evaluations in support of TRADOC combat and training developments programs. These programs encompass:

- -Combined Arms field testing relating to material, tactics, organization and doctrine.

- -Command Systems testing involving intelligence integration, electronic warfare, and tactical automatic data processing.

- -Training Developments testing and evaluation of effectiveness of training programs, simulators and devices.

b. Generic Systems Tested. TCATA is the only organization located at Fort Hood that possesses an Opeational Test and Evaluation (OTE) capability. Fort Hood, being the host organization, controls all the test ranges and training areas.

With the support of the Fort Hood facilities and III Corps resources, TCATA can conduct tests up to the scale of brigade or even division level operations including all combined arms and support elements. TCATA owned instrumentation provides the capability for position fixing, automatic event data collection at central sites and weapons scoring of as many as 200 elements. Thus it is possible to monitor and record simulated firing engagements of a large number of elements very closely. The position fixing and data collection capability is well suited to monitoring ground forces activities since both of these equipment systems employ small enough field units to be carried by infantry personnel and field test monitor personnel without serious impact on tactical realism.

TCATA with the cooperation of the III Corps, is capable of instrumentation and evaluation in the following areas:

Helicopter

Tanks

Ground Mobility

Intelligence and Target Acquisition

Threat Environment

Camouflage

Command, Control and Communications

Airspace control

Logistics and Control

2. General.

a. Army Units. Troop units at Fort Hood are listed in Table B-1. Although the primary mission of these units is not test support, any listed unit may be used in testing given FORSCOM approval. Actual use of Fort Hood units as test participants has historically been based on the relative importance of the test compared to the importance of other activities with which testing would interfere. Tests which also provide good training are most likely to be supported.

b. Maintenance Capabilities. The III Corps provides the standard corps complement of equipment repair and maintenance shops. These include aircraft, automotive vehicles, combat vehicles, construction equipment, electronic and communications equipment, missiles, armament, general equipment, and calibration.

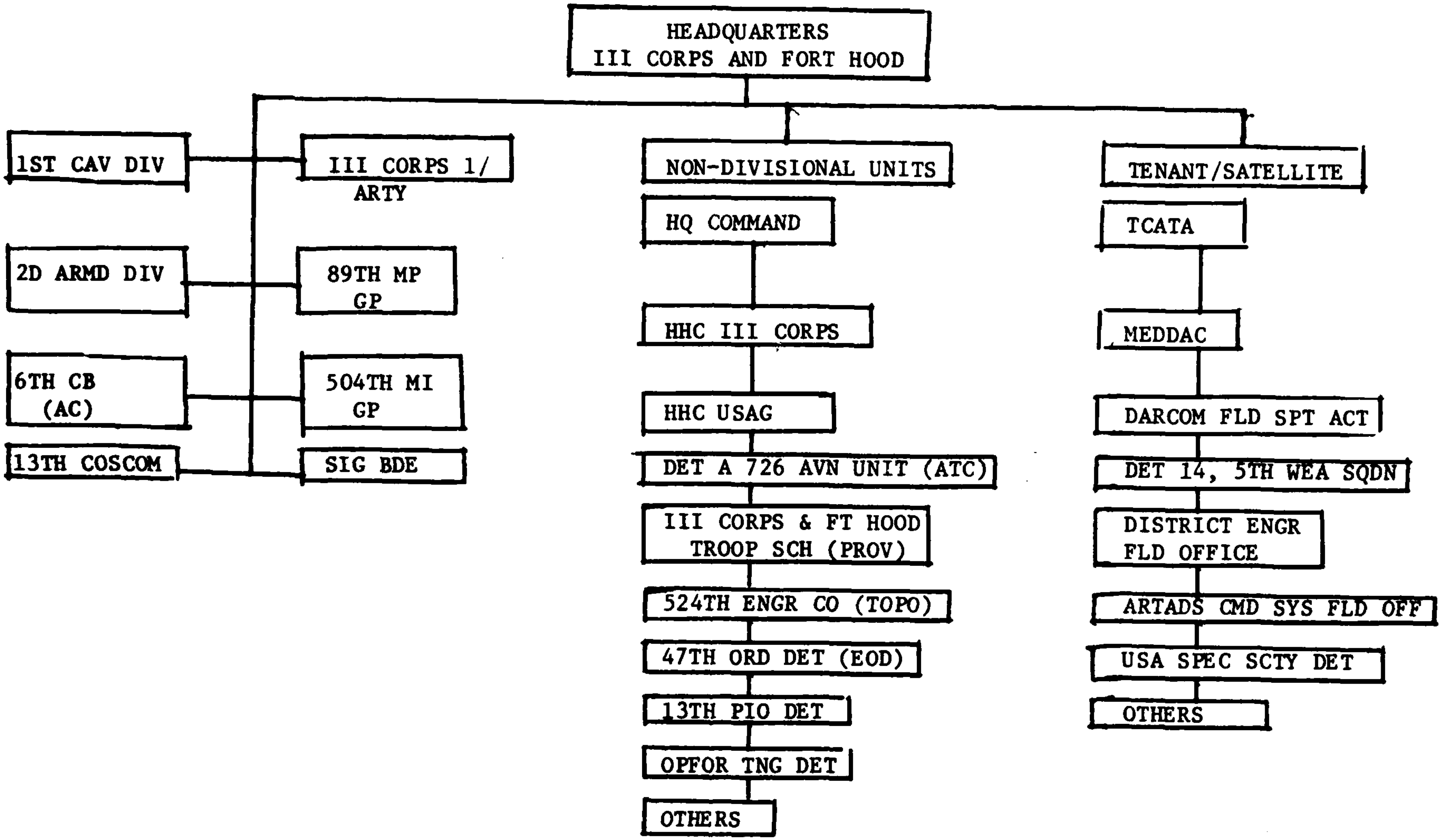
Specialized maintenance support for the TCATA test instrumentation system at Fort Hood is provided by TCATA through its own contractor.

c. Access.

(1) Air. Scheduled airlines to the area are Rio Airways, which services the Killeen Airport from Dallas/Fort Worth Airport, and Texas International Airlines and Rio Airways at Draughen-Miller Airport, Temple, Texas. Robert Gray Army Air Field (AAF), located adjacent to West Fort Hood, has runways of 10,000 feet, capable of supporting any type of aircraft, including the C-5A. Gray AAF is equipped to handle both visual and instrumented flights.

(2) Rail. Fort Hood has its own loading docks and access to the railroad network.

III CORPS AND FORT HOOD COMMAND RELATIONSHIP CHART



1/ LOCATED AT FT SILL, OK

Table B-1. Troop Units at Fort Hood.

(3) Road. US Highway 190 provides access to Fort Hood from Interstate 35 at Belton, Texas.

d. Logistic Support. Housing, mess hall, and supply facilities are presently available to support the approximately 45,000 men and women stationed at Fort Hood. In addition, housing and mess facilities exist at North Fort Hood for 8,000 additional troops. These facilities at North Fort Hood are used during the summer by the National Guard and Reserve Units for summer camp and are vacant the remainder of the year.

e. Recurring Commitments. Throughout the summer months, Reserve and National Guard units utilize North Fort Hood and some of the firing ranges and maneuver areas for two-week encampments. Presently, no weekend training exists for these units.

f. Special Operational Restrictions. Special consideration must be given in any test planning to a high-pressure fuel line. This line crosses Fort Hood in an east-west direction approximately 12 miles north of the Main Post area. Crossing of the underground pipeline is allowed only at designated points. No dud-producing munitions are allowed north of the pipeline.

g. Facility Organization. The commanding general of Fort Hood, Texas also commands III Corps. TCATA, a TRADOC activity, is provided installation support from Fort Hood. Initial contact and authorization of visitors to TCATA should be made with Protocol Office of TCATA shown in the TCATA organization chart in Figure B-1.

Scheduling of tests to be performed by TCATA is the responsibility of the DA Test Schedule and Review Committee (TSARC), TCATA takes all direction with respect to test scheduling and reporting from this committee through HQ TRADOC. The DA TSARC is chaired by the OTEA Commander and thus OTEA has direct access to the planning and scheduling of operations to take place under the TCATA program.

h. Environment (Climate).

(1) General. The Fort Hood area, near the boundary of two major climatic zones (the semi-arid zone on the west and on the warm, rainy zone on the east), bears a climatological classification of a warm, temperate, rainy climate with hot, dry summers. Records show a normal yearly rainfall of 30 to 35 inches, with May considered the month of maximum precipitation. Precipitation occurs an average of 5 to 7 days per month and is mostly in the form of rain showers or thunderstorms. The average maximum temperature of 95 degrees occurs in July and August; the average minimum temperature occurs in December and January, averaging 37-38 degrees with snow rarely occurring in measurable amounts.

(2) Climatology by Seasons.

(a) Spring. Flying weather shows considerable improvement over that of winter months. Thunderstorm activity is associated with frontal

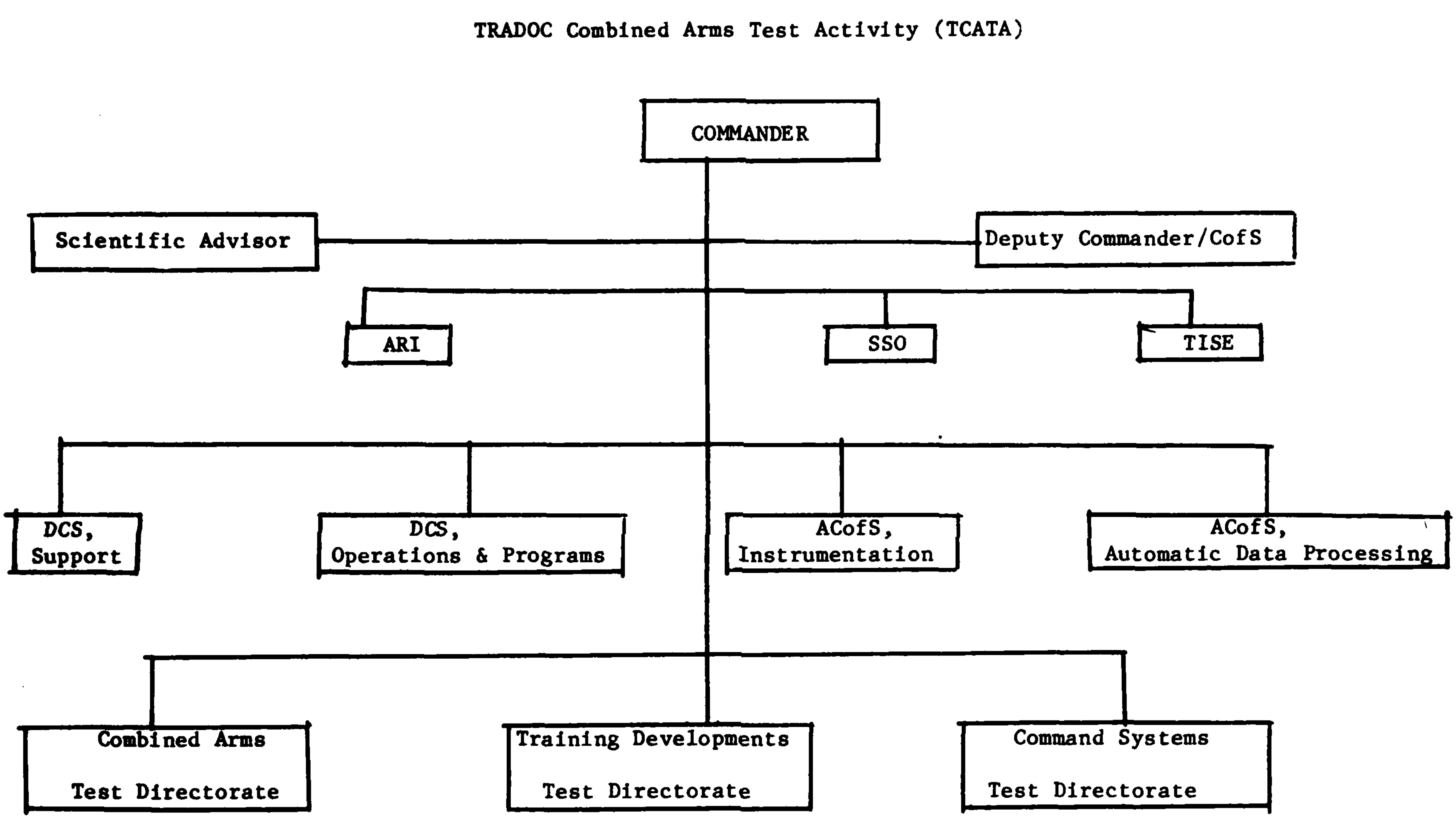


Figure B-1. TCATA Organization Chart (December 1979) systems or their squall lines. April and May show the maximum accumulation of precipitation for the entire year.

(b) Summer. Flying weather is VFR 93 percent of the time. Thunderstorm activity is considerable and generally occurs around 1600 hours and continues until 2100 or 2200 hours. In the late summer, periods of low ceiling and visibility can be expected as weather over the area is influenced by conditions in the Gulf of Mexico.

(c) Autumn. Flying weather is VFR 87 percent of the time. Gusty surface winds may create a hazard more at this time of year than during the summer. Thunderstorm activity continues, but the convecting storms decrease in October and November. Frontal thunderstorm an' squall formations are common. Frontal systems occasionally become stationary over the area and cause periods of low clouds and poor visibility due to light rain or drizzle.

(d) Winter. VFR flying weather ranges from a high of 90.4 percent in February to a low of 88 percent in December. There are five to six frontal passages per month. Temperatures average from the low 40's to the low 60's with alternate periods of cold and warm temperatures. Precipitation is only 5 inches during the winter months but falls for long periods in the form of light rain or drizzle.

i. Topography. The terrain at Fort Hood is semi-arid with rolling hills. The areas of West Fort Hood and southwest Fort Hood have rather sparse vegetation and these areas are considered to be good terrain for European theater simulation. The east Fort Hood test area has heavier vegetation and has been utilized for Asian theater simulation. The east Fort Hood test range suffers in this role from a lack of any truly dense rain forest area and from a complete lack of any waterway network. The only significant body of water in the area is the Belton Reservoir.

One noticeable test constraint resulting from the semi-arid nature of the terrain is the fact that during daylight hours at virtually all times of the year, tracked vehicles and, to a great degree, other types of vehicles leave significant dust trails when they move, thus enhancing their visibility. Although this may be an accurate part of many simulations, it may also degrade the realism of some types of simulated operations.

j. Airspace Restrictions. R6302, above Fort Hood, is restricted to all aircraft to 30,000 feet above mean sea level at all times. In addition, past tests have involved helicopter operations in areas surrounding the restricted air space. By coordinating with the FAA, these test operations can be carried out but actual control of the airspace is limited.

k. Power Availability. Power is available from two commercial sources and may be switched in minutes. No present or future power capacity problems are anticipated.

l. Communications. Communication is restricted to land lines on the test ranges plus the standard Corps-level radio communication. There are no special communication facilities for test purposes.

3. Dimensions.

a. Landscape. Fort Hood occupies 218,000 acres of land area. It consists of three inhabited areas (Fort Hood, North Fort Hood, and West Fort Hood), plus an impact area and a maneuver area. The latter two occupy the majority of the Post.

(1) Test Area Contiguity. All the test areas are contiguous and surround a central impact area. However, practical considerations preclude mass troop movement across Highway 190 which separates the Post into a north and south area. All live-firing occurs in the northern area. Fort Hood has lease agreements which allow limited operation (such as trailer-mounted communication points or helicopter landing points) at scattered locations up to 30 or 40 miles outside Fort Hood.

(2) Easements. Cattle grazing is allowed on most areas of Fort Hood. Some hunting and forestry is also allowed which may present some operatonal problems during certain times of the year.

(3) Impact/Live Firing Areas. Ranges are available on Fort Hood to support all the weaponry systems used by the III Corps. These are listed in Table B-2.

Table B-2

FORT HOOD RANGES

DIRECT FIRE

Range	Number
Rifle Trainfire OG A, B, C OC 1A, 1D, 1C, 2A, 2B, 2C OC 1 & 2	11
Rifle KD PK A & B; NFH A & D	4
Pistol PK A, D, C; NFH	4
Machinegun PK A, B; NFH A, B; S/L MG Trans	5
SMG PK & NFH	2
Shotgun HC	1
Hand Grenade PK	1
M79 Grenade PK	1
ATR EK M72 LAW; NFH A, B, C	4
Recoilless Rifle Brookhaven 25H, FF Svc	3
Arty Direct Fire Post Oak; EK CEV	2
Tank Tables S/L 1, 11, 111, 1V, V, VIS, VIN, V11, V111; RUTH 1, 11, 111; Tank Zero, Crittenberger	14
Helicopter Gunnery Trapnell, Cold Spr, Dalton Pipeline	4
Air Defense Vulcan; Redeye	2
Flamethrower HC	1
Live Fire Courses Tank Co, Mech-Inf, SPAC Blackwell Plat, MECHONED Tank Plat	6
Demo Areas HC, EK, Hubbard	3
Field Fortification HC	1

Indirect Fire

Range	Number
Artillery FPs	155
Mortar Ranges Reed Mtn, Sugar Loaf, Curry N, C, S, West Range 5 & 6	7
Mortar Teardrop	1
M31 Arty Trainer Jackson Knob; EK	2

b. Airspace.

(1) Landscape/Airspace Relationship. All of Fort Hood north of the Main Post area is within the designated restricted flight area (R-6302). With the cooperation of the FAA, temporary increases in the restricted area size are permissible. Control in the expanded area is minimal.

(2) Easements. Air traffic is permitted over Fort Hood above 30,000 feet.

(3) Manned Airborne System. Only helicopter and light aircraft operations are permitted at Fort Hood.

(4) Unmanned Airborne Systems. Not permitted.

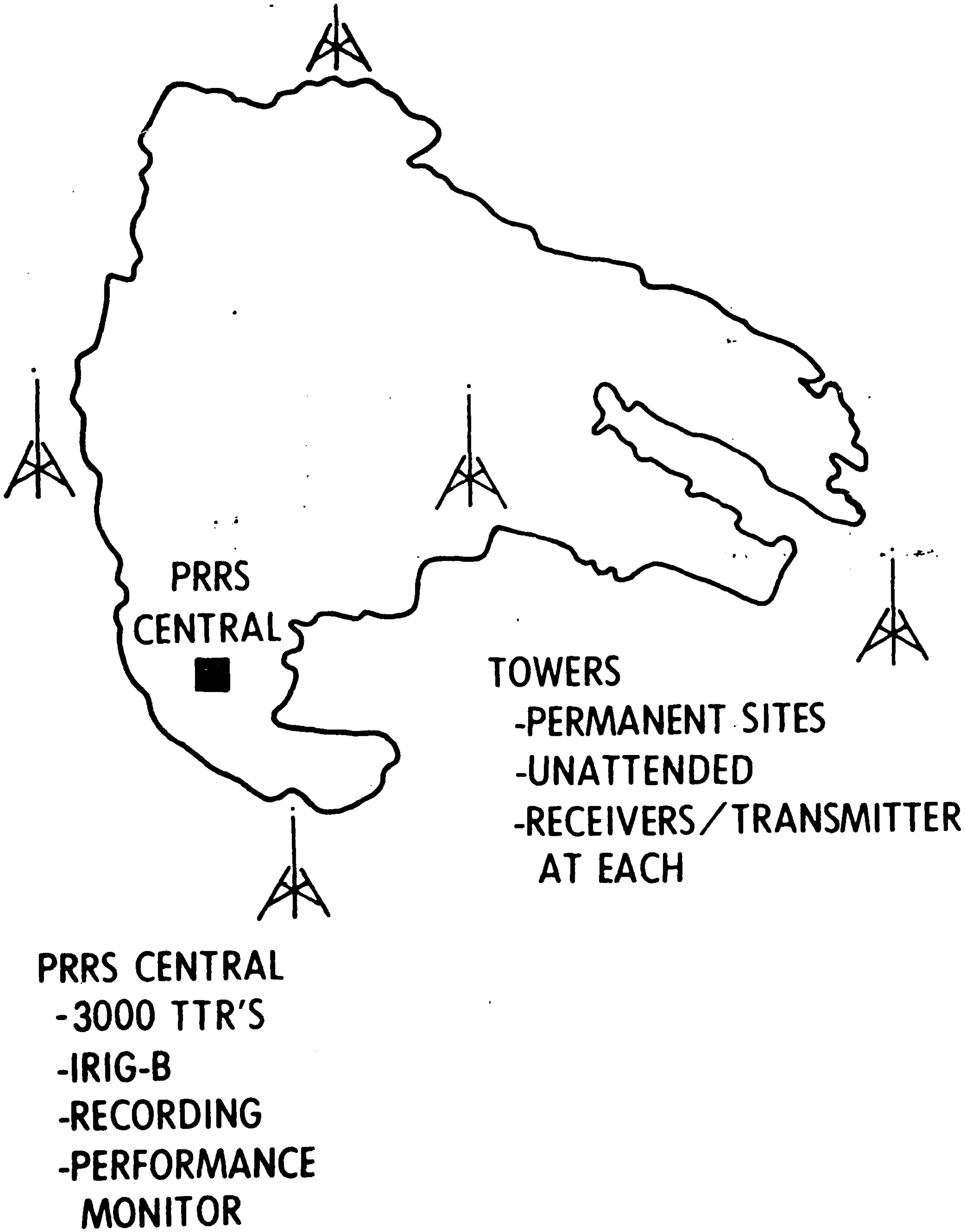
(5) Area Surveillance. Primary airspace surveillance is visual. However, radar surveillance of Fort Hood is possible using the Approach Surveillance Radar (ASR) located at Hood AAF or Robert Gray AAF. No information is normally available from the ASR, other than approach and departure contol to Hood AAF and Gray AAF.

4. Instrumentation. Several major instrumentation systems are located with the TRADOC Combined Arms Test Activity (TCATA). The present TCATA Automated Field Instrumentation System (TAFIS) consists of position determining, engagement scoring, data collection, range timing and voice recording systems. Popular names of these systems are Position Reporting and Recording System (PRRS), Long Range Navigation (LORAN), Weapons Engagement Scoring System (WESS), Automatic Data Collection System (ADCS), Voice Recording System (VRS) and Voice Recording System Reduction Facility (VRSR). A transponder type positioning system (PDS) also provides position information. Other equipment items complete the instrumentation inventory and consist primarily of photographic, meteorological, photometric and audiometric equipment. TAFIS and video instrumentation applications are time correlated using the IRIG-B time signal from the National Bureau of Standards. All of the major range instrumentation systems are operational and have been used extensively in support of TCATA testing and III Corps training except the PDS which has just recently been acquired.

a. Position Systems

(1) PRRS

(a) System Description The Position Reporting and Recording System is a fixed site, phase difference, position determining system. Major components of the PRRS include mobile transmitters, five tower receivers/frequency converters, a central receiving and position computing facility, and a computation system. A simplex omni-directional data link provides position information to the ADCS mobile recording stations.



PRRS
CENTRAL
TOWERS
-PERMANENT SITES
-UNATTENDED
-RECEIVERS/TRANSMITTER
AT EACH
PRRS CENTRAL
-3000 TTR'S
-IRIG-B
-RECORDING
-PERFORMANCE
MONITOR

FIGURE B-2

The PRRS determines the Universal Transverse Mercator (UTM) grid location of elements maneuvering anywhere on the Fort Hood reservation, continuously records these locations, reports them in realtime for other instrumentation system processing and displays position information for test analysis and control. The system consists of 200 Mobile Units (MU) which are adaptable for vehicle or aircraft installation; a network of five basic array receivers on 150-foot permanent towers; a central processing facility; and three independent display facilities. Each MU transmits three unique CW frequencies in the 1642-1772 KHz band which are relayed to the central processing facility via the fixed towers located around the reservation (refer to figure B-2) and are then processed at different rates in conjunction with a reference signal. MU locations are then computed at a central location and recorded on magnetic tape in ten-digit grid coordinates. The location and identification data for each MU are also presented in realtime on video display units with a synchronized gridline and photomap background for use by test control and analysis personnel.

MU transmitted signals are received by the five basic array receiving towers. In turn, the towers relay the phase of the received signals through an FM Data Link Network to the Control Center, which determines the position of the MU from the incoming information. The position coordinates of the MUs are then recorded on magnetic tape and displayed on the CRT monitors and displays screens. The Control Center also provides timing and control information through the command transmitter to the basic array receiving towers, thereby enabling unmanned operation of the towers.

Since the PRRS magnetic tape is a continuous record of the location of each MU, the tape can be used in post-test analysis to plot the true course of maneuvering elements during a designated time frame. These scaled plots can then be used as map overlays; in data reduction and test reports.

(b) <u>Salient Features</u> The salient features of the PRRS follow:

<u>1</u> Determines realtime position of up to 200 MUs simultaneously.

<u>2</u> MUs (weighing approximately 10 pounds) are easily attached to wheeled and tracked vehicles and aircraft.

<u>3</u> MUs have only one operating control (an ON-OFF switch) and thus require essentially no attention on the part of the player personnel or vehicle to which they are attached. PRRS provides position fixing within a 20 X 25 mile rectangle containing the Fort Hood area.

<u>4</u> Provides position fixing of aircraft up to 50 miles from the center of the Fort Hood base.

<u>5</u> Computes realtime position of all elements at the PRRS Command Center.

<u>6</u> Records Position data for post-test review and analysis, and displays realtime position data graphically for test monitoring purposes.

7 Operates on a ground wave principle and thus its performance is not degraded by terrain masking.

Realtime display of the MU/vehicle location on a photomap background is available for viewing in the PRRS central facility. Selectable area coverage which may be viewed range from the entire Fort Hood area down to a 3.5 X 3 kilometer section with 500 meter gridlines which can be accessed for display purposes by the system operator. The display consists of a terrain background picked up from a film slide chain and camera, with computer output data overlayed on the photomap background. The computer provides the position of MUs with their identification numbers on the terrain background. In addition, there is a file of symbols to more readily identify the type of player to which an MU is attached. These include symbols for tanks, helicopters, field command, etc. In addition, special identification alphanumerics can be encoded by the operator to be attached to an MU as viewed on the display.

There are three independent display channels operated by keyboards attached with the display screen. One of these is permanently committed to operation of the PRRS. The other two are provided to the operator personnel for control of up to two independent, simultaneous tests. As MU movement is displayed on the CRT screen, an historical trace of their progress can be displayed for the viewer. This past history is a key-in option which can be requested or deleted by the operator.

(2) LORAN The TCATA LORAN System is a high performance radio frequency "position fixing" and "aid to navigation" system marketed under the trade name ACUFIX by Megapulse, Inc. This system utilized the concept and signal format of the LORAN System but is intended for use over short ranges.

The LORAN System consists of three transmitting stations located on an arc generally 90 miles northeast, southeast, and southwest of Fort Hood. It provides LORAN coverage throughout a 100-mile by 200-mile oval extending northwestward through Fort Hood. The system is used for testing LORAN receivers; testing concepts and techniques; and for operational use by organizations employing LORAN equipment. The LORAN may be used to supplement existing TCATA instrumentation in testing, tactical training, maneuvers, and exercises involving the forces stationed at Fort Hood.

The system is designed to establish an accurate and repeatable LORAN grid over the Fort Hood area. Actual positional data will depend upon particular receivers used. The grid network at Fort Hood was established in order to test newly developed receivers and provide field navigational capability for air and ground vehicles and personnel in support of conceptual testing.

Currently, the LORAN System is used extensively by the USAF as an aircraft positioning aid in conjunction with aircrew training practice bombing runs on Fort Hood ranges.

(3) PDS The PDS is a basic compact portable transponder type radar system which fixes the position of a cooperative vehicle through a

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range/loop range output. Equipment subsystems include a master station (range console), a remote reference station (ballon unit), fixed reference stations, and mobile reference stations.

The PDS operates on the principle of pulsed C-band radar. A pulse position radar coding scheme is used to selectively interrogate up to sixty-three addressable mobile reference stations. Unique pulse spacing codes are used to identify these reference stations. The mobile reference stations are selected for interrogation by the operator through a unique code assigned to each station.

The PDS measures the distance (range) between the remote reference station and the mobile reference stations and sends this data to a data processor. Additionally, the system measures and sends to the data processor the distance (loop range) around the triangle formed by the remote reference station, the mobile reference station, and one of the three fixed reference stations. The known distance between the remote reference station and fixed reference station coupled with the range and loop range data permits the data processor to apply trilateration techniques to determine mobile reference station position and permit continuous tracking. This information is sent from the data processor and recorded at three second intervals for each interrogated reference station as UTM coordinates on the data terminal or recorded on a magnetic tape. The information can also be sent to the ADCS for integration with WESS data.

Location accuracy is ± 10 meters to a range of approximately 18km, dependent upon line-of-sight constraints. Line-of-sight between the remote reference stations is an absolute necessity. To reduce the effect of this constraint, the remote reference station is mounted on a moored balloon platform and flown at an altitude of 1500' AGL. The fixed reference stations are mounted on 100' portable towers. Evaluation of PDS capabilities is scheduled for 3QFY81 prior to field for test purposes.

b. Weapon Engagement Scoring System (WESS)

(1) System Description Weapon engagements are simulated by a laser communication link established between attacked and defender (Target) at the time of attack weapon firing. The weapon type and identification are encoded on the laser communication link consisting of a laser transmitter on the attacker and laser pulse receiver on the defender. The kill/no kill decision is always generated at the target. A computer controlled weapon engagement simulation/data collection system is composed of the WESS used in conjunction with the ADCS.

The major advantage of the WESS is that it can be installed and operated with minimal modification to vehicles, thereby making it a mobile system.

The Weapons Engagement Scoring System (WESS) provides a tool for TCATA in the area of weapon engagement systems. WESS is used to simulate various attack-target events during tests conducted at Fort Hood. WESS is integrated with the PRRS or PDS and the ADCS to provide large area coverage over the Fort Hood test range.

WESS is capable of operating in a stand-alone mode when the PRRS/PDS/ADCS system is not available or required for test support.

The WESS consists of a combination of subsystems capable of equipping 190 weapons systems on the test battlefield. The major subsystems are a Laser Weapon Simulator (LWS), Signal Processing and Control Logic Unit (SPCLU), and a Detector Array Subsystem (DAS). The LWS is used to simulate the firing of actual weapons; the DAS is used as a receiver for the LWS signals; the SPCLU is used to coordinate and control all the data from the basic subsystems and to generate a kill/no kill decision.

The DAS consists of 12 photo diodes mounted on an aluminum hemisphere to provide greater than 180° hemispherical coverage. One DAS is mounted on ground vehicles to give a field-of-view greater than hemispherical to allow for detection of the laser weapon simulator pulses from any direction. Two DASs are mounted on the helicopters, one on each side, to provide a field-of-view approaching full field exposure.

The SPCLU consists of an encoder, a probability of kill (P_k) calculator, a data sorter, master control panel, and a special purpose controller (SIMP), programmed to perform the functions of hit counting, storage timing, control, and interfacing.

The encoder trigger switch selects the mode of weapon fire; that is single shot, automatic, or missile mode. An ID generator then produces a train of laser "fire-pulses" to the LWS. These "fire-pulses" consist of 20 identical messages per each on-tenth of a second fire round. Each of the messages in a round is comprised of three laser data pulses. The relative position of each pulse encodes the actual message information. The first pulse starts a time reference that will be used to decode the succeeding two pulses (this is time multiplex coding). These pulses carry information of the weapon type and mode of fire and the SPCLU serial number.

Operational description of the WESS will be aided by the block diagram at Figure B-3. The MUs, a part of the PRRS system, are attached to each WESS vehicle and routinely provide position data to the ADCS through the PRRS link. The mobile reference stations of PDS can also provide this data. The BPD's provide an RF data link between the WESS/ADCS. Upon the activation of the trigger of the WESS firng vehicle, the SPCLU provides pulsed data messages to the LWS. These messages identify the firing vehicle SPCLU number and the weapon type being simulated. At the same time the LWS is fired, an on-board printer (if used) records engagement event, time and date, the fire simulator is turned on, and the data message provided to the BPD. The BPD, when polled each three seconds, informs the ADCS of the engagement data and BPD number. The ADCS accepts this information and time tags it. The LWS fire message is received at the target vehicle DAS, sent to the SPCLU, and decoded. The target SPCLU activates its under-fire light and outputs the event data to the printer (if used). At the same time, the event information is sent to the BPD to await transfer to the ADCS upon being polled. The ADCS accepts this information, time tags it, and computes the range between the firing (LWS) and the target (DAS) vehicles from position data provided by PRRS central. Based on this range and the predetermined effectiveness of the firing weapon against the type of target vehicle, a probability of kill index is obtained from the appropriate

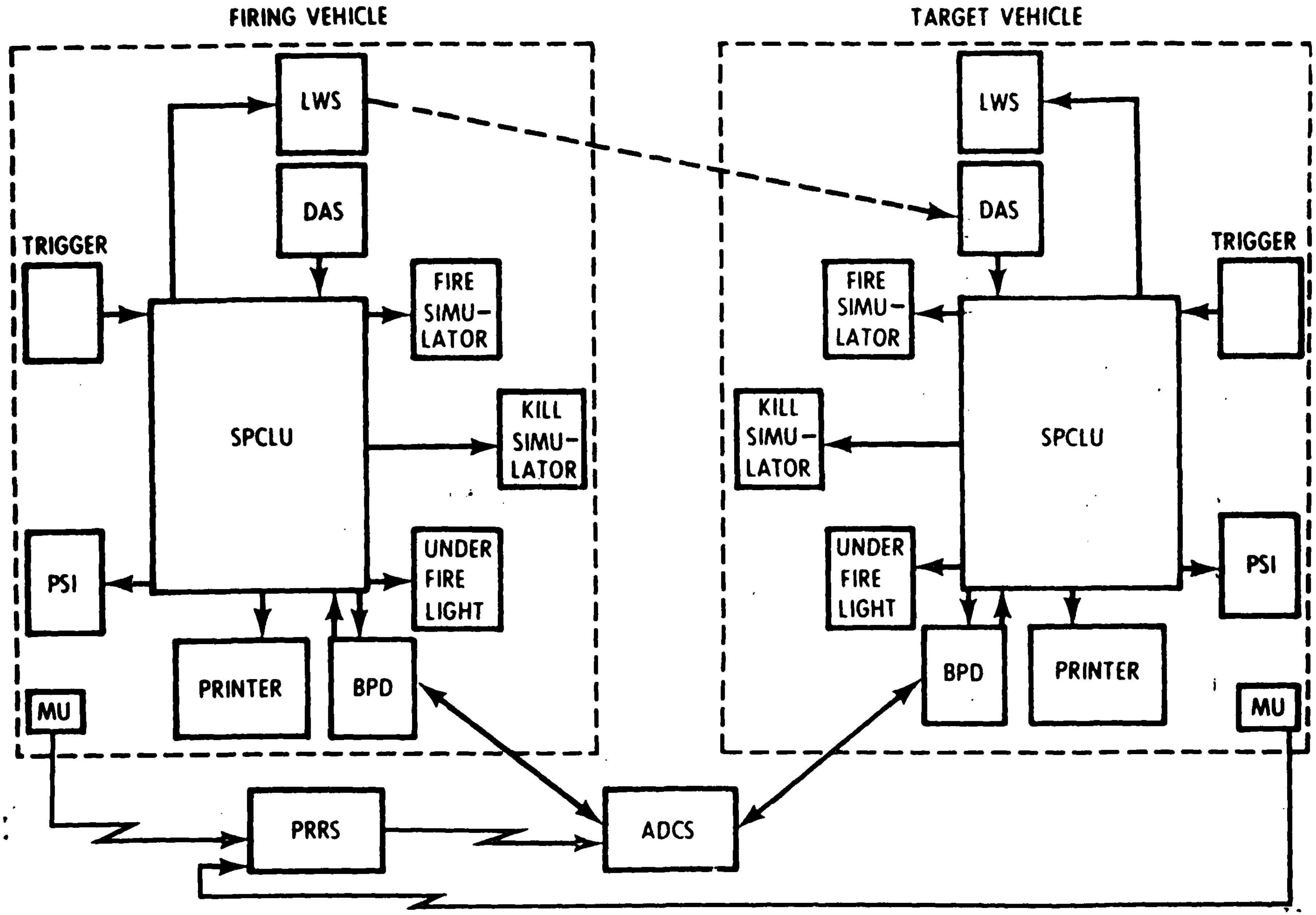

FIGURE B-3 WESS OPERATION

look-up table in the ADCS computer. This index is transferred through the BPD to the target SPCLU where the P_k associated with the index is compared to a random number generator (using Monte Carlo techniques). If this operation determines that a kill has occurred, the target SPCLU activates its kill signal, transfers kill data to the printer and BPD, and deactivates the target LWS vehicle to simulate a kill. The kill signal includes the operation of a flashing light, detonation of a smoke grenade, and activation of the kill light on the Timing and Control Panel (TCP) on the target vehicle. During the next polling period, the BPD information of kill data is transferred to the ADCS for time tagging and storage.

To simulate reload and logistics support, the WESS incorporates a rearm control. This control resets the round counter of the weapon's basic load and readies the entire system for subsequent engagements. This action can be accomplished manually at the SPCLU or automatically by a reset command from the ADCS.

In the stand-alone mode, the WESS operates independently of the ADCS and PRRS. The operation is similar as described except the P_k value is determined from pre-set information in the SPCLU and the time is recorded only if the printers are used.

(2) Salient Features

(a) Design capability 200 armed vehicles.

(b) Interfaces with ADCS for data exchange.

(c) Realistic attrition imposed as a function of firing weapons type, target thickness and range.

(d) Selectable P_k (probability of kill).

(e) Eye-safe laser operation.

(f) Adjustable basic load, missile flight time and round-to-round delay.

(g) Vehicular powered.

(h) Free play.

(i) Ranges up to more than 3000 meters.

(j) Automatic or manual rearming.

(k) Stand alone capability with reduced performance.

(3) Laser Laboratory A Laser Laboratory has been built to establish a semi-clean room in which laser devices can be tested, repaired, and aligned. A four-foot wide tunnel approximately 75 feet long has been constructed along side the laboratory. The tunnel is used to align lasers for later optical boresight with weapons on test vehicles and to electronically bench check lasers to insure that eye safety standards are

met. The Laser Lab houses special optical equipment for viewing the infrared emissions generated by lasers and special test and handling equipment required to test and repair them.

c. Voice Recording System (VRS) and Voice Recording System Reduction (VRSR) Facility. The VRS is a trailer-mounted, highly mobile recording system. The VRSR facility is designed to reproduce audio signals that are recorded by the VRS. The VRSR has 13 dual track Lafayette cassette recorders responsive to the 13-channels of audio recorded on the VRS tape. Audio is taped on the left channel of the cassette while IRIG-B is taped on the right channel to correlate test events. The cassettes have a one-hour capability and record from the VRS tape only when voice activated, thereby eliminating "dead time." Cassettes are issued to users, along with Remote Recording Units (RRU's), to enhance test officer analysis efforts. The RRU's consist of a small cassettee player, an IRIG-B Time Recorder Display unit that indicates time of each conversation, volume-controlled earphones, and a power cord. All units are housed in an attache case for ease of handling.

d. Timing -IRIG-B A time standard "locked" to National Bureau of Standards is transmitted throughout the Fort Hood test area using an Inter-Range Instrumentation Group standrard type B modulation, IRIG-B. Advantage of this system is that all major collection and storage centers are able to generate "time tagged" data records. Time signals are available for all instrumentation systems to use.

e. Television Fifty (50) channels of time-correlated video instrumentation configured for airborne and ground mobile application are available. Table B-3 lists equipment on hand as of 1 Oct 80.

f. Photography An extensive number and variety of still and motion picture cameras are available. All still picture processing is accomplished in-house. Motion picture film is processed by contract. Table B-4 lists photographic equipment available as of 1 Oct 80.

g. Other General or Special-Purpose Instrumentation

(1) Telemetry: Not addressed.

(2) Meteorological: Not addressed.

(3) Survey: Not addressed.

(4) RFI/Electromagnetic Capability TCATA has a limited capability to perform RFI testing under laboratory conditions.

(5) Visibility: Not addressed.

(6) Sound Measurement TCATA has a limited ability to measure sound using an octave hand analyzer and sound level master.

(7) Soil Conditions: Not addressed.

EQUIPMENT ON HAND
1 Oct 80

Remote random access control, VTR	Sony RM 300	2
Monitor	Sony 115	12
Monitor	Sony 112	4
Monitor	Panasonic	11
LLTV w/pan & tilt	Cohu model 2856	1
Radio, portable	Motorola MX 350	8
Video XY plotter	Hill Electronics mdl #582	1
Camera, color, video	Hitachi, FP20S	1
Recorder, video	Sony 2860	2
Editing control, video	Sony RM 430	1
Video player	SLP 300	2
Monitors, color	Panasonic model CT-911VA	2
Audio recorder	Sony TC-377	2
Recorders, video	Panasonic 9200A	2
Cassette player audio	Wollensak 2750AV	1
Inverter	Model 5060-24	1
Freq changer	Model FC 5060U	2
IRIG time code generator	Systron Donner model 8526	2
Camera, video	Edo Western model 1411	6
Time date generators	IET model VTG 302	10
Time date generators w/IRIG update	IET VTG 307	30
Time date generators w/IRIG update numeric inserter	Hill Electronics Mdl 507	1
Video XY plotter	Hill Electronics Model	1
Recorder, video	Sony AV 3400, Rover	4
Recorder/player video	Sony SLO 340	33
Camera, video	Sony 3450	38
Videorecorder	Sony 3600	4
Videorecorder	Sony 3650	3
Monitors	CVM 115 Sony	10
Monitors	Panasonic TR-920m	4
Monitors	JVC #4800	2
Camera, video	Sony 3250	7
Camera, video	Panasonic WV-241	4
Editing control, video	Panasonic	1
Camera, video, cold	Sony DXC 1640	2
Monitor, monochrome	CVM 1900	2
Monitor, color	PVM 8000	1
Recorder/player video	Sony SLO 323	4
Camera, video, color	GS-4800U JVC	2
Monitor, color, video	JVC 7139UM	2

Video Equipment

Table B-3

PHOTO EQUIPMENT

35mm cameras, Nikon, Model F7F25
120 film camera, Mamiya R.367, SLR
120 film camera, Bronica S2A, SLR
120 film camera, Hasselblad, SLR
4X5 camera, Crown graphic
4X5 Vue camera, Calumet
Copy camera, MP-4

Camera, motion picture
Camera, 16mm, K.321, Milliken
Camera, 16mm Bolex H-16
Camera, 16mm Arriflex, 16SB6S
Camera, 16mm 1VN, Photosonics

Image Stabilizing System, Dyna Lens
Motion analyzer, 16mm Vanguard
Film projector/analyzer, MW Mdl 224
Projector, 16mm, sound, Singer

Recorder, audio, 1/4", Nagra 4.2L

Enlarger, Chromega, 4X5, model D
Enlarger, Durst, 2 1/4 X 3 1/4, M800
Processor, film, Image Maker, Mdl 5000

Mounter, slide Pako 35
Duplicator, slide, Chroma Pro
Duplicator, slide, Repronar
Moviola, 16mm, UL20CS

Photographic Equipment

Table B-4

h. Special Purpose Instrumentation

(1) Ballistic Data: Not addressed.

(2) Environmental Chambers: Not addressed.

(3) Vehicle Performance: Not addressed.

(4) CBR Instrumentation: Not addressed.

5. Threats/Targets

The Weapons Engagement Scoring System (WESS) described in paragraph 4b provides a source of both air and ground targets.

6. Data Handling/Processing

a. Data Collection

(1) System Description The primary function of the Automatic Data Collection System (ADCS) is to control the engagement simulations as they occur and to generate a record of all test activities. All elements of "free play" test are "linked" to the ADCS system by a sequentially polled (3 second), 24 bit data link. Engagement control messages to and from all active test participants are transferred on this data link. All data is recorded on magnetic tape to perform the data collection function.

The Automatic Data Collection System (ADCS) is designed to relay data by RF and wire from various points within a test zone to a central recording system (RS) van. The system includes three RS vans so that three tests may take place simultaneously in different sections of the base, or at different bases. The ADCS system consists of the following basic elements:

(a) 3 RS vans.

(b) Fixed and portable relay towers.

(c) 200 basic portable devices (BPD).

(d) 100 Patrol input devices (PID).

(e) 50 keyboard input devices (KID).

The RS van contains a computer (CPU), associated peripheral devices, receivers, and transmitters that communicate with external devices, and two magnetic tape recorders. Data is received from up to 200 BPD's when these are polled by the van's polling transmitter. All BPD's are sequentially polled every three seconds. Data is processed by the van's CPU, then transferred to peripheral devices for readout and storage. A central synchronized time standard (IRIG-B) format is also received, processed, and sent to the CPU to time tag events as they occur. Position information is received from the PRRS by FM data link, collated with the event information, and used to determine engagement range between participants. The RS relay is used to extend the range of the receivers in the van. Reception and transmission functions of the van are normally provided by erection of a 100-foot tower adjacent to the van.

An RS van has assigned to it at the beginning of a test some portion of the 200 BPD's. The BPD's respond to the poll if they have a message to transmit to the RS van. A BPD message consists of 24 bits of data which equates to four alphanumeric characters. The messages received at the RS van are stored on magnetic tape and up to 10 BPD's data can be printed out in realtime under computer control within the RS van. In addition, the RS van has the necessary computer facilities to do calculations and data formatting for realtime printout or display on a CRT. Within the polling operation, the RS van has the capability of sending control characters to the BPD's for messages to the RS van and can transmit limited control messages to the BPD's.

The BPD's are designed to work with three types of peripheral devices. The simplest of these is the PID which contains a 9-key keyboard plus four control keys. This unit is designed to be hand carried by personnel either participating in the exercise or serving as monitors of the exercise. Observers or participants can report significant events in the test through the use of a predetermined set of four character code words. The ADCS system receives the messages and tags them with the time of day to an accuracy of one second. The second peripheral device is the KID which operates in the same manner as the PID and has a full 64-key character keyboard. The messages still are limited to four alphanumerical characters but the selection of characters is more extensive with this keyboard. The third type of data input to the BPD's is through a connector on the BPD's referred to as the unspecified input device. This connector is used to connect the BPD to other equipment. The equipment can format messages to be relayed to the RS van and can be controlled to a limited extent from the RS van through the use of the control functions in the polling transmission. Thus it is possible, for instance, to put a measuring device in the field and to have the device respond with the measured parameter any time the RS van sent out a specified control function indicating that a reading was desired.

Each RS van is capable of maintaining fairly extensive observation of a single test in progress. The ADCS network provides an RS van with the capability of gathering data from a variety of sources in the field and has the capability of tapping the PRRS position data as desired. In addition, it has magnetic tape storage capability and an automatic data processing capability sufficient to provide formatted record of the test, limited realtime analysis of the test, and some limited control over equipment involved in the test through the use of these unspecified input connections to the BPD's.

(2) Salient Features

(a) Design capability - 200 field elements.

(b) Frequency - 26.65 and 29.9 MHz.

(c) Portable and fixed relay towers.

(d) 3 second polling cycle.

(e) 24 bit data work.

(f) Flexible programming.

(g) Three vans - each 200 element capacity.

(h) RF mode - 15 km/wire mode - 2 km.

(i) Entire Fort Hood reservation coverage.

(j) BPD's can be operated from battery of vehicle power.

(k) Automatic correlation of PRRS data.

(l) Automatic or manual field input.

(m) Down-link command capability.

b. Quick-Look Capabilities The PRRS, PDS, and ADCS have some realtime display and printing capabilities.

c. Processing The data processing support of TCATA is the responsibility of the Assistant Chief of Staff, Automatic Data Processing, using a computer facility provided by a private company, Planning Research Corporation. This facility, called Contractor-Owned, Contractor-Operated (COCO), is unique in the Army in that it provides for hardware, operations, and maintenance from a contractor, with all the software being the responsibility of Government personnel. This facility is for exclusive use of TCATA and is located at West Fort Hood in the tunnel complex, Building 92026W. Other computer facilities on Fort Hood are not available for OT&E use.

The COCO contract calls for 15 8-hour shifts of operation per week that can be rearranged to meet requirements given seven days notice. Full 24 hours per day, seven days per week operation can be arranged on a limited basis by paying contractor overtime. Classified processing can be accomplished in the batch mode only.

A brief outline of the computer facility is as follows:

(1) CPU: IBM 370/145

1 megabyte main memory

(2) Operating System: OS/VS1

(3) Software: FORTRAN, COBOL, Assembler

CICS

(4) Disk storage: 6 each IBM 3340 disk drives

2 each IBM 3344 disk drives

Approximately one billion bytes storage

(5) Tape units: 6 each IBM 3420 tape drives, 9-track,

800/16000 BPI

(6) Printer: 1 each IBM 1403 printer

(7) Card reader/punch: 1 each IBM 2501 card reader

1 each IBM 1442 card punch

(8) Communications: IBM 3704 communications controller

Various IBM 3277 local terminals,

Harris 8110 remote terminals,

Texas Instrument silent 700 terminals,

Hewlett-Packard terminals, and low-speed printers

Two remote reader/printers

(9) Plotting: Calcomp 1055 plotter

Calcomp 925 controller

(10) Optical Mark Reader: IBM 3881 OMR

No readtime processing or automated connection to the instrumentation systems is accomplished by the COCO computer facility. All processing on the IBM 370/145 is accomplished by either batch or interactive using terminals. The two remote reader/printers are located within the tunnel complex in support of Government programmers.

Available on the COCO computer is the statistical package, BMDP77, provided by the University of California at Los Angeles. This package contains a large variety of statistical routines. These routines can be executed from the remote terminal located throughout TCATA.

Another feature of the COCO computer is the availability of IBM's Advanced Text Management System (ATMS). This allows for the automated management of large or small amounts of text entered through a terminal. Documents of several hundred pages can be prepared using this system and subsequently printed on the high-speed IBM printer in a short time. This printed output can then be reproduced on page size sheets for binding.

ANNEX C

OPERATIONAL TEST INSTRUMENTATION GUIDE

USA COMBAT DEVELOPMENTS EXPERIMENTATION COMMAND (USACDEC)

Fort Ord, California

CONTENTS ANNEX C

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ANNEX C

US ARMY COMBAT DEVELOPMENTS EXPERIMENTATION COMMAND (USACDEC)
Fort Ord, California

1. Introduction.

a. Overview. US Army Combat Developments Experimentation Command (USACDEC) is assigned to HQ TRADOC. The USACDEC headquarters is located at Fort Ord, California with field experimentation operations located at Fort Hunter Liggett. It is a military laboratory whose mission is to participate in the combat development process by conducting scientific experimentation that will:

(1) Develop and provide experimentally derived data as input for models, simulations, or war games used in the analysis and evaluation of alternative solutions to combat development actions.

(2) As directed, test and provide experimentally derived data on developmental options created by TRADOC centers and schools.

(3) Examine for validity the basic rationale used in the analysis actions of TRADOC centers and schools.

(4) Verify recommended solutions for operational concepts, material requirements, and organizational structures.

(5) Assist TRADOC centers and schools in experimental design, instrumented field testing, and scientific analysis to further the evaluation of training programs, methods and devices.

(6) Perform other combat development activities as required.

b. Generic System Tested. The US Army Combat Developments Experimentation Command is an organization that possesses operational test and evaluation capability. USACDEC'S major testing includes:

(1) Mounted combat operations.

(2) Dismounted combat operations.

(3) Indirect fire support operations.

(4) Aircraft operations.

(5) Combat support operations.

(6) Training evaluation

USACDEC testing is performed primarily at Fort Hunter Liggett (FHL) since the remoteness of FHL makes it an ideal site to conduct experiments in that most variables attributed to man can be controlled. Simulations of combat conditions are possible over a wide variety of terrain conditions. Limited airspace above FHL permits only restricted employment of indirect fire weapons and Army aviation experiments. Night experimentation is possible due to the low artificial light levels on the fort. Radio frequency interference is considered to be minimal at FHL.

2. Instrumentation Philosophy.

a. USACDEC instrumentation is designed to provide comprehensive data collection while stressing objectivity, reliability, and accuracy. The keys to this design are flexibility and adaptability using basic modular concepts which facilitate variety in configuration and installation to fit men, machines, environment, and the experimentation data requirements.

b. The goal of USACDEC's instrumentation program is the collection of the maximum amount of objective scientific data while maintaining and contributing to the highest feasible degree of realism. To this end, planning and application are oriented on causing or permitting the player, both man and machine, to perform normal functions without impediment or undue influence, while the instrumentation measures, records, and reacts in prescribed manners to player actions.

c. USACDEC strives to provide the necessary data collection capability needed to measure the required experimentation parameters. Accordingly, adaptability is one of the prime requisites for instrumentation.

d. Simulation techniques are provided by USACDEC's on-line real-time computer systems to create realistic operational configurations. USACDEC has numerous standard techniques and software configurations, and the software development capability to create new user programs when required to adapt instrumentation to the specific data requirements of an experiment. Also available is a group whose prime mission is to design and provide new and improved software for instrumentation operation and data reduction. Real-time processing permits early casualty assessment. Rapid readout permits data reduction and analysis to be completed 24-28 hours after experimentation trials. The results can be subjected to ORSA methods and, if found to be statistically valid, can justify curtailment of portions of an experiment at considerable savings to the government. Compaction and storage of data for rapid retrieval is also possible, thus providing data for use by customer agencies to avoid redundant experimentation.

e. The primary instrumentation capability provided by USACDEC is two-sided casualty assessment in real-time. This capability can be provided for multi-type weapons and combat elements simultaneously for mounted, airborne and/or dismounted operations. By proper combination of the Range Measuring System (RMS), the Direct Fire Simulator (DFS) System, the Range Timing System (RTS) and the Multi-Computer System (MCS) under the control of real-time casualty assessment software programs, field experiments can be conducted for infantry, mounted and/or airborne elements. The real-time casualty assessment system currently provides weapon target pairing, position location of players (this is used to establish range between weapon and target at engagement), a kill assessment by the computer, and notification to both weapon and target of a hit or kill. All events are time-tagged as they occur. Plans are underway to augment this capability with Indirect Fire Casualty Assessment Suppression (IFCAS) data and Intervisibility data.

f. To improve the flexibility for adapting the RMS and DFS in real-time operations, a new micro-miniaturized Programmable Integrated Pallet System (PIPS) is used. This PIPS, and upgraded MIPS, with on-board Micro-processing control system correlates all events and data necessary for successful real-time casualty assessment experimentation. Additionally, the PIPS provides a limited on-board casualty assessment capability.

g. USACDEC's capability to instrument most any kind of player/equipment to meet the data collection requirements of an experiment in a rapid and flexible manner is based upon a modular concept. This translation of an Instrumentation Plan to an integrated fielded system involves design and fabrication of many interface devices and installation hardware, as each experiment is different.

h. USACDEC has many mounting kits, input/output devices, control boxes, and visual and audio display equipment that must be adapted to fit the data collection requirements. New mounts and event collectors are designed and built depending upon the data required.

i. USACDEC's quick reaction capability is due in part tc a scientific support contractor who provides engineering and maintenance personnel for expert technical support. The facilities available to provide this flexible support are a 7,500 square foot Engineering Developments Laboratory and a 22,000 square foot Maintenance and Fabrication Facility. Both military and contractor personnel have the use of these facilities.

3. Long Term Development.

a. USACDEC's instrumentation program is very dynamic in nature to meet ever-expanding proponent needs; technological advances in Army material frequently dictate improvements and additions to USACDEC's instrumentation. For these reasons, a Five Year Instrumentation Program (FYIP) is now an important part of the USACDEC five year program. Where suitable instrumentation is commercially available, that equipment is of course procured.

b. When suitable instrumentation is not available, however, the FTIP provides for developing performance characteristics and specifications to satisfy requirements, procuring prototype instrumentation, testing the prototype, and then procuring production instrumentation to add to the inventory.

c. Instrumentation systems are continually evaluated during and subsequent to use, which also serves to stimulate the FYIP. In some systems, second and third generation equipment have been procured to increase accuracy, reliability and efficiency of operation; to reduce size and weight; or to expand the capability to accommodate more, as well as an increased variety of players and weapons. In addition, the FYIP seeks to enhance data collection and data reduction. A most important element of the FYIP is to establish or enhance the mobility of the instrumentation and to allow experimentation at multiple areas simultaneously.

d. USACDEC has established a well-planned and achievable FYIP using both RDTE and OPA funds to implement the ever-increasing data collection requirements caused by increased complexity of experimentation and system concepts being tested.

4. Personnel: USACDEC is organized under the Deputy Chief of Staff structure as shown in figure C-1.

a. Military Units

(1) HHC, USACDEC

(a) Manpower: 182 Officers, 4 WO, 206 SM, 69 Civ.

(b) Mission: Performs command functions and administrative functions for enlisted personnel of the Headquarters and Headquarters Company.

(2) Experimentation Support Command (ESC)

(a) Manpower: 40 Officers, 8 WO, 1032 SM, 1 Civ.

(b) Mission: Provides command and control of assigned attached units that support experimentation and training operations of CDEC.

(3) Instrumentation Command (Provisional)

(a) Manpower: 60 Officers, 3 WO, 313 SM, 19 Civ.

(b) Mission: Provide instrumentation support for scientific field experimentation conducted by USACDEC as directed by the Commander, USACDEC. Provide engineering and planning required for instrumentation support for future scientific field experimentation.

b. Scientific Support Laboratory (SSL): From the outset of USACDEC, it was recognized that the experimental battlefield would be a joint military-scientific creation with a blending of military experience with scientific methodology. The Scientific Support Laboratory presently employs 200 scientists, engineers, and technicians providing support in the following areas: project planning and analysis, software and instrumentation development, maintenance, field experimentation, report preparation, and general program support.

5. Location/Environment.

a. Topography. Fort Hunter Liggett (FHL) is irregular in shape averaging 11 miles in width and 26 miles in length of which about 80% is usable for experimentation. The entire reservation is interspersed with hills and mountains. The Santa Lucia Range lies adjacent to the coast and the crest roughly forms the western boundary of the reservation at approximately 3,000 feet elevation. Paralleling this range are several lesser unnamed ranges which form the valleys of the San Antonio and Nacimiento Rivers. The majority of the Fort Hunter Liggett watershed drains into these two rivers. They form a significant portion of the Monterey County watershed system. The Nacimiento River Valley is generally intermittent and narrow with only one appreciable flood plain, whereas the

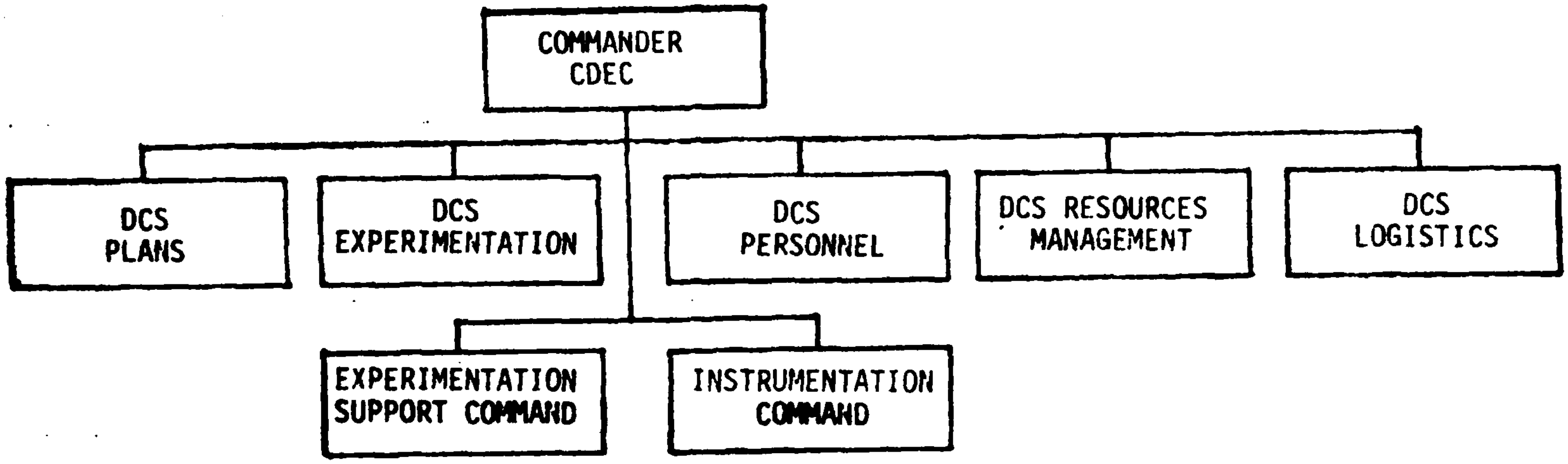

Figure C-1. CDEC Organization Chart

San Antonio River Valley has a significant amount of relatively flat ground that is suitable for many uses.

b. Access.

(1) Air. The FHL airfield consists of one large helipad. Fritzche Army Airfield, with a runway of 3000 feet, is located at Fort Ord. Commercial air transportation is available through San Francisco International Airport (10600 feet) and Monterey Peninsula Airport (6000 feet). Both have facilities for jet aircraft; Monterey Peninsula Airport can accomodate the Boeing 727. Mesa Del Ray Airport is located in King City. Currently, there is no commercial air service into King City.

(2) Rail. The main coast route of the Southern Pacific Railroad, which parallels US Highway 101, provides access to two railheads with direct connections to Fort Ord. The nearest railhead to FHL is located at King City; the other is at Camp Roberts. McKay Railhead, Camp Roberts, is ideal for the shipment of armored vehicles due to the proximity of California National Guard elements which provide security and loading/unloading support, and a tank trail leading directly to Fort Hunter Liggett. This makes it possible to move vehicles to the railhead without having to rely on transport equipment.

(3) Road. Access to FHL is via US Highway 101 on the western border of the reservation. The Jolon-Bradley Road connects FHL to US Highway 101.

(4) Water. Port facilities in the Monterey, Moss Landing, San Francisco areas are available.

c. Logistic Support Capability. The logistical support capability of Fort Ord and FHL are adequate for supporting present and reasonable future operations. Definite requirements are necessary before a comprehensive review of maintenance/logistical capability could be provided.

d. Recurring Commitments. During the months of June and July, the National Guard and Army Reserve utilize FHL on a priority basis. There are several two-week training periods dispersed throughout these months.

e. Special Operating Restrictions. Presently there are no special operational restrictions governing the use of FHL.

f. Airspace Restrictions. The major portion of FHL is within restricted airspace. R-2513 is restricted up to 24,000 feet above sea level.

g. Environment. FHL is characterized by relatively cool winters and extremely hot summers. The coldest month is January which, at the FHL airfield, averages a minimum of 32°F with a record low of 21°F. The warmest month is August, which averages a maximum of 96°F with a record high of 108°F.

The relative humidity is inversely proportional to the temperature, with the highest occuring in the early morning and the lowest in the afternoon. There are two humidity seasons, with the relatively lower humidity experienced during the summer months.

Average annual rainfall in the FHL area is influenced by the coastal mountains, averaging 16 inches on the coastal, 16 inches at the airfield, and 11 inches at King City. The Nacimento Valley receives 29 inches and the Gabilan Valley receives 22 inches annually. From November to March, this rainfall causes an extremely muddy condition to exist which severely limits cross-country vehicle travel.

Snow rarely falls in the San Antonio Valley, although it annually falls on Junipero Serra Peak.

The predominant influence on the winds at FHL is the ruggedness of the surrounding terrain. Wind speeds at FHL are usually light, especially in the valleys.

6. Operational Equipment.

a. Multi-Computer System (MCS).

(1) General. The MCS consists of a Digital Equipment Corporation (DEC) System 1070 Computer, 12 PDP 11/45 mini-computers and associated peripheral equipment. It is housed in a building specifically designed and built for that purpose. Generators providing emergency power backup are located onsite. The DEC System 1070 computer has a 512,000 (36-bit) word core memory. The 12 PDP 11/45 computers are connected through an interface providing additional processing space for 672,000 (16-bit) words.

(2) Capabilities. The MCS has the capability of computing real-time position location and casualty assessment. The multi-programming feature of the MCS allows for high speed real-time processing of large amounts of experimentation data. Remote terminals allow analysis of data from points at FHL other than the MCS and from Ft Ord.

(3) A specially designed computer building of approximately 11,000 square feet in area, houses the MCS. Areas for maintenance, systems analysis and programing, supply, tape and disc storage, and administration and control are provided in the building.

b. Visual Information Display System (VIDS).

(1) The VIDS is an experimentation display system designed to monitor field experiments in real-time and enhance analysis of experimentation results.

(2) General Description. The VIDS is self-contained in an environmentally controlled, EMI shielded, semi-trailer measuring 55 by ten feet. It includes one large screen CRT and six high resolution color CRT displays. A maximum of three of the displays connected to the CPU, simultaneously, operate independently of each other. The other four displays can be slaved to the three which have computer interfaces. The system is linked to the Multi-Computer center via CODEX adapters and a 600 meter data link. The system also includes a video map converter which

digitizes maps or other static data. This digitized information is merged with RMS data for display.

c. Real Time Position Location System.

(1) General. The Range Measuring System (RMS) interfaced with the MCS provides a position locating capability. In addition, the system provides a two-way telemetry link for data distribution and collection to or from a player element. The RMS was conceived as a means of rapidly determining the position of men, vehicles, and/or aircraft in mock battles in relation to time with one another.

(a) The USACDEC system currently consists of the following basic components: 54 A-Stations; 104 B-Units; five C-Stations; three D-Stations; and four micro-A/D Stations which can be used as either A or D-Stations. Units of the DDRE, Yuma PG and the Air Force HAMOTS systems are interchangeable with the USACDEC RMS units.

(b) The A-Station, an interrogator station, is a semifixed radio link between the C-Station and the Field units (B-Units). The station consists of an RF transmitter and receiver, solar power modules, and antenna.

(c) The B-unit is a man-transportable responder which weighs three pounds and has a volume of 40 cubic inches. It consists of a transmitter/receiver assembly, logic module, battery power supply, an antenna and one of a variety of input/output units which may be connected to the unit. The unit may be man-carries, ground-vehicle mounted or mounted in aircraft.

(d) The C-10 and C-11 station, the Mobile Master Control Station (MMCS) and the Fixed Maintenance Test Set (FMTS), are interfaced to the MCS. These have the capability of driving the RMS/MCS combination or operating in a stand-alone data collection mode of RMS. The MMCS and FMTS have the capability of communicating via cable or microwave to the MCS from remote sites.

(e) The C-5 and C-6 stations are used for maintenance and engineering development. The C-3 station is used in the field for instrumentation checkout.

(f) The D-station is a relay used as an intermediate radio link between the C and A-stations where direct communication is not possible. The station consists of an RF transmitter and receiver, solar power modules, and antenna. By use of a microwave dish antenna, the range between the C-station and the D-station can be extended to allow direct RMS operations at Camp Roberts.

(g) The micro-A/D station possesses the same characteristics as the A-station and the D-station and can function as either one during a given time interval. The function of the A/D units is controlled by an address of the control station.

(2) Capabilities.

(a) The C-stations are interfaced with the MCS so that ranging data and event information can be stored and calculated in real-time.

(b) Position location of a B-unit can be calculated by the computer from the ranging data between three or more A-stations. Computer programs are available to provide position data from stationary and moving ground vehicles and aircraft.

(c) B-units can be used in an infantry mode of operation in conjunction with the Infantry DFS.

(d) Event information can be input into the B-units either by manual entry or direct interfacing. Output of event data from the B to the player element is also possible.

(e) Two-way communications up to 42 bits of data exist which allow real-time casualty assessment.

(f) Typical accuracy of plus or minus 5 meters in the X-Y plane is achieved.

(g) To track airborne elements, USACDEC employs RMS with precision radar altimeters.

(3) Limitations.

(a) Radio line-of-sight is required between any two RF communicating components.

(b) Maximum range from A-station to B-unit is 64 km.

(c) Minimum range from A-station to B-unit is 30 meters.

(d) Z accuracy does not meet the requirement of most airborne experiments.

d. Simulated Fire Systems.

(1) General. USACDEC is able to safely evaluate the effectiveness of advanced tactics through use of actual troops and weapons in realistic battle scenarios by instrumenting each combatant with equipment to simulate and monitor weapons engagements. Direct fire weapons such as rifles, guns and missile launchers have lasers mounted to them so that they can engage vehicles, aircraft and personnel equipped with detectors. The equipment that controls the lasers communicates with a central computer that performs casualty assessment. Indirect fire weapons such as artillery and mortars are simulated under control of the central computer (MCS).

(2) Capabilities.

(a) Direct Fire Simulator (DFS) System: Direct fire weapons are able to generate simulated casualties by firing eye safe infrared, laser light at targets equipped with special laser detectors. The instrumentation provides laser simulation, as well as data formatting, weapon signatures, laser coding/decoding and data communications between personnel and the central computer.

1 Infantry Direct Fire Simulator System (IDFSS). Up to 90 soldiers can be instrumented with all the necessary equipment in backpacks. A small laser mounts to the front of the M16 or other weapon and the antenna for data communications is mounted on the helmet.

2 Vehicle Systems. Up to 50 basic vehicle systems can be equipped with the Programmable Instrumentation Pallet System (PIPS) controlling 5, 12, or 30 watt lasers depending on weapon range. In order to provide an additional 130 vehicle systems, equipment from the IDFSS can be mounted with each of 130 Programable Logic Boxes (PLB) to obtain the same performance as that from the PIPS. These systems are microprocessor based to provide flexibility in function.

(b) Lasers. Generally the type of laser used on a weapon is based on the effective range of the weapon.

1 IDFSS (Small Gun) Laser. This laser is switchable from 1 to 5 watts for ranges from 800 to 3000 meters. There are 129 of these lasers.

2 DFS (Large Gun). This 12 watt laser is used to 5000 meters. There are 26 of these lasers.

3 ARMVAL DFS Laser. Sixteen of these 15 watt lasers were purchased for an experiment and are now owned by USACDEC. They are used out to 6000 meters.

4 Mounted Direct Fire Simulator (MDFS) Laser. These five lasers consist of two lasers each; one similar to the ARMVAL DFS Laser and the other a wide beam at about 35 watts.

(c) Indirect Fire Simulation/Cueing. Present emphasis on indirect fire simulation/cueing continues to be concentrated on the following projects:

1 Forward Observer Cueing Panel (FOCP). The FOCP has been developed for mounted and dismounted operations. This system consisting of small hand or pistol-belt mounted electronic box which provides information display lights and artillery range/deflection distances. These distances simulate corrections to computer generated artillery fire which a forward observer would send to a fire direction center. Update of information on the panel for near real-time input is provided via the RMS system to the CDEC Multiple Computer System.

2 Indirect Fire Terminal Effects Cue (IFTEC). A pneumatic launcher (feasibility model) was developed to fire man-safe artillery impact cues to a range of 150 meters. The projectiles are made of polystyrene and provide flash, bang, and smoke cues upon impact. A follow-on prototype is planned.

e. Range Timing System. The Range Timing System provides time correlation and references for data obtained from various data gathering systems in the experimentation area. One system is a standard commercial timing system for receiving and adjusting the precise timing signals (from WWV in Boulder, CO) and generating locally transmitted (wire and FM radio) timing signals. This system contains triple redundant oscillators and IRIG B time code generators, that feed into one of two transmitters; one of which always on standby while the other is being utilized. A second contains seven Satellite Time Receivers. These units receive a time signal that is transmitted by the National Bureau of Standards over two geostationary operational environmental satellites. The time transmissions are maintained by the NBS to better that one millisecond over the entire United States.

f. Television.

(1) General. The CCTV system collects video and audio data during an experiment and time-tags the data for later reduction. Video recording during an experiment can be made from ground mounts or stationary vehicles; also in the man carried mode direct input or time data or other character generation is possible.

(2) Capabilities. The CCTV systems are versatile enough to instrument a variety of systems. Thirteen studio quality video tape recorders (Sony 3650 series) permit quality video productions to be made. Forty one video time character generators can be used to insert time-tags or fixed information on the video data. Video monitor inventory contain both AC and DC powered units.

g. Photography.

(1) Photographic Instrumentation Data Recording System (PIDRS).

(a) PIDRS is used to photographically record data from various vehicles, troop weapons and aircraft at Ft Hunter Liggett. These instrumentation film camera systems deliver detailed time tagged silent motion picture records of slow or normal speed events. High speed events can be slowed down for detailed analysis.

(b) The system utilizes a 16mm Photosonic 1P camera with frame rates of 16, 24, 48, 96, 200 and 400 frames per second. Film magazines 100, 200, 400, and 1,200 feet film capacity are available. The standard lenses used are 50, 100, 150, and 300mm. Larger lenses can be used but are not in the CDEC inventory. The system can be battery operated or use regulated vehicle power.

(c) The system is currently being upgraded to what is now called the Miletus Film Data Recording System. The FDRS (Film Data Recording System) provides a means for recording real time and external data on film. A BCD format is used and is printed between the sprocket holes at the side of the film out of the normal picture area.

(d) The major components of the system are. A 16mm Camera (1-P), the control electronics or FDRS and a battery charger. Eighteen systems are equipped with the Miletus upgrade.

(2) General Photographic Equipment. This equipment is utilized in support of experimentation for general documentation coverage and for a wide range of photographic data recording situations and includes motion picture cameras, still cameras, and black and white or color film processing equipment.

(3) Photometers. Photometer support is provided by the Army Meteorology Team attached to USACDEC.

(4) Motion Picture Sound Recording System (MPSRS). The MPSRS is used for mixing sound recording tracks with black and white and color motion pictures in support of experimentation. This system gives CDEC the capability and flexibility needed for the mixing of sound recording tracks with motion pictures.

h. Instrumentation Calibration Capabilities.

(a) There are two major facilities at FHL which support instrumentation. One is a shop facility which has approximately 22,000 square feet of floor space for maintenace of electronic equipment, fabrication of wood, metal and plastic items, and for environmentally controlled storage of instrumentation equipment and magnetic tape. The other facility is a 7500 square foot Engineering Developments Laboratory which provides support for electronic development, fabrication and testing of equipment built specifically for instrumentation. Both facilities, however, provide only very limited calibration capabilities. The major source of calibration is provided by a team from the Sacramento Army Depot.

(b) Test equipment used in maintenance is generally GFE to the maintenance contractor who uses it for calibration, maintenance, and check-out of all existing instrumentation. The test equipment located in the Engineering Developments Laboratory is used to develop system interface prototypes, construct breadboard models of system modifications and interface systems needed to use various instrumentation systems together as a data collection system for an experiment.

i. General Instrumentation.

(1)Telemetry. See the section covering the RMS. Telemetry functions are provided by equipment built into each systems.

(2) Meteorological. An Army Meteorological Team with normal authorized equipment is assigned to FHL for meteorological duties. These duties include such items as forecasting, standard surface observations, upper air observations by Rawinsonde and Pibals, and Micromet observations such as temperature, humidity, air pressure, wind speed, etc.

(3) Survey.

(a) USACDEC presently has 121 survey points whose final adjusted horizontal positions and elevations are accurate to plus or minus 0.3 meter relative to the basic network survey which is itself positioned with an accuracy of plus or minus 0.1 meter relative to the Transcontinental Traverse Stations. The RMS has the capability of self-survey for an array of A-stations to accurate relative locations. By using a known first order point as the cornerstone, the array can then be oriented to the real world.

(b) The surveying system consists of the K&E Ranger V distance measuring equipment, Wild Model T-3 theodolite and associated equipment required for surveying. The device uses a visible light laser for distance measuring. The system will be used primarily to survey additional RMS A-station sites, but may also be used to survey sites to meet experimentation requirements. The system is capable of measuring the LOS distance between two points to an accuracy of plus or minus 5cm up to a distance of 25km. Using proper surveying techniques, the systems can perform third order survey.

(4) Radio Frequency Interference/Electromagnetic Capability. The Electromagnetic Interference (EMI) measuring equipment provides detection, recording, and analysis of unwanted radiations in the electromagnetic environment which could result in degradation or loss of data handled by intrumentation systems.

(a) Capabilities. The EMI monitoring system is mounted in a four wheel drive vehicle for mobility. All monitoring equipment is powered by a built-in motor generator providing a self-contained operation. This initial capability was concentrated in the RMS frequency band of 918 MHz. The spectrum analyzer will cover 100 Hz to 18 GHz; however, the frequency range is limited to 30 MHz through 15 GHz by antenna design.

(b) Limitations. There is no antenna system installed to measure below 30 MHz.

(5) Sound Measurement and Analysis.

(a) Voice Recording System. The purpose of the Voice Recording System (VRS) is to collect audio data during the conduct of an experiment and time-tag it for future data reduction.

(b) USACDEC currently has two VRS systems. These are van-mounted systems to support mobility.

(c) Capabilities.

1 Records and time-tags up to 72 tactical communications channels, observer data, or controller communications during experimentation trial runs.

2 One channel of each recorder can be used to record timing from the Range Timing System.

3 Six channels on each recorder are available to record voice transmissions.

4 Each of the twelve recorders are capable of rapid search to stop the tape at any selected time mark, thus simplifying reduction of data.

5 Provisions are made for direct input of tactical radio transmissions into the system through a patch panel.

6 Direct land line communications can be recorded in addition to the radio inputs.

(6) Range Communications System (RCS).

(a) The RCS provides communications in support of CDEC instrumentation installation and maintenance teams during experimentation setup and provides intra-communications between various remote instrumentation sites without interference with operation (tactical) radios.

(b) General Description. The RCS is basically a line-of-sight Frequency Modulated FM Radio Communications System with minimal hard wire integration.

ANNEX D

OPERATIONAL TEST INSTRUMENTATION GUIDE

ABERDEEN PROVING GROUND
Aberdeen, Maryland

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ANNEX D

ABERDEEN PROVING GROUND (APG)
Aberdeen, Maryland

1. Introduction

a. Overview

Aberdeen Proving Ground (APG) is located on the shore of the Chesapeake Bay about 30 miles northeast of Baltimore, Maryland. The host organization (APG) is collocated with the Headquarters, U.S. Army Test and Evaluation Command (TECOM) which controls and directs all nine assigned Test Centers, Test Activities, and Proving Grounds, including APG.

The primary mission of APG is to conduct testing of all classes of military materiel, except long-range artillery, rockets, missiles, and helicopters.

Total acreage is 72,000 acres; however, no maneuver areas are available for tactical units. The major land areas are devoted to test firing ranges and automotive test courses. Other testing performed by the tenant organizations is primarily developmental and experimental in nature. The majority of test capabilities enumerated in the following sections are all part of the Materiel Testing Directorate (MTD), that portion of APG directly concerned with implementation of the TECOM testing mission.

These types oif testing, coupled with little or no maneuver areas, make operational testing capabilities very limited.

b. Generic Systems Tested

.Power Generators
.Air Conditioners/Heaters
.Boats
.Bridges
.Other General equipment
.Textile Materials and Uniforms
.Other Special Equipment
.Artillery Weapons
.Artillery Ammunition
.Small Arms Weapons
.Small Arms Ammunition
.Automatic Weapons
.Fire Control Systems
.Special Ordinance
.Tracked Vehicles
.Tracked Vehicle Weapon Systems
.Wheeled Vehicles
.Armor

Table D-1

APG STATION LIST

(1) Aberdeen Proving Ground
(2) Chemical System Laboratory
(3) US Army Communication Command Detachment
(4) 149th Ordnance Detachment (EOD)
(5) Company D, 5190th, MI Battalion
(6) APG Resident Office, 902DMI Group
(7) Defense Property Disposal Office
(8) USA Test and Evaluation Command
(9) US Aremy Technical Escort Unit
(10) USA Materiel Systems Analysis Activity
(11) Ballistic Research Laboratory
(12) USA Human Engineering Laboratories
(13) Joint Military Packaging Training Center
(14) DARCOM Military Packaging Training Center
(15) ARRCOM Detachment
(16) USA Ordnance and Chemical Center and School
(17) ARRARCOM Support Element
(18) USA Environmental Hygiene Agency
(19) National Guard Bureau
(20) Field Support Division
(21) Technical Coordination Office USAMBRDL
(22) Maryland Army National Guard
(23) ATM Sci Lab Aberdeen MET Team (ECOM)
(24) USA Special Security Group
(25) USA ARRADCOM Liaison Office
(26) TRADOC Liaison Office
(27) US Marine Corps Liaison Office
(28) Canadian Forces Liaison Office
(29) TARADCOM Liaison Office
(30) Public Health Service Liaison Office
(31) APG, Resident Agency 1st Rgn USACIDC
(32) Aberdeen Area Office, US Army Audit Agency, APG

2. General

a. Military Units

(1) Army Units. The Military Support Division has 159 MOS qualified enlisted personnel who perform operational field support and maintenance support of Army materiel undergoing testing at APG.

(2) Other Military Units. None.

b. Maintenance Capabilities. General maintenance plus armor welding, specialized electrical and electronic work, optical fire control, automatic weapons, machine shop, sheet metal and heat exchanger shops, and missile group support equipment bays. Facilities are sufficient for major maintenance of test items, particularly vehicles and weapons.

c. Access

(1) Air. Phillips Army Airfield (8,000-foot runway) at APG; Weide Army Airfield (3,000 feet) at Edgewood Arsenal; Baltimore Washington International Airport (9,500 feet); and Greater Wilmington Airport (7,200 feet).

(2) Rail. The rail network on Post in interconnected with the Penn Central Railroad.

(3) Road. Interstate 95 and U.S. Route 40 pass near APG. For more detail, see Figures D-1.

d. Logistic Support Capability. Billets and messing facilities are normally available for several hundred men.

e. Recurring Commitments. Annual training commitments limited to 200 enlisted men at any one time. No limit on number of officers.

f. Special Operational Restrictions. Permissible noise and blast damage limited by local APG regulations.

g. Facility Organization. The organization of both APF and HQ TECOM are addressed separately.

h. Environment (Climate). Middle Atlantic Coastal Plain.

(1) Summer. Daytime temperatures over 90° F commonly; over 100° F occasionally, high humidity (over 90 percent) common.

(2) Winter. Typical daytime temperatures +35° to +50° F, occasionally +20° F or less, humidity typ]ically high, occasionaly snowfall usually quick-melting, occasional icing.

i. Topography. Partly wooded, partly swampy, low lying, highest point on Post is 57 feet above sea level. Soil is normally very soft in impact zones.

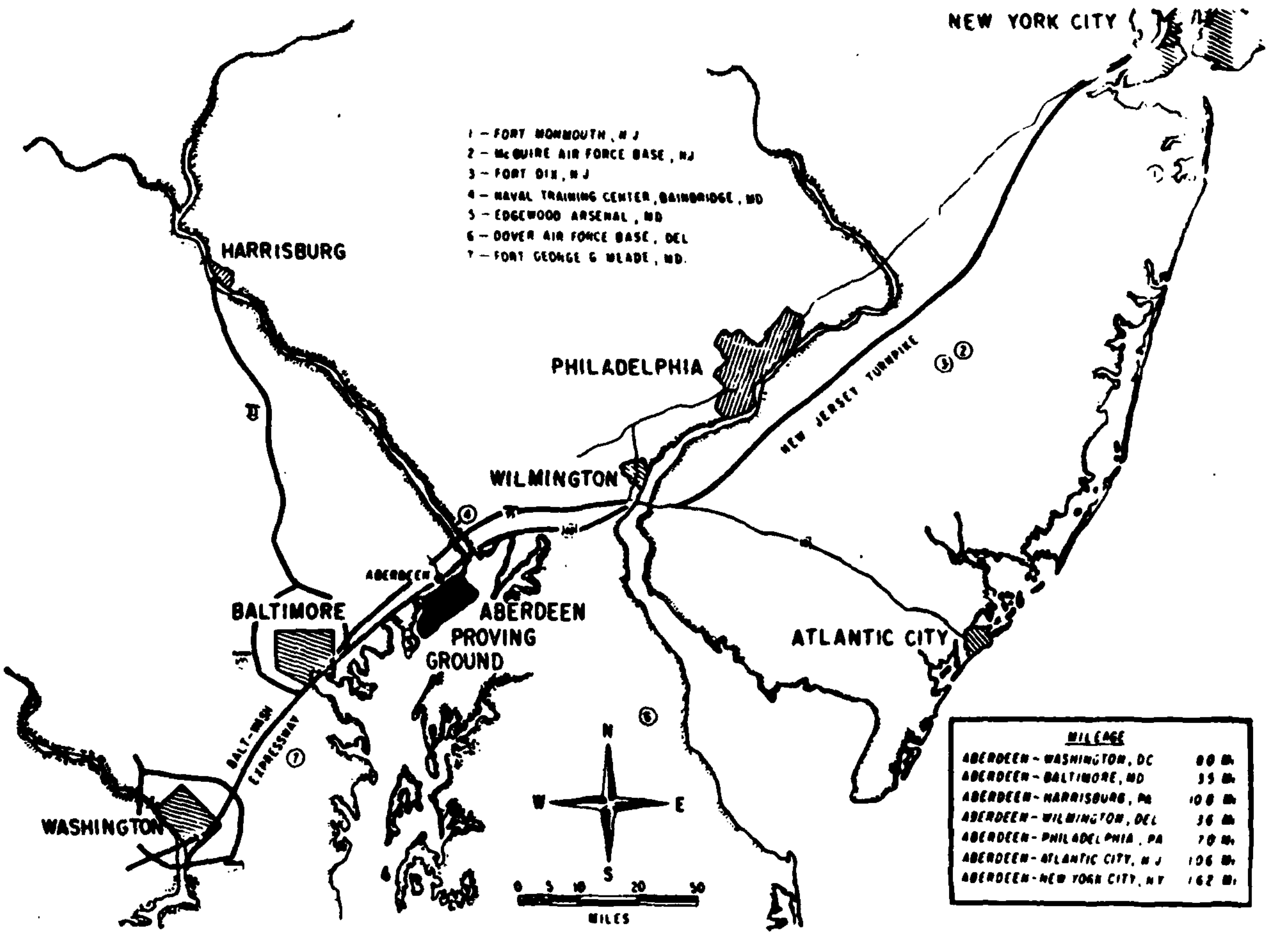

Figure D-1: APG Location Map

j. Airspace Restrictions. R-4001: fully restricted 1200-0500Z; restriceted below 10,000 feet from 0500-1200Z; higher altitudes by NOTAM. See Reference 3.

k. Power Availability. Power is available at most firing positions - in some cases up to 440V. In a few cases there is some power available downrange.

l. Communications. Both telephone and radio communications are available.

(1) Ground Radio System. Two-way VHF FM voice system, fixed, mobile, and portable, linking control towers, boates, and ground stations.

- 73 fixed base stations
- 46 mobile units
- 114 portable units

Three separate nets are operated.

(2) Ground-to-Air Radio System. Two-way UHF voice system linking control tower and ground stations with aircraft.

- 7 fixed base stations
- 4 mobile units
- 7 portable units

Two separate nets are operated.

(3) Ship-to Shore Radio System. Two-way HF/VHF aAM/FM voice system.

- 12 portable units

One net is operated: VHF FM.

3. Dimensions

a. Landspace

(1) Contiguity. There are two major test areas; see References 4 and 5 in the Bibliography.

There are also extensive vehicle test facilities at APG. Reference 2 of the Bibliography gives detailed descriptions of these test facilities but does not cover the equipment and instrumentation used on the test courses.

(2) Easements. Hunting is permitted on a non-interference basis.

(3) Impact/Live Firing Areas

(a) Explosive Ranges

1 Weapons and Munitions Range Complex. Consisting of: 6 Direct Fire Ranges, including fixed, moving ranges; 2 indirect range complexes.

The range complex is a rectangular-shaped facility covering approximately 100 square miles (64,000 acreas). The facility is used to conduct direct and indirect firing programs for artillery, infantry, aircraft, anti-aircraft, and short range rocket weapon systems. Direct-fire capabilities include six ranges instrumented up to 3,000 meters to include high-speed photography, multi-stage X-ray, time-of-flight, defeat armor and weapon system accuracy. Numerous indirect fire ranges are available to accommodate large caliber weapons with complete ammunition recovery and observation facilities located at approximately 3,000-meter intervals extending to 21,000 meters. Other recovery means include parachute, vertical firings, sawdust, water, sand, or celotex and accommodates projectiles of all types (up to 8" diameter).

Instrumented indoor ranges are available to study weapons with distances up to approximately 300 feet. Over water firings can be conducted with all size weapons to a range of approximately 35,000 meters with special water patrol beyond 26,000 meters. Majority of testing is contained within the 26,000 meter boundary. Instrumented observation towers are available along the shoreline throughout the entire range. A large array of targets are available to evaluate terminal effects and include combat-stored aircraft, tank bunkers, concrete fortifications, animals, personnel dummies, fuels, munitions, and specific materials such as armor steel, concrete, personnel armor, and protective devices.

2 Tank Gunnery Ranges

Facilities to fire up to 4000 meters at stationary targets, and up to 3000 meters at moving targets.

b. Airspace

(1) Landspace/Airspace Relationship.

(2) Easements. None, other than normal FAA agreements.

(3) Manned Airborne Systems. Airborne operations are controlled by gound weapon firing schedules.

(4) Unmanned Airborne Systems. Not allowed at APG.

(5) Area Surveillance. This function is provided by patrol boates for overwater firings.

4. Instrumentation

a. Space Positioning and Velocity Vector. The two most frequent requirements at APG are for grund vehicles positioning and aircraft tracking.

(1) Ground Elements. None.

(2) Airborne Elements

(a) Radar

1 Muzzle Velocity Radar (6 ea). Lear Seigler Model DR 810, consisting of antenna unit to be mounted on weapon or tripod, data unit, and power unit. Operates on doppler principle to provide muzzle velocities from 50 to 1750 meters per second. Output available on LED display or at front panel connector. Useful for conventional ammunition 30mm and above. Accuracy ±0.2%.

2 AN/MPQ-33 Radar (Modified) (2 ea). AN/MQP-33 Hawk illuminator CW radar modified by manufacturer for use as velocimeter, van-mounted; measures radial velocities from 150 to 10,000 ft/sec of projectiles (5.56 to 175mm) and rockets. Maximum range 20,000 meters. Tracking rates + 12°/sec in azumuth; 24°/sec in elevation. Seven-channel tape recorder for doppler frequency, time base, zero-time pulse, azimuth and elevation outputs. Capability for spectrum analysis of doppler signal is available. Accuracy is 15 percent.

(b) Laser. See para 4f(3)(d).

(c) Optical

1 Askania Cinetheoidolite System (4 ea). Manual tracking, portable 35mm film, 4 frames per second (f/sec), 40-inch lens, radio and line pulse transmission; tracking rate 4°/second; static accuracy, 30 seconds of arc.

2 Akely Phototheodolite System (15 ea). Manual tracking, portable, 35mm film, 15 f/sec, 12-inch lens, radio and line time transmission link; tracking rate 4°/sec; static accuracy 0.5 mil.

3 M45 Tracking Telescope Mount (1 ea). Manually controlled, power-driven, portable-tracking rate adjustable 0-60°/sec, 35mm high speed (60 to 250 f/sec) cameras with 80" to 150" lenses.

(d) Relative (Miss-Distance). None.

(e) Airborne-to-ground Target Matching. None.

b. Timing. At the present time the IRIG B timing code (resolution 1 ms) is transmitted range-wide at 150.775 MHz with 100 Watts of power. The IRIG A code (resolution 0.1 ms) will be transmitted on a separate frequency as soon as a frequency allocation is obtained from DA.

c. TV

(1) Gated TV system uses video collection techniques to measure vehicle mounted weapon pointing errors in real-time. Accuracy $\pm0/5\%$ FOV, timing update 60 Hz.

(2) Automated video Target Scoring System uses a video camera, a programmable calculator, and a video XY position digitizer to code mean position and standard deviation of a shot group.

(3) Video Muzzle Position System measures gun muzzle movement with respect to the mantlet.

(4) Video Surf Measurement and Analysis System measures the height, velocity, and period of surf throughout an entire surf zone.

(5) Automated Video Shell Fragment Area and Velocity Measuring Systems. The velocity measuring system analyses high speed movie film for fragment velocity. The shell fragement area system uses collimated light sources and a shadowbox to calculate fragment area automatically.

(6) Gunner's Sight Pattern Recorder in combination with a bore-sighted video camera is used to obtain fire-control system errors.

(7) Target Simulation Facility (TSF) (1 ea) - The TSF is an indoor facility for evaluating combat vehicle fire control systems. Test of tracking, laying, and simulated firing are performed within the facility on stationary test vehicle versus a maneuvering target. The image of a target is projected on a screen in front of the test item and maneuvered by a digital computer through unlimited prespecified two dimensional movement patterns. Complete digital data acquisition, which includes digitized video, is employed. This facility has the following advantages: long ranges are easily scaled to small working distances; testing is accomplished indoors, thereby eliminating dependence on weather conditions; target maneuverability is greatly increased; testing costs are reduced; and the entire test set-up is computer controlled to increase data accuracy and consistency.

(8) Projected Evasive Target System extends the advantages of the TSF to the firing range A projection screen is constructed of replaceable target panels. A coaxial laser and video camera are steered by a scanning mirror mount to provide a completely automated and precisely controlled maneuvering target and scoring system. Target position accuracy ±0.1 mrad, max velocity 100 mrad/sec (simulates 40 mph). Scoring is by video with redundant acoustic: Accuracy 1/2 diameter of round, max rate of fire 3600 rounds/min.

d. Photography

(1) Motion Picture Capabilities

(a) Camera, Ballistic Continuous Surveillance (1 ea). 70mm camera with two lenses and dual film transport systems; 400-ft film capabity. A unique system designed to record short duration, self-luminous phenomena and eliminate the possibility of not recording events which could occur between frames when conventional cameras are used. Two complete camera systems contained within a single housing. Photographs a scene with no "blind" time between pictures. Framing rate 30/sec each film. Fixed exposure, 1/30 sec each film; 5-1/2 inch lens each film.

(b) Camera, Ballistic Mirror-Tracking (3 ea). 70mm Hulcher coupled to rigid platform which contains programmed cam operated rotating mirror; 400-ft film capacity. Provides capability for recording trajectory (range and height versus time) for direct-fire missile testing. horizontal tracking angle exceeds 90°. 0 to 30° per second tracking rate with fixed camera accuracy. Framing rates 10-25 f/sec (5" format). Coded timing recorded on film. Radio link for time transmission and operation. 20-inch focal length lens.

(c) Cameras, Ballistic Synchro (Smear) (18 ea). 35mm Fastax 100-ft capacity (15); 35mm 100-ft capacity (3); operating speeds 30-100 ft/sec. Obtains detailed observations of missiles and projectiles during dynamic testing. Used in various combinations to record shell function time, spin rate, parts integrity etc. Coded timing recorded on all cameras.

(d) Cameras, Instrumentation, Medium Speed (20 ea). 16mm Photo-Sonics, 100-ft capacity; 16mm Locam, 200-ft capacity. Framing rates 8-1000 f/sec. Used in various combinations to obtain time history performance of weapon components, fire control, and gunner tracking and laying; stabilizer system performance. Coded time recorded on all cameras. Radio link for time transmission and operation. Lenses available - 10mm-40 inch. Heavy duty tripods and bases available.

(e) Camera, High Speed (15 ea). 35mm Fastax 1/2 frame, 100-ft capacity; 16mm 1/2 frame Fastax, 100-ft capacity; 16mm full-frame Fastax and Hycam, 100-ft capacity; 16mm Oscillo-Faxtax, 100-ft capacity. Framing rates 200-20,000 f/sec. Used in various combinations to obtain time-motion history. Coded timing recorded on all cameras. Time resolution is 5 x 10 sec. Heavy duty tripods and bases available for all types. Lenses available 13mm -20 inch.

(f) Camera, Ballistic and Photogrammetic (6 ea). 35mm Mitchell, 400-ft capacity; Bowen-Acceleration, 100-ft capacity. Framing rates 30-180/sec. Used in various combinations to obtain space time histroy to $\pm$0.1 mil. Three types tri-axial precision mounts available. coded timing recorded on all cameras. Radio link for time transmission and operation lenses available 35mm-40 inch.

(2) Still Photography. Facilities are present at APG to take documentary photographs.

(3) Airborne Capacilities. None.

e. Instrumentation Calibration Capabilities. Calibration Division, Quality Assurance Office, is classified as an Army Internal calibration facilty responsible for the support of the testing mission at APG. Present capabilities include a full range of electrical, physical, and microwave calibration capabilities.

f. Other General Instrumentation

(1) Telemetry

Radio Link Telemetry System (1 ea). This system consists of six transmitter packages for mounting on vehicles under test and a mobile ground station. All transmitter packages are capable of accepting, conditioning, multiplexing, and transmitting analog transducer outputs in the FM/FM mode. Three of the packages conform to IRIG proportional bandwidths (7.5 percent) channels 8 through 18. The other three packages conform to constant bandwidths channels 1A through 11A. The ground station is housed in a semi-trailer which is equipped with antenna. The van contains VHF and UHF receivers, tape recorders, discriminators, time code generator, monitor, and communications equipment. Capable of line-of-sight transmission of the output of a variety of transducers mounted in vehicles. Suitable for ground-to-ground or air-to-ground applications. Basically, a low-frequency response system with maximum data bandwidth of 1000 Hz. System accuracy is ±2% of full scale.

(2) Meteorologival

(a) Surface Meteorological Observations Systems (4 ea). Surface meteorological instruments consisting of hygro-thermograph, barograph, pyroheliometer, and anemometer. Also, precipitation gauges. Measures and records temperture, humidity, pressure, solar radiaion, wind direction, wind speed, and precipitation.

Uncertainty of Measurements

Ambient temperture ±0.2° C R (3 std dev)
Relative Humidity ±1% R (2 std dev)
Wind direction ±3° R (2 std dev)
Wind speed ±1-3/4 mph R (2 std dev)
Atmospheric pressure ±0.01 in. Hg R (3 std dev)
Precipitation ±0.02 in. R (2 std dev)
Solar radiation ±5% R (G.E.)

(b) Upper-Air Meteorological Observations Systems (2 ea). Radio direction finder with meteorological recorder and meteorological data processor. Rawlin Set, AN/GMD-1 and WL-2DF LQ-CATE NAVAID Integrated System. Used to secure and reduce upper-air meteorological data to various parameters consisting of temperature, pressure, humidity, density, wind direction, and speed.

Uncertainty of Measurements

Temperature ±1° C R (2 std dev)
Relative humidity ±10% R (1 std dev)
Atmospheric pressure ±4 millibars R (2 std dev)
Wind direction ±0.05° max error between 10° and 60° elev R (2 std dev)
Wind speed ±0.05° max error between 10° and 60° elev R (2 std dev)

(c) Meteorological Forecasting Facility (1 ea). Digital facsimile (DIFAX) system consisting of an Alden/DARCOM 1800 digital chart recorder with a DACOM reconstructor modem and an Alden model 9500 digital recorder. Receives and records weather maps transmitted at regularly scheduled times.

(d) 670401 Teladvisor Digital Weather Station (1 ea). This system authomatically measures wind direction, wind speed, barometric pressure, relative humidity, dry bulb temperature, wet buln temperature, black globe temerature, fabric surface moisture, precipitation, and solar radiation at four different locations. These parameters are transmitted in an eight-unit ASC II code to a teletypewriter, which is a combined page printer and tape perforator, operating at 100 words per minute. Initiation for readout may be set at several pre-determined intervals; in addition, the system may be initiated manually when required.

(3) Survey

(a) Electrotape, Survey System (1 ea system - 3 units). Precision electronic distance measuring system, 12 volt DC, internal or external battery, FM two-way radio, freq. 10.0 to 10.5 SATET, portable. Range 50 feet to 50 miles, digital readout, accuracy 1 centimeter ±1 part in 3000,000. All weather operation.

(b) Theodolite System Observation, Digitized (13 ea). Theodolite, digitized, recording, portable, counter, and printer combination, friction azimuth and elevation rotation for tracking; 12V DC and 117V 60 cycle power, power 8X, field of view 7°, erect image. Static accuracy ±0.01 degrees, solid state, TTL compatible output; tracking rate 4°/sec; recording rate three lines/sec; hard copy output.

(c) Conventional Survey Instruments (37 total)

- 3 Wild T-1 Theodolites
- 1 Wild T-3 Theodolite
- 16 Observation transits
- 11 Survey transits
- 4 Zeiss N 2 levels
- 2 K&E Theodolites

(d) Ranger IV Distance Measuring system (2 Systems). Precision electronic (lazer optical) distance measuring system, 12 Volt DC, portable. Range 3 feet to 42,240 feet, digital readout, accuracy .001 foot or meter.

(e) Uniranger Distance Measuring System (1 System). Precision electronic (optical) distance measuring system, 12 Volt DC, portable. Range 3 feet to 26,400 feet, digital readout, accuracy .001 foot or meter.

(f) MicroRanger II Distance Measuring System (2 Systems). Precision electronic (optical) distance measuring system, 12 Volt DC, portable. Range 3 feet to 5280 feet, digital readout, accuracy .01 foot or meter.

(4) Radio Frequency Interference (RFI): Electromagnetic Test Facility - EMI/EMC. The US Army Aberdeen Proving Ground's Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) Test Facility was designed to perfrom EMI/EMC tests in accordance with MIL-STD-461/462/463 and other EMI/EMC specifications and standards.

The EMI/EMC Test Facility consists of one calculator controlled spectrum surveillance system and two semi-automated systems. One of the semi-automated systems covering the frequency range from 30 Hz to 10 GHz is mounted in a step-van. The primary function of this mobile system is to perform EMI/EMC tests at remote test sites on equipment that cannot be tested in the shielded enclosure, such as watercraft, firing tests of weapons and smoke generators. This system is also used to perform site ambient surveys and field intensity measurements.

The second semi-automated system and the calculator-controlled system are permanently installed in a solid shielded enclosure (12' x 12' x 8') inside of the large shielded enclosure (94' x 60' x 28') at APG. The calculator-controlled system covers the frequency range from 30 Hz to 18 GHz. Included in this system are three synthesized signal generators covering the same frequency range which are used to drive power amplifiers during the performance of susceptibility tests. All pertinent software is available.

An EMI Shielded Enclosure, 94' x 60' x 28', is used to satisfy EMI/EMC test requirements of large vehicles such as tanks, tractor-trailer combinations; shelters containing electronic equipment; construction and material handling equipment; and engine-generator sets. It has an electric field shielded effectiveness of 100 dB, supports a floor loading of 125 psi, and includes an air exhaust blower system capable of moving 12,000 cfm of air through the enclosure. It has 120/208 VAC 60 Hz, 120/208 VAC 400 Hz, and 28 VDC filtered electrical power at various locations within the enclosure. The enclosure has an equipment door opening of 16' x 16' and two 48" x 80" personnel doors.

RF power sources, a parallel plateline, and antennas are available to perform susceptibility tests in accordance with MIL-STD-461. Existing instrumentation provides coverage over the frequency range from DC to 18 GHz and field intensities up to 50 Volts/meter.

Additional instrumentaton is available to measure power density and field intensity of RF transmitters, radar sets, and other high power RF sources over the frequency spectrum from 20 Hz to 10 GHz. Approved instrumentation required to measure emissions (leakage) from microwave ovens in accordance with the FCC, HEW regulations is also available.

(5) Visibility (Light Level Measurement)

(a) Photometric Measuring system (1 ea). Four Spectra-Prichard Photometers plus one oscillograph carried in an M14 van are used to measure ambient light from 10 to 10 foor lamberts, brightness from 10 to 10 foot candles with spectral response closely matching that of the human eye. Accuracy is ±2%.

(b) Photometric Light Measurement System (1 ea). The system includes standard light source, photometer, telephotometer, and photometric microscope. Photometer and telephotometer are portable for field use. Calibrated for foot-lambert readout. Photometers for mesuring IR radiation are all the EC&G Model 585. The Army standards for IR equipemnt are 3- to 5-micron wavelength and 8- to 14-micron wavelength.

(c) Radiometric Light Measurement System (1 ea). The system includes two detector heads and three gratings covering the ultra-violet visible and infra-red region from .35 to 1.2 microns.

The system can make spectral irradiance measurements of lights sources from .35 to 1.2 microns. The minimum energy pulse width required is one nanosecond. Calibration acuracy is 1% of absolute from 0.2 to 0.15 nanoseconds.

(d) Laser Measurement Instrumentation. Calibrated photodiodes, photo-multipliers, and calorimeters are used to measure energy power and beam shape of Ruby Lasers. At 6943 Angstrom (Ruby wavelength) these units can measure pulse rise time and pulse shape of Q-switched laserrs. The calorimeters are broadband and will measure from 10 millijoules to 1,000 joules with an energy measurement error of less than 2.5 millijoules or ±3%. Pulse rise time is 0.3 nanoseconds. Power measurement accuracy is 10%.

(6) Sound Measurement and Analysis. The Sound Pressure Measurement System consists of: sound level meters; microphones; tape recorder; octabe band analyzers; impact analyzers; cathode ray oscilloscope; oscilloscope camera. Steady-state measurements are made up to 20 kHz for A, B, and C weighting and octave-band through narrow-band measurements. Impact noises of 765-185 dB, with frequency respnse up to 100 kHz may be recorded using oscilloscope and camera. system accuracy: ±2% of full scale.

(7) Safety and Security. One marine-type Raytheon Model 1650 and one Model 1660 fixed radar as installed in 50-foot towers overlooking the Chesapeake Bay for detecting the presence of small boats in the range area. These are E-band, with a range of 10 miles.

(a) TV for Monitoring Hazardous Operations. APG uses TV for hazardous operation monitoring and environmental testing surveillance. All systems currently in use at APG are black and white only. A total of 18 cameras, 18 monitors, and 2 line-of-sight microwave systems are available for transmission of closed circuit video (either color or black and white).

(b) Toxic Fumes Instrumentation. Portable and console type systems of various sizes and capacities. Direct readout or strip chart recordings of: Carbon Monoxide (CO) - 0 to 6,000 ppm. Nitrogen Dioxide (NO) - 0 to 10 ppm; Ammonia (NH) - 0 to 500 ppm; and Sulfer Dioxide (SO) - 0 to 10 ppm.

(8) Soil Conditions

(a) Cone penetrometer.

(b) Soil shear strength measurement equipment.

g. Special Purpose Instrumentation

(1) Ballistic data

(a) Ballistic Test Site Terminal (3 ea). 16 channel computer based ballistic data acquisition system, van mounted. Used for measurement of strain, sound pressure level, chamber pressure, displacement, acceleration, current, and voltage. Independent A/D conversion and temporary 16K word storage, each channel, for capture of transient phenomena. Digitizing rates settable from 977 to 800,000 samples per second, or optional automatic sampling rate data compression scheme. 50 Mbyte disc mass storage. System is portion of APG distributed systems data acquisition network. Pressure: 0 to 100,000 psi, ±2%; recoil distance: 0 to 72 inches, ±.05 inches; recoil velocity: 0 to 60 fps, ±5%; strain: 70 to 3000 u in/in, ±2%; blast overpressure: .1 to 500 psi, ±3%; sound level: 64 to 180 dB, ±1 dB; acceleration: 0 to 5000g, ±5%.

(b) Ballistic Data Acquisition System (5 ea). Record and playback on 1-inch tape, magnetic, 12 FM Data channels (IRIG A and event). Quick-look at recorded data with oscillograph. Equipment mounted in 40-foot van, with heat and air conditioning. Frequency response 0-80 kHz for measurements from transducers: strain gages, pressure sound level, recoil displacment, acceleration, current, and voltage. Pressure - 0 to 100,000 psi ±2% recoil distance to 72 inches .05 inches; recoil velocity to 69 fps ±5% strain 70 to 3,000 u in/in ±2%; blast overpressure .1 - 500 psi ±3%; sound level 64 to 180 dB ± dB; acceleration to 5,000g ±5%.

(c) Balllistic Data Acquisition System (1 ea). Equipment is mounted in 34-foot van with electric heat and air conditioning. Record/playback on 1-inch magnetic tape, eight data channels, two timing channels.

Frequency response 0-20 kHz. capable of measuring strain and chamber pressure to an accuracy of ±2%, recoil velocity to 60 fps ±5%, recoil distance to ±.05".

(d) Pointing Angle Measurement System (PAMS) (2 ea). PAMS is a compact, high performance electro-optical system designed for precision angle tracking of point and extended area targets. The system is designed for accurate tracking and angle readout (accuracy ± milliradian for azimuth and elevation lead angle) of airborne targets under dynamic flight conditions from a moing vehicle under conditions of base motion, shock and vibration. PAMS is configured as three units; the sensor head, electronics box and remote control console. The sensor head and electronics box are vehicle mounted and are interconnected via a multiconductor cable. The vehicle mounted units communicate via a telemetry link with the remote control console.

(e) Target Simulation Facility (TSF)/ See para 4c(7).

(f) Automatic Target Scoring System (ATSS) (2 ea). Tranducers, pre-amp, teletype, computing unit. Portable shock wave sensors consisting of 4-foot sections of aluminum rod and piezo-electrical transducers forming a vertical rectangular 16' x 16' target. Automatic, non-destructive scoring system measuring impact coordinates of supersonic projectiles. The ATSS will score minimum velocity of 1300 ft/sec, maximum rate 3000 rd/min. Accuracy: size 30mm or less diameter, $\pm$0.1 inch; greater than 30mmm $\pm$0.5 of projectile diameter.

(g) Projectile velocity Recording System (3 ea). Computer based projectile velocity recording system consisting of following components: Detectors (lumiline screens, photoelectric sky screens Weibull GP80, solenoid coils, breadscreens), transmission cable network connecting sensors to remotely located instrumentation, interval counter chronographs (Dana Model 9514 with IEE 488-1975 interface), HP 9825A desktop computer, and HP 9866 thermal line printer. Acquires projectile velocities, times of flight, and rates of fire for automatic weapons. Computes and displays statistical results. System accuracy, $\pm$0.1%.

(h) Digital Oscilloscope Velocity Recording System (2 ea). Consists of Nicolet Explorer II digital oscilloscope. Used to record output from projectile sensors for subsequenct computation of velocity. Resolution, 12 bits; conversion rate, up to 2 MHz; sweep width, 4096 points, sweep time accuracy, $\pm$0.02%.

(i) Permanent Velocity Towers (5 ea). Steel Velocity Towers, various heights ranging from 90 to 180 feet, supporting velocity cages up to 3 feet in length and 48 inches in diameter. Provides velocity cage support for projectile velocity measurements on weapons firing at elevations up to 85 degrees.

(j) Fuse Chronograph System (8 ea). Infrared detector, 8 mm x 8 mm lead sulfide cell, focused on 6-inch reflector; counter and recorder for visual or digital printout on paper. Hardwire or radio link for zero firing signal, field of view eitht degrees, portable. Time of flight for airburst function to 0.001 seconds, up to 35,000 meter range in daylight hours. Accuracy 0.05 sec.

(k) Acoustic Automatic Target Scoring System. Microphones mounted in the ground below the target with associated processing electronics. This system provides totally automatic scoring of targets up to 30' x 30' with any supersonic round. Accuracy 1/2 diameter of round. Max rate of fire scored is 5000 rounds per minute.

(2) Environmental Chambers. Chamber with controlled temperature and humidity for preconditioning and storage of items undergoing test. Temperature ranne - 100-200° F +2° f; humidity - relative humidity (RF) 15-98% ($\pm$2%); capacity - 2' x 3' x 6'. Chambers with controlled temperature range of -80° F to 160° F.

o Chamber #1 - 24'L x 15'W x 10'10"H

o Chamber #2 - 19'L x 10'8''W x 10'9"H

o Chamber #3
Front Roc - 28'4"L x 18'6"W x 13'11"H
Conditioning Room - 41'7"L x 23'8"W x 14'H
Humidity control in Chamber #3 (Conditioning Room) only: 15-95% RF from 0° F to 160° F.

(a) Chamber for simulation of high-altitude environment; 0-200,000 ft; capacity: 3.4 cubic feet.

(b) Stratosphere Chamber

Front Room - 8'2"L x 9'W x 6'6"H; Rear Room - 11'6"L x 9'W x 6'6"H. Temperature range: -70° F to +160° F; simulation of altutude: 100,000 feet.

(c) Salt Spray Chamber. Chamber with salt spray facility for evaluating effects of salt water/corrosion. Air humidity - 85-100% (at 120 ±5° F); capacity - 25"W x 33"H x 48"L.

(d) Salt Spray (Fog) Chambers (2 ea). Test Chamber sizes - 2' x 3' x 4' and 10'W x 10'H x 12'L. Meets requirements of MIL-STD-810.

(e) Sand and Dust Chamber. Chamber providing simulated desert/dust/wind conditions. Temperaturee range - 77-106° F (below 30% RH); velocity range - 100 to 2300 ±500 FPM; capacity 5'H x 4'W x 8'L.

(f) Sand and Dust Chamber. Chamber size - 5' x 4' x 8'. Meets requirements of MIL-STD-810.

(g) Solar Radiation Chamber. 10' x 12' x 10' test chamber equipped with built-in temperature, humidity and solar radiation control Range of operation: temperature ambient to -185° F' humidity 5 to 95% RH; radiation - 0 to 140 watts/ft.

(h) Temperature-Humidity Conditioning Units (11 ea). Range of test chamber sizes: 3' x 3' x 3' to 5' x 5' x 6'. Temperature-humidity rnge (-100° F to +200° F) (5 to 95% RH). Excellent/adequate.

(i) Extreme Temperature Conditioning Units (27 ea). Range of test chamber sizes: 3' x 3' x 3' to 10' x 10' x 12'. Cooling-basically by liquid CO. Heating-electric sheath type. Temperature range: (-100° F to +200° F).

(j) Mortar and Recoilless Rifle Temperature and Humidityt Conditioning Unit. Portable chamber size: 7' x 8.5' x 13'. High and low temperture and humidity (-100° F to +200° F) (5 to 95% RH).

(k) Explosive Atmosphere Test Chamber. Chamber size: 5' long x 3' diameter. Meets requirements of MIL-STD-810.

(1) Rain Test Facilities.

Simulated Wind-driven:
Rainfall 4 in. to 27 in. per hour over a 3 sq ft. area. Wind velocity to 95 mph.

Freefall:
Rainfall to 24 in. per hour over a 300 sq ft area.

(3) Vehicle Performance

(a) Data Acquisition System (4 ea). Digital data acquisition systems centered around minicomputers support automotive and fire control test instrumentation requirements. Three of the systems are located in semi-trailer vans and one is located in a building adjacent to the APG Munson Test Area. Radio telemetry links the gound station to the test item. Pulse code modulation equipment and techniques are utilized to acquire up to 64 data channels. Three video channels are included with the fire control instrumentaion system to obtain weapon and sight pointing measurements. Monitoring and quick-look capabilities are available as well as software for realtime analysis of certain types of data.

(b) Temperature Measurement Instrumentation. A wide variety of temperature indicating and recording instrumentation is available with either single or multi-channel capability. Numerous units are compatible with various types and ranges of thermocouples, providing required overall mission capability. Recordings are either make on graduated chart paper or printed in digital form. Range: -100 to +2000° F. Provides either manual or automatic control of temperature environments. Limited to direct-connection to test item; however, measuring equipment can be located up to 100 feet away from test item. Accuracy: ±0.3% of recorded value.

(c) Pressure-Strain Electrical Instrumentation. This instrumentation consists of recording oscillographs, pressure trandücers, electrical shunts, slip rings, strain gages, and electronic conditioning equipment required for the various transducer signals. Provides static and dynamic measurements such as turret response, drive axle torques, hydraulic pressure, speeds of rotating shafts. Accuracy: ±2% of reading.

(d) Lab Dynamometer (3 total). Eddy Current, 2 units, each has absorption capabilities only; electric, 1 unit, has both motoring and absorption capabilities. Horsepower - 50 to 1200; speed (max) - 4000 rpm; horsepower (absorption - 1/8 to 100; horsepower (motoring) - 1/8 to 3; speed (max) - 12,000 rpm up to 3 hp, 4,000 rpm above 3 hp.

(e) Cold Starting System. Consists of recording oscillograph, temperature recorder, electrical power measuring equipment, engine speed sensors, and pressure sensors. Temperature measurement - 1200 to +600° F; voltage, dc - 0 to 500 volts; current, amps - 0 to 2000; speed, rpm - 0 to 2000; pressure, psi - 0 to 10,000.

(f) Weighing Systems. Platform scale, 11'11" x 19'11"; mechanical-type wheel load platforms; electronic-type wheel load platforms; platform scale - 0 to 200,000 lbs; individual wheel loading - 0 to 20,000 lbs (mech), 0 to 20,000 lbs (electronic).

(g) Mobile Field Dynamometer (1 system - 2 units). Self-propelled, two-units, articulated steer, track-layer; absorption device is a dydraulic retarder. Soft soil absorption capability is 0 to approximately 50,000 lbs of drawbar loading - no permanently mounted instrumentation.

(h) Mobile Field Dynamometers (3 ea). Three self-propelled, diesel (2 ea) and gasoline (1 ea) engine powered wheeled vehicles, each of different capacity, equipped with power absorption components and instrumentation packages; vehicle drawbar pull, resistance to towing and winch performance tests on paved roads. Absorption capability - 100 to 100,000 lbs of drawbar or winch loading; towing capability - 0 to 45 mph; instrumentation - speeds, drawbar pull, resistance to towing and termperatures.

(4) CBR Instrumentation. None.

(5) Mobile Data Van. Mobile data van with recording system. Has 24-channel capability and consists of two magnetic tape recorders, resistance bridge conditioners, calibration, amplifiers, and piezoelectric conditioners. Auxiliary equipment available for monitoring, timing, and audio requirements. On-board electrical generator and temperature conditioning permit data van mobility while acquiring test data.

5. Threats/Targets

a. Ground

(1) Electromagnetic. None.

(2) Weapons

(a) U.S. armor is tested against foreign-type wseapons. Targets are built to order. They may be of cloth, wood, steel, or combinations thereof. Some are mobile and remote-controlled.

(b) Scoring Capability. See para 4c(2),(7),(8), and g(1)(f)

(c) Destroyable/Non-destroyable. None.

(d) Physical environment. None.

(3) Radiological Environment. The Army Pulsed Radiation facility is used to simulate neutron and gamma effects of neclear weapons. The facility is unize in its capability of simulating an air burst as well as providing a large in-core irradiation cavity for high level exposures. The reactor is highly mobile both indoors and outdoors. On-site support includes data acquisition and handling, dosimetry, health physics, technical support and normal laboratory services. Tests are performed in conjunction with blast, prompt gamma spike, low and high energy X-ray, and electromagnetic pulse effects. Test and research coordination and consultation is available in the areas of electronics, propellants, explosives, lasers, vehicle shielding and dosimetry. For a more detailed

description see Defense Nuclear Agency publication DNA2432H (Tree Simulation Facilities" 2nd Edition 1 Jan 79.

(4) Other. None.

b. Airborne. None.

6. Data Handling/Processing

a. Data Storage and Retrieval Capabilities

(1) Digitized

Digital Data Acquisition System (1 ea). The Digital Data Acquisition System is a transportable analog-to-digital measuring system which automatically scans and measures up to 25 channels of analog data. The information is displayed in digital form and recorded on paper tape.

The system is capable of single or continous scan of any combination up to 25 inputs, such as resistance, ac and dc voltage, frequency, temperatures, and other sensor to transducer outputs. The voltage range of measurement is from one millivolt to 1,000 Volts and the frequency range of measurement is from 0-100 kHz. The system accuracy is ±0.02% and the time display (digital clock) accuracy is ±0.1 second. The printout rage, 1-8 lines per second, is on paper tape.

(2) Analog

(a) Analog-to-Digital Conversion System (1 ea). Hewlett Packard Model 21 MX with conversion to HP1000 System. Includes Honeywell 9600, 12-channel analog tape unit and HP 7970E digital type drive (9 track-1600 bpi). Sampling at any rate to 40,000 samples/second real time which may be increased or decreased by varying the playback speed between 15/16 and 120 inches per second.

(b) Analog-to-Digital Conversion System (1 ea). Radiation corp Mod 5018. Approximate size: height, 7 feet; length, 8 feet; width, 3 feet. Includes 12-channel Sangamo one-inch tape unit (analog), Ampex one-half inch tape drive unit (digital), 150 inches/second at 200, 556, and 800 bits/inch density, 12-channel multiplexer. Sampling at any rate from external pulse or from internal clock up to 40,000 samples/second real-time may be increased by varying playback speeds. Accuracy: 1 count in 4095. Modes of digitizing: manual, tone, and peak.

(c) Oscillograph Reader (2 ea). Auto-Trol Mod 3400S curve tracer for manual output only. Accepts galvanometer records up to 12-inch width. resolution: 200, 400, or 1000 counts/inch. Output in machine counts.

Altek Mod 290 Graphic Digitizer with a 42 x 60-inch back-lit board for viewing and measuring of galvanometer records or X-ray photographs. Output to 9-track, 1600 bpi magnetic digital tape unit with interface Techtronix Model 4051 graphics terminal and Mod 4631 Hard Copy Unit.

(d) Oscillograph Reader (1 ea). Auto-Trol Mod 3400S curve tracer and incremental magnetic tape recorder Mod 1500. Accepts galvonometer records up to 12-inch width. resolution: 200, 400, or 1,000 counts/inch. Output in machine couts.

(e) Filmreader System (3ea). Two Benson-Lehner Mod 29E and one Telecomputing Copr 29C, each with digitizer, punched tape and type output. Accepts 16mm, 35mm, and 70mm film. Magnification: 5x, 10x, 20x, and 40x. Resolution: 200, 400, or 1,000 counts/inch of projected image. Output in machine counts.

b. Quick-Look Capabilities. The Ballistic Test Site Terminals, and the Vehicle Performance Data Acquisition System are mini-computer controlled data collection system. They have a large capacity for on-site, real-time data presentation and analysis. Quick-look data, and data analysis done on iste is usually presented on a CRT but may be printed or plotted.

c. Processing

(1) Digital

(a) System and Model. The Materiel Test Directorate (MTD) has on location an IBM 360/30 computer as a terminal to the TEAM-UP East system and the Ordanance Center and School use an IBM 360/20 terminal for TEAM-UP access. TEAM-UP is the acronym for "Test, Evaluation, Analysis, and Managment Uniformity Plan," and is a TECOM subprogram of the DARCOM Five-Year ADP Plan.

All 14 TECOM activities comprise the two TEAM-UP networks. Aberdeen Proving Ground (APG) and White Sands Missile Range (WSMR) serve as the host activities for the East and west TEAM-UP networks, respectively. The central computer at Aberdeen Proving Ground is a 360/65.

(b) Languages. FORTRAN, PL-1, COBOL -- all standard IBM available software.

(c) Input/Output Options. Card reader, card punch, line printer (600 LPM), two magnetic tape units, punched paper reader and punch.

(d) Real-Time/Post-Test. The MTD terminal is used for batch processing and remote job entry.

(2) Analog. This system consists of two audio spectrum analyzers and one correlation and probability analyzer housed in standard equipment racks. Dat recorded on magnetic tape during laboratory and fild testing programs is reproduced for simultaneous amplitude and spectrum analysis, resulting in X-Y plots. Monitoring and test equipment are included in the system.

Spectrum analysis is selectable over nine ranges from 0-20 Hz to 0-20 kHz with constant bandwidth filters set at 1/200th of frequency range; linear and square detectors with either peak or average outputs are provided. Amplitude analysis yields cross-correlaion, auto-correlation, probability density, or probability distribution. Oscilloscope of X-Y outputs are provided.

(3) Optical. Optical data acquired by using a variety of 16mm and 35mm cameras can be processed inhouse with a high priority turnaround time of 24 hours, and an average time of two days.

d. Distribution (Turnaround Time). Depending upon priority of job, from immediate to next day (overnight processing).

e. Displays

Plotter (1 ea). California Products, Digital Incremental Plotter Mod 763 and Mag Tape Unit Mod 780. Accept IBM compatible digital tape with selected subroutines to insert grid, scales, labels, etc. Plots on paper of 12 or 30 inch widths and 120 foot length. Resolution: .005 inch.

ANNEX D - BIBLIOGRAPHY

Reference Documents

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Reference Maps

3. Unites States Governement Flight information Publication, Air Navigation Chart, enroute Low Altitude, US #L-24, U.S. Department of Commerce, National Ocean Survey, Distribution Division, Riverdate, MD 29840.

4. Aberdeen Proving Ground Reservation Map, U.S. Army Engineer District, Baltimore, Marylnad, Drawing No. 18-02-09, April 1969.

5. Edgewood Arsenal reservation Map, U.S. Army engineer District, Baltimore, Maryland, Drawing No. 18-02-17, June, 1968.

ANNEX E

OPERATIONAL TEST INSTRUMENTATION GUIDE

U. S. ARMY ELECTRONIC PROVING GROUND
Fort Huachuca, Arizona

CONTENTS - ANNEX E

LIST OF FIGURES

ANNEX E

US ARMY ELECTRONIC PROVING GROUND (EPG)
Fort Huachuca, Arizona

1. Introduction.

a. Overview. The US Army Electronic Proving Ground is an independent test and evaluation activity under the command of the US Army Test and Evaluation Command. Since its establishment in 1954, the Proving Ground has been involved in testing communications-electronics equipment and systems which are intended for use by the military services. These have included such items as manned and unmanned aircraft, all tactical radios utilized in the Corps and Division areas, all equipment used in tactical telephone systems, e.g., switchboards, modems, wire, repeaters, etc., radars, inertial navigation devices, cameras, film, image interpretation devices, combat surveillance equipment, communications security (COMSEC) devices, electronic warfare systems, tactical intelligence gathering equipment, command control systems, tactical computers, jamming and anti-jamming devices, and radiological survey instruments. The resultant reports are guides for the Army, other defense agencies, our allies, and the equipment manufacturers in the further development or production decisions of the materiel being considered. Tests are also conducted of new production items and product improvements to standard items.

Fort Huachuca, at approximately 5,000 feet elevation, is situated in the foothills of the Huachuca Mountains and has an average rainfall of less than 16 inches per year. The Fort's clear electromagnetic environment, excellent climate, and freedom from aircraft congestion provide the Proving Ground with an unusually fine area for electronic testing.

b. Generic Systems Tested.

- Command and Control
- Communications-Electronics
- Electronic Warfare and Intelligence
- Avionics and Navigation
- Intelligence Surveillance & Target Acquisition
- Air Defense

2. General.

a. Military Units.

- US Army Communications Command (ACCOM)

- o Communications-Electronics Engineering Installations Agency (CEEIA)
- o US Army Intelligence and Security Board (USAINSBD)
- o US Army Intelligence Center and School (USAICS)
- o US Army Communications Systems Agency (USACSA)
- o US Army Intelligence Center and School (USAICS)
- o US Army Communications Security Logistics Agency (USACSLA)

b. Maintenance Capability. EPG has its own motor pool and provides minor maintenance on its own vehicles. Major maintenance (overhaul a truck engine, replace a transmission, etc.) is provided by the Fort Huachuca Headquarters Command. The aviation maintenance is confined to the airborne test equipment belonging to EPG and, if required, the avionics equipment under test.

c. Access.

(1) Road. State Highway 90 from Interstate 10 at a point two miles west of Benson, Arizona, goes south 29 miles to the east entrance of Fort Huachuca. This highway separates the east and west ranges of Fort Huachuca.

(2) Rail. A Southern Pacific Railway spur that served Fort Huachuca has been discontinued. Rail service is available at Benson, AZ (32 miles) and Tucson, AZ (75 miles).

(3) Air. Libby Army Airfield (runway length, 5,300 feet) on the Fort Huachuca reservation serves both the Fort and the adjacent town of Sierra Vista, which has a civilian entrance to the field from Highway 90. Bisbee-Douglas International Airport (runway length, 7,500 feet) about six miles north of Douglas, is approximately 60 miles from Fort Huachuca via state highways. Tucson International Airport (runway length, 12,000 feet) is 75 miles from Fort Huachuca, of which 45 miles is on Interstate 10 and the remainder on State Highway 90.

(4) Water. There is no water access.

d. Logistic Support Capability. Housing is available through Headquarters Fort Huachuca (HQFH) Command. Medical facilities are available through the Medical Department Activity (MEDDAC) at Fort Huachuca.

The EPG Logistics Directorate consists of four divisions: Logistics Management, Calibration, Aviation and Maintenance.

Typical customer support includes: Vehicle, aircraft, power units, heavy engineer support equipment, electronic instrument equipment pool, maintenance and calibration of electronic equipment.

e. Recurring Commitments. Annual National Guard/Reserve Training is conducted at Fort Huachuca.

f. Special Operating Restrictions. Entry into firing areas must be coordinated.

g. Facility Organization. The EPG organization chart is shown in Figure E-1.

h. Environment (Climate). Frequent summer showers and a high elevation combine to provide a mild year-round climate. The average area rainfall is 16" with approximately 65% occurring in summer and 16% (including infrequent light snow) occurring in mid winter. The mean temperatures for January and June are 46°F and 76°F respectively and the average wind velocity is 5.6 mph.

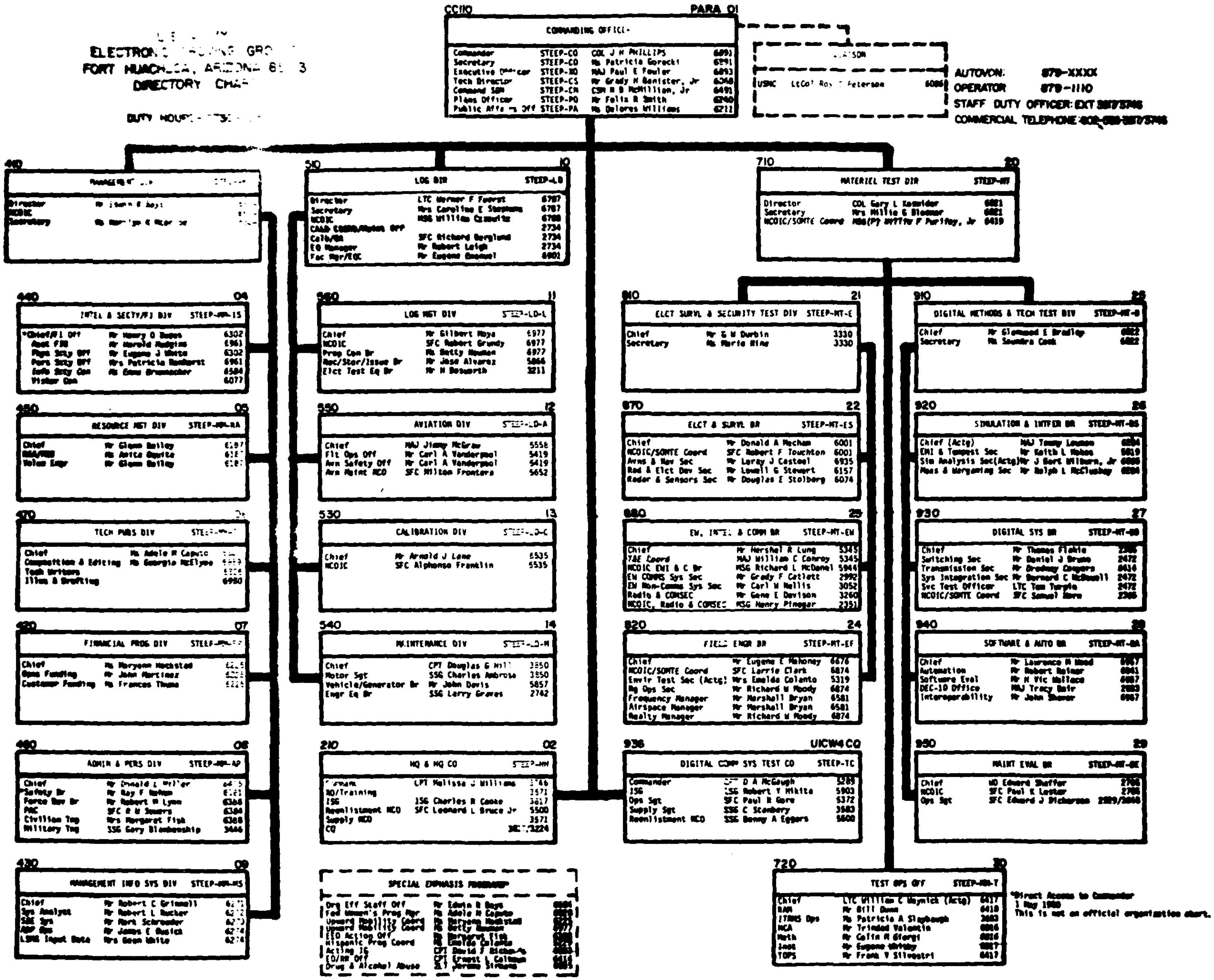
ELECTRONIC ... GROUP
FORT HUACHUCA, ARIZONA 85613
DIRECTORY CHART
DUTY HOURS
CC110
PARA 01
COMMANDING OFFICER
Commander STEEP-CO COL J H PHILLIPS 6091
Secretary STEEP-CO Ms Patricia Gorecki 6291
Executive Officer STEEP-XO MAJ Paul E Fowler 6093
Tech Director STEEP-CS Mr Grady H Banister, Jr 6268
Command SGM STEEP-CR CSM R B McMillian, Jr 6491
Plans Officer STEEP-PO Mr Felix R Smith 6240
Public Affairs Off STEEP-PA Ms Delores Williams 6211
LIAISON
USMC LtCol Roy E Peterson 6086
AUTOVON: 879-XXXX
OPERATOR 879-1110
STAFF DUTY OFFICER: EXT
COMMERCIAL TELEPHONE
410 MANAGEMENT DIR
510 LOG DIR 10 STEEP-LD
Director LTC Werner F Fuerst 6787
Secretary Mrs Caroline E Stephens 6787
NCOIC MSG William Czmutis 6788
710 MATERIEL TEST DIR 20 STEEP-MT
Director COL Gary L Kosmider 6821
Secretary Mrs Willie G Bledsoe 6821
NCOIC/SOMTE Coord MSG(P) William F Purifoy, Jr 6419
440 INTEL & SECTY/PI DIV 04 STEEP-MM-IS
450 RESOURCE MGT DIV 05 STEEP-MM-RA
470 TECH PUBS DIV 06
420 FINANCIAL PROG DIV 07
460 ADMIN & PERS DIV 08 STEEP-MM-AP
430 MANAGEMENT INFO SYS DIV 09 STEEP-MM-MS
560 LOG MGT DIV 11 STEEP-LD-L
550 AVIATION DIV 12 STEEP-LD-A
530 CALIBRATION DIV 13 STEEP-LD-C
540 MAINTENANCE DIV 14 STEEP-LD-M
210 HQ & HQ CO 02
SPECIAL EMPHASIS PROGRAMS
810 ELCT SURVL & SECURITY TEST DIV 21 STEEP-MT-E
870 ELCT & SURVL BR 22 STEEP-MT-ES
880 EW, INTEL & COMM BR 23 STEEP-MT-EW
820 FIELD ENGR BR 24 STEEP-MT-EF
936 DIGITAL COMM SYS TEST CO UICW4CQ STEEP-TC
910 DIGITAL METHODS & TECH TEST DIV 25 STEEP-MT-D
920 SIMULATION & INTFER BR 26 STEEP-MT-DS
930 DIGITAL SYS BR 27 STEEP-MT-DD
940 SOFTWARE & AUTO BR 28 STEEP-MT-DA
950 MAINT EVAL BR 29 STEEP-MT-DE
720 TEST OPS OFF 30 STEEP-MM-T
*Direct Access to Commander
1 May 1980
This is not an official organization chart.

Figure E-1

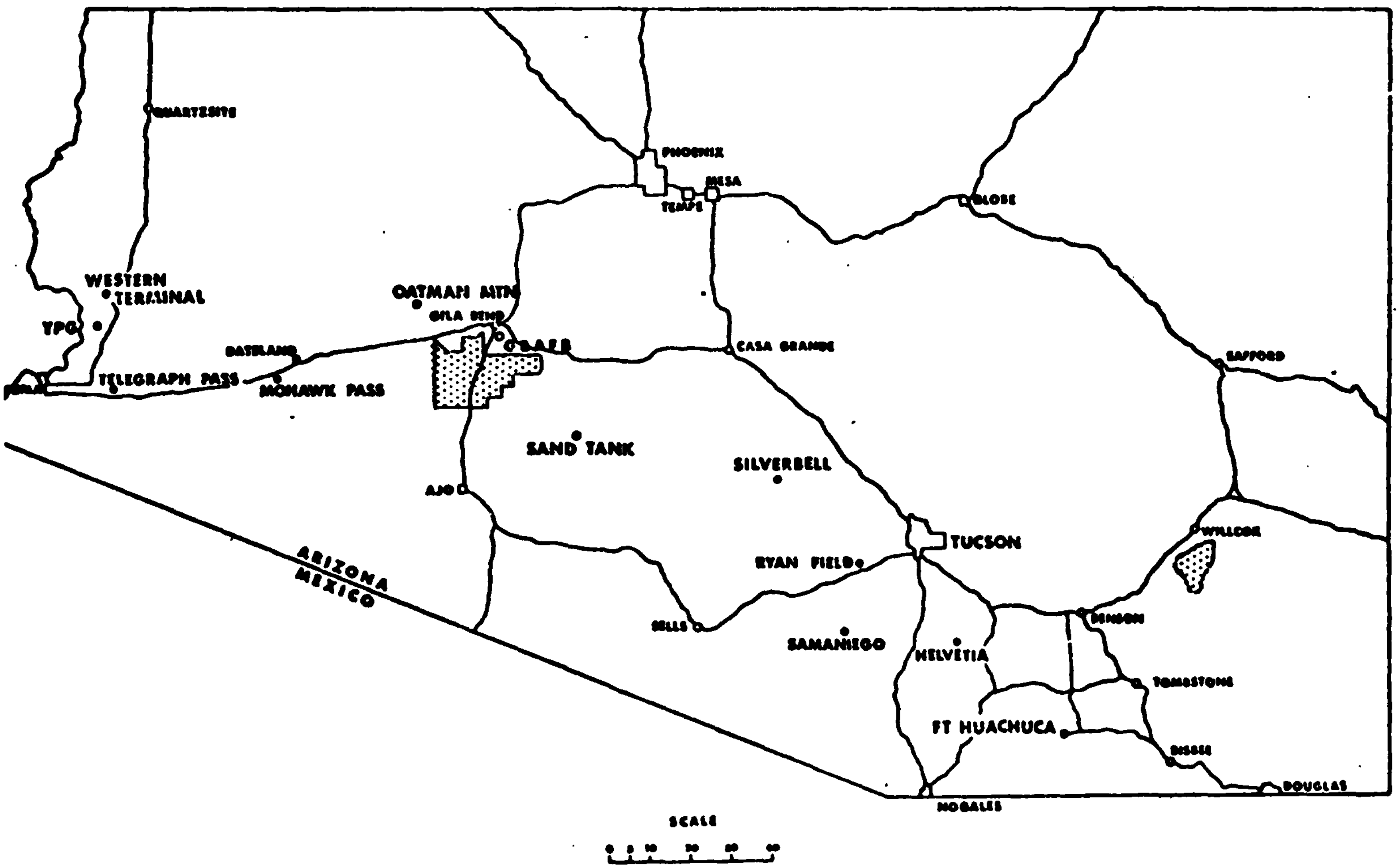

Figure E-2: Fort Huachuca, showing outlying Test Facilities

i. Topography.

(1) Fort Huachuca Military Reservation (73,600 acres). The north and east portions of the reservation are relatively flat desert with elevation ranging from just over 5,000 feet at Main Post, down to about 4,000 feet at the extreme northwest corner of the reservation. The south and west portions of the reservation are mountainous with elevations that range up to 8,406 feet (Huachuca Peak).

The area includes mountains, plateaus, and river bottoms with a gradual eastward slope from the Huachuca Mountains to the San Pedro River. Vegetation varies from shrubs, grasses, and small oak trees in lower areas to yellow pine and deciduous trees in higher areas.

(2) Willcox Dry Lake (23,000 acres). See Figure E-2. This is a very level desert area at an elevation of slightly less than 4,600 feet.

(3) Gila Bend Area (1,500,000 acres).

(a) Description. The field facility near Gila Bend, Arizona, consists of a 40 x 60 mile area (available on request) that may be used to test all types of communications and electronic systems under open field conditions.

j. Airspace Restrictions. FAA restricted airspaces in the Fort Huachuca Military Reservation Area are R-2303A (0-15,000 feet) and R-2303B (15,000-45,000 feet). Waivers can be obtained for higher altitudes.

k. Power Availability. Commercial power (signal phase, three phase, wye and delta connected) is available throughout the Fort proper. Some remote locations are wired for commercial power, others are supplied motor-generator sets for power as required.

l. Communications.

(1) Radio.

(a) Air-ground communications include UHF-AM sets at Fort Huachuca, Mount Lemmon, and Oatman Mountain, plus HF SSB sets at Fort Huachuca and Mount Lemmon. This system can be operated from Fort Huachuca.

(b) The range communications system (FM) includes fixed, mobile, and portable VHF (132-174 mHz) sets at Fort Huachuca with repeater stations at Oatman Mountain and Mount Lemmon. Also in use are UHF 406-420 mHz point-to-point microwave stations, located at Fort Huachuca, White Tanks Mountain, Oatman Mountain, Telegraph Pass and YPG (Site 4). These provide interface and communications for STF operation.

(c) The test support system (FM) includes two HF (25-50 mHz) base stations at Fort Huachuca and one at Mount Lemmon. There are also VHF (132-174 mHz) base, relay, and mobile stations on hand as part of the test support system.

(d) The system's test facility Backbone Microwave System (7,155-8,145 mHz) connects Fort Huachuca with Mount Lemmon and has a capacity of 24 channels. A point-point microwave link from Mount Lemmon to Oatman Mountain is the interface to this system. It provides six channels for communications and data.

(2) Telephone. In addition to the permanent base telephone system at Fort Huachuca, all-weather cable is available for temporary installation.

3. Dimensions.

a. Landspace.

(1) Contiguous Test Areas. See Figure E-2. At Fort Huachuca there are three ranges: East, West, and South. The West and South ranges are contiguous and include the Fort complex. The West and East ranges are separated by State Route 90. The total land area available for EPG is 73,600 acres. At Willcox Playa, 23,000 acres of dry lake bed provide a measurement range facility. The above areas are strictly controlled by the Army. The Gila Bend area, 40 x 60 miles, is privately-owned land which is leased for test purposes.

(2) Easements. The Gila Bend area is a grazing area for cattle; therefore, only stationary equipment is deployed there.

(3) Impact/Live Firing Areas.

(a) Explosive Rounds. The major portion of the East range may be used as an artillery impact area for infantry and artillery weapons to 8-inch howitzers. In addition, the northwest corner of the West range is also used as an artillery impact area as well as a tank maneuver area.

(b) Inert Rounds. Same as explosive rounds.

b. Airspace.

(1) Landspace/Airspace Relationship. The entire Fort Huachuca Military Reservation, as well as considerable surrounding areas (on all sides) are enclosed by restricted areas R2303A, sea level to 15,000 feet, and R2303B, which encloses R2303A, from 15,000 to 45,000 feet.

(2) Easements (FAA-high altitude air routes). The restricted airspace areas are under FAA control (Albuquerque, NM). Normally, this airspace is used exclusively by Fort Huachuca. On rare occasions, FAA requests routing of commercial air traffic through these restricted areas because of weather, e.g., thunderstorms.

(3) Manned Airborne Systems. Located at Libby Army Airfield, Fort Huachuca, the USAEPG Aviation Division provides aviation support for tests conducted at the Proving Ground.

The Aviation Division personnel complement includes aviators, pilots, aircraft maintenance crews, and aviation safety officer, and the necessary internal administrative and logistical support individuals. Division aircraft available include OV-1D Mohawks and UH-1 helicopters. Other types of aircraft can be made available on request.

(4) Unmanned Airborne Systems. The remotely piloted vehicle (RPV) facility consists of two runways: one approximately 1,000 x 100 feet; another 800 x 100 feet and a 2800-square foot work area adjacent to the runways, housed in a metal building. Data instrumentation and logistic support are available. Flights may be conducted with unmanned aerial vehicles in Restricted Airspace R 2303A, surface to 15,000 feet MSL and Restricted Airspace R 2303B, 15,000 to 45,000 feet MSL. Special test and maintenance equipment is available to assemble, checkout, maintain, and repair RPV's.

(5) Area Surveillance. Surveillance radars are installed on Laundry Ridge at Fort Huachuca and at Oatman Mountain. Each location has one AN/FPS-6B height-finding radar and one AN/FPS-33 surveillance radar, which together provide a three dimensional space picture. The acquired data is relayed to the appropriate control centers, where it is automatically plotted and projected. This system is used to provide information for range safety, acquisition support for the tracking radars, and vectoring in support of manned and unmanned aircraft.

4. Instrumentation (See reference 2 of Biblography).

a. Space Positioning and Velocity Vector.

(1) Ground Elements. There is no specialized instrumentation for this purpose.

(2) Airborne Elements.

(a) Radar.

1 Three precision AN/FPS-16 radars are used to vector aircraft to a prescribed path in accordance with a prepared flight map and to provide space position data on aircraft used in tests. They are capable of manual or automatic acquisition and tracking of targets in flight or orbit by target echo or beacon. Range is from 500 to 8,000,000 yards; range accuracy is ± 5 yards. Indicated azimuth and elevation are accurate to 0.1 mil.

These radars are used in the STF. At Fort Huachuca, one is situated at an elevation of 5981 feet on Scott Peak in the West Range and another at 4961 feet at Laundry Ridge. The third is located on Mount Lemmon at an elevation of 9184 feet, making it the highest tracking radar in Arizona. It is a dome-covered AN/FPS-16(V)/CAPRI model which has capabilities that are similar to that of the AN/FPS-16 radar.

The two AN/FPS-16 radars located at Fort Huachuca are also equipped with bore-site television. This extra capability permits visual display and taping of the target aircraft for use in test evaluation.

2 The AN/MPS-26 (XN-1) radar is located at the Oatman Mountain facility, Gila Bend. It is a G-band (5.43-5.825 gHz) model used to vector aircraft and provide space position data on manned and unmanned aircraft

used in tests. Coverage is 360° in azimuth and -8° to +89° in elevation with instrumentation accuracy rate 0.5 mil in both azimuth and elevation. The range is from 2,000 to 400,000 yards with instrumentation accuracy of ±10 yards.

(b) Laser. EPG does not employ laser tracking systems at this time, however, instrumentation is available to measure the performance of laser systems operating in the optical portion of the electromagnetic spectrum.

(c) Optical. Mobile cine mounts and Locam Camera systems (16 mm) are available for tracking airborne objects.

(d) Relative (Miss-Distance). EPG has no instrumentation designed especially for this purpose.

b. Timing. An IRIG (Inter-Range Instrumentation Group) timing system including a Frequency Correlation Transfer Unit (EECO-ZA-37150) and Cesium Standard (FTS 4050 is installed at EPG, and usually the IRIG-B format is used; other formats are available. Each EPG site (Fort Huachuca, Mount Lemmon, Oatman Mountain) has individual timing and measurement equipment; and the entire range can be sychronized to one master control at Fort Huachuca. Each site has a crystal frequency standard and WWV receiver to provide secondary and primary standards.

c. TV Equipment. Closed-circuit television (CCTV) systems provide remote surveillance, instrument readout under hazardous conditions, and instrument aids. The Human Factors Engineering Laboratory has a CCTV system available for use at various test sites.

d. Photography.

(1) Motion Picture Capabilities. Four 16mm Locam Camera Systems.

(a) How Presently Used. The instrumentation cameras are used primarily for airborne object tracking.

(b) Designed Operating Environment. Equipment is available for fixed, mobile, and portable applications.

(c) Film Developing Capabilities. EPG has a precision film processing capability used sensitametric testing. Routine processing is performed by Fort Huachuca's pictorial-graphic division. Both color and black and white film can be processed.

(2) Still Photography. The pictorial-graphic division of Fort Huachuca processes all film and produces both color and black and white prints.

e. Instrumentation Calibration Capabilities. The Calibration Division offers services of certification and calibration not only to USAEPG and its supported agencies but to all units stationed at Fort Huachuca. Accuracy is assured by calibration traceable to the National Bureau of Standards.

Calibration is possible in the following parameters: resistance, AC and DC voltage and current, inductance, capacitance, time and frequency with a primary standard, audio analysis, mass, length, flatness of surfaces, temperature, and complete radio frequency measurement capability up to 40 GHz.

All calibration is done in a controlled environment. Fixed calibration and reference standards are maintained in an environmentally controlled room. A modern air-conditioned mobile van can duplicate practically all calibration work in the field.

f. Other General Information and Instrumentation.

(1) Telemetry. Two fixed D and E-band telemetry systems are located at Fort Huachuca and at Oatman Mountain. These systems provide RF telemetry data reception and tracking by three modes: manual, automatic, and slave (to radar tracking a target). Frequency coverage is 1,435-1,540 mHz and 2,200-2,300 mHz bands. The system is capable of tracking any frequency in either band and simultaneously receiving two separate data signals in either or both bands, independently of the tracking signal. It is designed to receive any type data as listed in IRIG document 106-71. The PCM system capacity is 100 digital channels plus 40 real-time analog output channels. Tracking rates are from 0 to +15°/second in azimuth, and 0 to +10°/second in elevation.

The mobile facility has two transportable, sheltered telemetry systems with capability to receive composite signals on tape. Currently one mobile system is at Oatman Mountain and the second on Mount Lemmon.

(2) Meterorological. An Atmospheric Science Laboratories (ASL) Meteorology Team and Libby Army Airfield provide meteorological data to EPG. Fort Huachuca is provided meteorological data by an Air Weather Service forecast team from Libby Army Airfield.

(3) Survey. Surveying instruments and a survey team are available.

(4) Radio Frequency Interference/Electromagnetic Compatibility. Frequency assignments are made through the Area Frequency Coordinator. EPG has extensive monitoring and analytical instrumentation described under the special purpose instrumentation (para 4.g.).

(5) Visibility. The standard weather visibility observations are available from the ASL Meteorology team. A large inventory of optical measurement instrumentation is available in EPG's optical facilities.

(6) Sound Measurement and Analysis. Instrumentation for sound measurement and analysis is available in the Human Factors Engineering Facility, the Sensor Test Facility and the Voice Scoring Facility.

(7) Safety and Security. Radar airspace surveillance is provided.

(8) Soil Conditions. Descriptive material and studies are available at EPG.

A test site on the East range used for testing perimeter defense sensors has undergone extensive seismic survey and analysis to quantify seismic response and soil penetration characteristics.

(9) Equipment Pool. The Equipment Pool of the Electronic Proving Ground (EPG) is a centralized issue facility for electronic test equipment. Such a pool contributes to an economic inventory of high cost equipment and provides proper storage and maintenance to assure equipment readiness. locator and issue documentation files are maintained to assure equipment readiness. Arrangements are amde for calibration and maintenance of equipment being used by the technical branches conducting tests.

g. Special Purpose Instrumentation.

(1) Ballistic Data. No specialized instrumentation available.

(2) Environmental Chambers. The Environmental Test Facility (ETF) is capable of providing the effects of all major climatic extremes and a wide range of structural tests. Climatic chambers up to a 6x6x6-foot working volume and a 10x10x16-foot walk in temperature/humidity/altitude chambers are used for temperature-humidity, temperature-altitude, rain, sunshine, dust, salt fog, fungus, and explosive atmosphere testing. Various chambers are capable of providing temperatures from -100° to +350°F, simulate altitude to 250,000 feet, humidity from 20 to 96 percent, light intensity of 100 to 190 watts/feet^2, rainfall of 1 to 12 inches/hour with or without wind (up to 60 mph), and dust densities of 0 through 1 gm/ft^3. Facilities are also available for immersion tests. Structural tests include sine wave and random vibration, shock, loose cargo bounce, vehicular bounce, drop, and bench handling. The vibration system includes a 4,000 force-pound shaker with a range of 5-5000 Hz, and a 12,000 force-pound shaker with a range of 2-5000 Hz. The shock machine is capable of producing half sine, sawtooth, and square wave pulses up to 500 g's with a 200-pound test item. Shelter tests performed include vehicular transportation, watertightness, drop, fording, and rail impact. A 1600-cubic foot 10x10x16-foot walk-in temperature-humidity chamber was installed during 1977. A 10x11x16-foot walk-in temperature-humidity altitude chamber was installed in 1978. An FY79 MCA project connected two existing buildings of the ETF and provided an additional 2,000 square feet of needed floor space.

(3) Vehicle Performance. Shelter tests performed are vehicular transportation (road course), water tightness, drop, fording, rail impact, high and low temperature, humidity, and fungus.

The vehicle transportation course and a fording tank are for shelter testing per MIL-S-55286. The rain and wind facility is for shelter testing per MIL-STD-810C.

(4) Chemical/Biological/Radiological Instrumentation.

(a) Biological. The Microbiology Lab has the capability of maintaining, culturing, and stocking various genus of fungi which are used in determining equipment susceptibility to microbial growth when subjected to a microbial atmosphere. The lab also has the capability of analyzing the effects of biodeterioration of various substrates used on the equipment and identification of the causitene organism.

(b) Radiological. The Radiological Test Facility is located in the eastern half of Building 12508 (Blacktail Canyon) and is equipped with a variety of instrumentation to determine the exposure of personnel and the test items to radiation. Instrumentation includes Victoreen "R" meter; RADCON, Model 444 rate/dose meter; and "Vamp" area monitor; EG&G "TLD" System"; Nuclear-Chicago area monitoring system; a 1024 channel analyzer; Nuclear-Chicago single channel counter low level radiation detection and measurement system for detecting radioactive material in optical glass, Model PC-4 proportional counter, air sampler sources. Electronic test instrumentation such as recorder, scopes, and voltmeters are available from a common equipment pool.

NRC licensed sources are:

AD/UDM-1: 11 curies of cobalt 60
Radiation: Gama, energy 1.2 MEV
Approx 100 rad/hr at 32 cm;
10 rad/hr at 1 meter

AN/UDM-1A: 120 curies of cesium 137
Radiation: Gamma, energy .662 MEV
Approx 400 rad/hour at 32 cm
40 rad/hour at 1 meter
10 rad/hour at 2 meters

Model 138 Shepherd Associates, dual beam irradiator
100 curies of cesium 137
250 curies of cobalt 60
Approx 360 rad/hour at 1 meter

Model 179 J.L. Shepherd Neutron Source - 10 curies
Pu Be 250 n/cm^2/sec
Seiffert/Westinghouse dual tube
x-ray system
400KVCP max, 10mA, greater than 1000
r/hr @ 55 inches from the target

Sources licensed to the US Army:

Field Calibrator TS-784A/PD
Approx 25 millicuries of strontium
90-yttrium 90
Radiation: Beta, energies
.545 and 2.26 MEV
No correlation with rad/hour;
used as transfer std

Training Set M-3A1
120 millicuries of cobalt 60
Radiation: Gamma, energy 1.2 MEV
Approx 160 millirad/hour at 1 meter

Calibrator Set AN/UDM-6
Approx 1.4 microcuries
Pu 239 Alpha Energy 5 MEV

Radiation sources are calibrated annually by Sacramento Army Depot traceable to NBS. Radiation instrumentation is calibrated using the radiation sources above or at Sacramento Army Depot. Electronic test instrumentation is calibrated by the USAEPG Calibration Laboratory and is traceable to NBS.

(5) Other.

(a) Electromagnetic Environmental Test Facility. The Electromagnetic Environmental Test Facility (EMETF) is used to evaluate the ability of communications-electronics (C-E) to operate in their intended operational environments without suffering or causing unacceptable degradation. Testing includes electronic system and equipment performance with respect to both unintentional interference and vulnerability to electronic countermeasures (ECM). The EMETF has four empirical measurement facilities and a computer analysis capability. The measurement facilities determine equipment characteristics and the degree of degradation that different types of interference cause to C-E and weapons systems and the conditions under which the interference occurs. Data are used in conjunction with a computer-automated analysis capability (library of computer models) to analyze the probability of satisfactory operation or system effectiveness in a tactical scenario. These data are tabulated and displayed in the map room for evaluation and analysis.

The map room facility uses selected data from magnetic tape files of simulated deployments of battle forces and all their associated equipment. These data are used to evaluate the performance, vulnerability, and compatibility of radio and microwave links.

1 EMETF Instrumented Workshop. The Instrumented Workshop (IWS) was established in 1960. The IWS measures the performance of a communications system when subjected to varying degrees of electromagnetic interference or jamming. The transmitter of the communications system under test is placed in a screen room and modulated. The output is controlled by an attenuator and coaxially coupled into the mixing device. By controlled adjustment of the attenuators, the degree of degradation of intelligence transfer caused by various interference levels can be determined for all receiver signal levels. The Automatic Data Collection System (ADCS) enables three closed link communications tests to be performed simultaneously by time sharing the basic measurement instrumentation and output facilities.

2 EMETF Voice Scoring Facility. The Voice Scoring Facility determines the subjective degree of intelligibility of voice traffic transferred over a communications system when subjected to interference or jamming. In this system several word groups of 50 phonetically balanced

words, selected from a master list of over 1,200 words, are transferred over a military communications system under various conditions of interference from clear transmission to complete loss of intelligibility. The output of the system is then played to a group of six to eight trained listeners who indicate the words they thought they heard by means of a pushbutton word array containing an equal number of correct and incorrect words. By comparing the listener selections with the words actually transferred over the system, the percentage of words heard correctly can be determined. The relationship of this word intelligibility score has been correlated with message intelligibility by transferring typical military messages over the system under the same interference conditions and using trained military personnel to determine the degree of military message intelligibility.

3 EMETF Spectrum Signature Facility. The Spectrum Signature Facility performs measurements of C-E equipment characteristics in accordance with MIL-STD-499( ) or as required. Although the majority of measurements are concerned with transmitters, receivers, and antennas, specialized measurements on missiles, automatic data processors, switching equipment, and weapons systems are available. The fixed facility includes large screen rooms and a complete range of signal generators, spectrum analyzers, distortion analyzers, and other specialized measurement equipment covering a frequency range from dc to 40 GHz. The mobile vans can be equipped with similar instrumentation, but configured for field type measurements.

4 EMETF Weapon System Electromagnetic Environment Simulator. This facility provides a capability to determine the performance of radars and weapon systems under controlled and repeatable conditions when the system is subjected to interference or jamming. The Weapon System Electromagnetic Environment Simulator (WSEES) can generate under precise control exact duplicates of the real world radio frequency (RF) signals that would be associated with shell and mortar tracking, air defense, artillery, and combat surveillance radars or weapon systems and any other RF signals within the frequency range of 2-18 GHz. Up to 32 different pulse signals can be simulated. These signals may be combined into a single output or individually distributed to any of 12 separate outputs. The RF signal generating and control system is programmable from tape, keyboard, card reader, or computer. Each signal can be controlled as required for the system under test.

5 EMETF Library of Computer Models. The computer automated analysis capability of the EMETF utilizes a library of computer models in conjunction with a dedicated Cyber 172-4 computer to perform the following operations: (1) The Network Traffic Analysis Model simulates operation of individual equipments and their interaction within a system or network of equipments to provide network traffic analyses that are tailored to individual problems. (2) The Environmental Interference Effects Model is a combination of programs used to predict the EMC/EMV or C-E systems operating in a tactical environment. This model will also be used to aid in the determination of friendly and foreign equipment simulators which will be employed in the Realistic Battlefield Environment-Electronic (REBEEL) test fixture. (3) The Spectrum Integration Model is used to estimate threshold signal to interference values when empirical data are unavailable. (4) The Pseudoterrain Model is used for determining the electromagnetic communica-

bility, compatibility, and vulnerability, when it becomes necessary to calculate the propagation path loss between a transmitter and a receiver or between an interferer or jammer and a victim receiver. (5) The Frequent Hopping Model is used to determine the effects of introducing frequency hopping systems into a field deployment. (6) The Simulation Model for Mobile Subscriber Equipment is an event-sequence model simulating system functions as they are performed in the mobile subscriber equipment system.

(b) Communications Test Facility (CTF). The CTF and its three associated communications sites (Mount Lemmon, Site Sibyl, and Mule Mountain) form a network that permits the controlled testing of analog and digital communications systems. The buildings at the CTF are interconnected by cables in order to simulate the communications system from a headquarters element to 9 subordinate units. This configuration permits engineers to test several radio and/or wire systems simultaneously. In addition, US Army Communications Command (USACC) frequently utilize the CTF on a customer basis in order to test its new communications systems.

Each of the ten buildings in the CTF is well-equipped to conduct tests on separate items, such as teletypewriters, radio sets, tactical computer systems, satellite terminals, fiber optics systems, etc. Two of these buildings have additional security features necessary for the testing of communications security (COMSEC) equipment.

(c) Electromagnetic Interference Test Facility. The Electromanetic Interference Test Facility (EMI) is in a remote location where the surrounding mountains provide for a relatively quiet RF environment. The major instrumentation includes an RF anechoic chamber which can accommodate an Army truck or tank, three shielded inclosures (16x26x12, 12x12x12, 9x9x9 feet), and equipment storage and workshop areas. Testing performed in accordance with EMI standard MIL-STD-561. The facility is equipped for testing radars, radios, avionic control systems, computers, communications systems, missile control systems, and power sources. EMI testing consists of looking at emissions radiated from the equipment under test, and specifically for emissions through the case surrounding the equipment or through its interconnecting cables. EMI also tests for the type and level of external RF signals that can penetrate the case or interconnecting cables. The EMI facility has available signal generators, receivers, and antennas required to cover the frequency range of 20 Hz to 18 GHz. The EMI test data are collected semi-automatically on a Fairchild FSS-250 Spectrum Surveillance System. Recent modernization tasks have added a new set of specially designed RF probes.

(d) Sensor Test Facility. Sensor systems include perimeter defense types such as the Platoon Early Warning System (PEWS) and tactical intelligence systems such as REMBASS. Sensor types include seismic, acoustic, magnetic, electromagnetic, soil conductance and pressure. Bench test capabilities include special signal generators and isolation devices to simulate seismic, magnetic, and electromagnetic target signatures and background environments. Field Test capability consists of a computerized field data acquisition system. The system is capable of real-time monitoring and recording of a wide range of sensor test engineering parameters to include seismic, magnetic, acoustic, and electromagnetic signatures and background environments, target and sensor position location of ± meter, and a complete range of meteorological data. The primary field test site has undergone extensive seismic survey and analysis to quantify seismic response and soil penetration characteristics of test areas. Construction of a field facility building was completed in 1980.

(e) Radar/Avionics Test Facility. The facility located at the Libby Army Airfield complex, consists of a 7200-square foot building in a fenced, limited access area with aircraft taxiway. Approximately 1600 square feet of office space are provided within the facility. The remainder of the area contains laboratory type work benches and a wide variety of electronic test equipment used in making quantitative measurements of the performance characteristics of ground and airborne radars, IFF interrogators and transponders, airborne communications, navigation, guidance and control, air traffic control, and countermeasures equipment. Special facilities include a variable voltage and frequency source (0 to 250 volts, 45 to 7000Hz) and an extended range shielded enclosure 12 feet wide x 16 feet long x 8 feet high, providing a shielded effectiveness of 60 dB minimum at 5 kHz increasing to 100 dB minimum at 50 kHz (magnetic field) and greater than 120 dB from 15 kHz to 10 GHz (electric and plane wave fields.) The enclosure has a self-contained air conditioning unit and is completely electrically isolated from the parent facility.

(f) Tempest Test Facility. The mobile TEMPEST Test Facility is used to open-field test Army tactical C-E systems for compromising emanations during the research, development, test, and evaluation cycle. The facility consists of a 26-foot M119 trailer with electrical generators, radio receivers, analog-to-digital processors, recording devices, and a programmable calculator for analysis. Testing is conducted at Fort Huachuca as well as at customer facilities. Facility equipment allows conduct of all current categories of tests specified by the National COSMEC/EMSEC Memorandum (NACSEM) 5100, Compromising Emanations Laboratory Test Standard, Electromagnetics; and NACSEM 5112, NONSTOP Evaluation Techniques. The facility may also be used for conducting radiation intelligence (RINT) measurements. Capability exists for digitizing and recording signals for post-test as well as real-time analysis. The receiving system covers the frequency range of 1 kHz to 1 GHz, expandable to 12 GHz with IF bandwidths variable from 400 Hz to 50 MHz. The analysis system is based on a Wang 720C programmable calculator which performs some predictive signals analysis and provides limited computational/conversion functions. The receiving system, a Raytheon 1150, operates over the frequency range of 1 kHz to 1 GHz. This item is used to detect and measure conducted and radiated low-level data related signals obscured by random noise.

(g) Image Interpretation Facility. This facility is equipped with light-tables which support five image interpreters. The work area provides for large mosaic construction and ample film storage. The light-tables are able to handle film with formats up to 9 inches.

(h) Antenna Pattern Measurement Facility. This facility is used to determine radiation patterns from both mounted and unmounted antennas. It consists of a 114 foot tower, a 117 foot sensor-bearing arc, and two rotating turntables 30 feet in diameter, one under the arc and the other 500 feet east of the tower. The semi-trailer located below ground by the arc provides housing for the computer equipment which fully automates antenna pattern measurements.

The tower and arc are all wood above ground level and are held together by phenolic bolts. This type construction insures a totally non-reflective environment around the item under test.

The arc makes possible the determination of antenna patterns of various radiating devices while they are in operational configuration on an aircraft frame, vehicle hull, missile shell or whatever. The arc has essentially free space characteristics at frequencies above 1 GHz. The tower provides facilities for taking antenna pattern measurements in which ground reflections are a consideration.

Besides the arc with its 75 foot radius and the turntable, the system includes a rotatable platform which will support inverted aircraft airframes or other types of vehicles up to 10 tons in weight. The total environment is metal free. This facility is equipped with instrumentation for the evaluation of antenna systems at frequencies from 50 MHz to GHz.

(i) Infrared and Optical Test Facility. This facility is used to test ground and airborne photographic, infrared (IR), LASER, and television sensors, audio visual, drone systems, and fiber optics. The facility includes a clean room which is an enclosed structure internal to the main building and is temperature and humidity controlled. Clean room contamination is monitored and kept to less than 100,000 particles per cubic foot of air (0.5 micron size). Capabilities include precise measurements of optical component characteristics such as resolution, focal length, distortion, astigmatism, curvature of field, and aberrations. Other measurements include interferometer measurements, optical film densities, and dynamic (frequent dependent) performance characteristics of lenses. Laboratory equipment contained in the clean room includes: optical bench, infrared spectrophotometer, interferometer, microdensitometer, modulation transfer function test system, and vibration damped optical test bed.

(j) Human Factors Engineering Facility. The Human Factors Engineering Facility evaluates military equipment and systems from the standpoint of the soldier/machine relationship. The mission is to determine whether the engineering of the test item accommodates the limitations of the human.

Factors considered include: control and display characteristics; allocation of system functions to the machine and the operator; environmental conditions such as illumination, noise, wind movement, ventilation, heating, and cooling of the work area; freedom from toxic gases; and adequate work space.

The facility is equipped with many instruments to carry out scientific testing in the areas listed, and makes use of video and photographic systems to obtain data on human performance in military systems and equipment.

(k) Electro-Optical Scoring Facility. The Electro-Optical Scoring Facility (EOSF) is used primarily to measure the degradation of electro-optical (EO) sensors when subjected to the intended environment. Other capabilities enable evaluation of low level television (LLTV), IR (imaging and nonimaging), LASER designators, and missile tracking systems. The devices under test can be utilized in clear channel, obscured, or interfered conditions by means of various controlled interferers such as simulated gun flashes and flares. The optical transmission environment can include smoke, fog, or dust of the same composition as that found in the battlefield.

The facility is a rectangular tunnel type structure, 5 meters wide, 5 meters high, and 46 meters in length. One 6x6-meter terminal area will be used to house the test item sensor, radiometric instrumentation, and the test control equipment. The second terminal houses target displays and optical environment simulators. The facility has a capability to generate atmospheric aerosol environments using a fog chamber and an intervening environment simulator (IES). The IES generates controlled and measured optical obscurants such as smoke and dust in order to evaluate their effects on EO sensor performance. The target area uses scaled representations to include active IR target simulation. The active interfering environment is simulated using solar simulators and other controlled coherent and incoherent optical signal sources. The collected empirical data provides key inputs essential to extending the existing computer-based Environmental Interference Effects Model (EIEM) through the optical spectrum.

(l) Software/Computer Evaluation Facility. Software testing is a new requirement brought about by the increasing use of software-controlled digital processors to implement system functions in C-E systems and subsystems. The Software/Computer Evaluation Facility (SCEF) is used to support the development tests of such systems. It includes special purpose software testing tools such as static and dynamic code analyzers, symbolic execution systems, test case data generators, software and system simulation facilities, and software systems necessary to develop, validate, and maintain these tools, the SCEF provides special purpose instrumentation for monitoring the internal states of the computers contained in systems undergoing test, and work space for the engineers, analysts, technicians, programmers, and scientists engaged in the test activity. The SCEF includes the following capabilities:

The capability to monitor the internal functions of the computers used in the systems under test.

The capability to construct and analyze models of systems that are to be tested. These models will be used to evaluate system tests that are proposed by the development contractors and/or to plan Government test of such systems.

The capability to generate test case data and/or scenarios to be used in loading the systems under test.

The capability to analyze code to determine the integrity of the flow of control and data and control of access to the data.

(m) Electronic Warfare Intelligence Facility. The Electronic Warfare Intelligence Facility (EWIF) is used to provide the capability for required validation and development testing of direction finding (DF), intercept, and electronic counter-measures (ECM) equipments. Testing includes both bench and field aspects of development testing as well as a mobile field vulnerability effort capable of conducting active ECM tests.

(n) Systems Control Facility. The Systems Control Facility (SCF) is an integrated communications, processing and data collection system designed to provide real-time or near real-time control of full performance C^3I field/bench test. The SCF will allow acquisition of data from widely separated elements, will transfer this data to a central processor, will process this data in real-time and will provide substantial off line S&E processing; will minimize the time required to process test data, will optimize data reduction techniques and will allow test operation with a minimum number of personnel. The SCF will control and record real-time test data from multiple simultaneous field tests and will serve as the focal point for operation of field and bench tests of complex C^3I equipments.

(o) Realistic Battlefield Environment-Electronic (REBEEL). The Realistic Battlefield Environment Electronic (REBEEL) will provide a realistic foreign threat environment for use in the testing of Communications Command Control and Intelligence (C^3I) systems. The development of this realistic electromagnetic environment will present items under test with a truer picture of foreign components against which they will be fielded and, hence, will provide an accurate determination of the effectiveness of the systems under test against the actual foreign threat. An adjunct of this effort will provide non-radiating (hulltype) devices for use in sensor type testing.
This project will be broken into four major areas; they include: the provision of communications devices, the provision of non-communications devices, the provision of nonradiating devices, and the provision of environment monitor devices.

(p) Test Drivers. The Test Driver Development Module consists of a set of transportable automated test item message loading devices which will exercise specific test equipments over a wide range of tactically realistic scenarios. Each individual test driver will consist of a rugged mini-computer with sufficient storage for both messages to be transmitted to the items under test and messages to be recorded from the items under test. It is envisioned that the Test Drivers will use pre-prepared types of messages (digital) representing stimuli to the systems under test which are not physically present. The Test Drivers will use the same communications channels, protocol, and encryption devices as the replicated systems and will to the maximum extent possible provide a simulation of the entire system (to include interfaces of the test system).

(q) ECM Field Facility-Vulnerability. The ECM Field Facility is designed to provide those equipments and resources needed to conduct field ECM tests of EWI and communications systems. These equipments will be mobile, will contain the capability of automated data retrieval and recording, and will be capable of interface with the SCF processor. EPG plans continued development of present facilities to insure availability of state-of-the-art ground and airborne ECM equipment. Improvements will also include upgrade of signal intercept and analysis resources and the development of integral communications capabilities.

(r) Automated Bench Test Facility. The Automated Bench Test

Facility (ABTF) is designed to provide a computer-controlled bench test environment capable of automated testing of RF receiving, RF transmitting, and RF/digital processing functions of systems and subsystems. In accordance with a computer test scenario, this facility will be able to conduct an entire subtest automatically by generating inputs, measuring outputs, and assuring that the measurement equipment is operating properly. EPG plans continued development of the present instrumentation to include the addition of automated control processors and GPIB-equipped items is planned. Included will be the fabrication of special purpose interface devices (between the test system and the item under test) and the development of necessary system software.

5. Threats/Targets.

a. Ground.

(1) Electromagnetic. Realistic Battlefield Environment-Electronic (REBEEL) (see para 4.g.(5)(o)).

ECM Field Facility-Vulnerability (see para 4.g.(5)(q)).

(2) Weapons. EMETF Weapon System Electromagnetic Environment Simulator (WSEES) (see para 4.g.(5)(a.)4).

(3) Radiological Environment. The Radiological Test Facility (see para 4.g.(4)(b)).

(4) Other.

(a) Radar Geometric Fidelity Facility. This facility is used for determining the fidelity of large area-mapping airborne radar systems up to a range of 100 miles without any defilade shadowing of targets. There are sixty-five concrete pedestals and each pedestal's reflector is a tetrahedron with an edge dimension of one meter and can be installed and adjusted to any desired azimuth and elevation angle. The facility is located at Willcox, Arizona, dry lake area and covers an area of over 35 square miles. The entire terrain surface is level to 10 inches and is dry except in rainy seasons. The location of the total system is accurate to first order, class 3, determined by national survey. Within the system itself, the accuracy is first order, class 2.

(b) Radar Resolution Facility. This facility is used to measure simultaneously the range and azimuth resolution of a radar. Numerous reflector sizes can give various radar target cross sections. The radar spoke consists of four arms which meet at right angles. Along each of four arms are 143 sites spaced at increasing distances ranging from 1 meter near the apex to a maximum of 512 meters at the ends of the arms. At each site a corner reflector, a whirli-flector which can be electrically rotated, or a sphere can be positioned. A moving target simulator track permits controlled and standardized measurement of threshold velocity and radar cross section of radar equipment. The moving target simulator system consists of four main components: the remote unit; tne motor control electronics cabinet; the Thymotrol and motor drive system; and the moving target indicator (MTI) track. The system is capable of setting target direction and speed from 0.1 to 19.9 mph. The system may be operated locally or by remote control. The MTI track consists of two continuously moving target carriages, each of which will expose its target (corner reflector) for a length of 208 feet. The system may be used to determine the threshold velocity of any MTI type radar up to 19.9 mph.

(c) Spatial Resolution Facility. The Spatial Resolution Facility (SRF) is used to measure spatial resolution and spatial distortion of photographic, television, and IR equipment. The facility consists of a flat concrete surface forming three wedges 678 feet long by 200 feet wide. One wedge is painted with aluminum horizontal and vertical bars for IR measurements; another with white bars on black background for photographic measurements; the third is painted with two shades of gray paint. Another part of the facility consists of an IR target array and radiation measurement instrumentation required to evaluate the thermal sensitivity and geometric resolution of a broad class of airborne IR surveillance systems. The target array consists of a series of active targets for short wavelength IR systems and a series of passive targets for mid to long wavelength IR systems. Target controllers provide for setting temperature differentials of 1° to 40°C. The canvas passive array consists of a 100-foot edge target for edge analysis and a series of six 40- by 40-foot panels providing a gray scale in the IR spectrum. The emulsion coated canvas panels have been calibrated by NBS.

b. Airborne.

(1) Electromagnetic.

(a) ECM Field Facility-Vulnerability (see para 4.g.(5)(q)).

6. Data Handling/Processing.

a. Data Storage and Retrieval Capabilities. The USAEPG Systems Control Facility and Test Site Facility include three interconnected processors: The DEC System 1070 (System Control Processor) handles detailed data reduction and analysis functions; the DEC VAX 11/780 (Test Control Processor) handles data acquisition, remote device control, and data preprocessing functions; and the PDP 11/34 (Test Site Facility) is a mobile facility to interface with test items and environmental facilities. Available test control software uses large data buffers in memory which allow data extraction, data merge, and network traffic handling processes to access the data as it is collected, without I/O waits. The initial operational configuration provides for simultaneous reception of two data streams (which must be merged), and buffering of network traffic going to and from the Test Site Facility (PDP 11/34) and to and from the System Control Processor (DEC System 10).

b. Quick Look Capabilities. The SCF is an interactive near real time system and offers the capability for quick-look outputs on either graphics terminals, continuous line plotters, or conventional terminals/printers.

c. Processing.

(1) System. EPG operates three processing facilities; a DEC System

10 with VAX 11-780 and Nordin 11-34; a CYBER System 172 and an IBM 360-20. The DEC System 10 is the keystone of an interactive network designed to control field testing and conduct near real time data analysis; the CYBER-172is a large machine oriented towards mathematical modeling and the IBM 360-20 is a data terminal connected to a large processor (for business application) at White Sands Missile Range.

(2) Languages

DEC System

FORTRAN
DEC ASSEMBLY
PASCAL
COBOL
SNOBOL
BASIC

CYBER

FORTRAN
COBOL

IBM

FORTRAN
COBOL

(3) Input-Output Options. Input options include disk, tape and cards. Output options include CRT/Conventional terminals, graphics terminals, printers and plotters.

(4) Real-Time/Post-Test. Both real-time and batch capabilities are available and can be tailored to the test at hand.

d. Distribution. Turnaround time is dependent on project size and priority. It can vary from real-time to overnight.

e. Displays. Displays include graphics and standard terminals as well as CAL COMP plotters.

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ANNEX F

AIRBORNE BOARD -
Fort Bragg, North Carolina

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ANNEX F

USA AIRBORNE, COMMUNICATIONS AND ELECTRONICS BOARD (ACEBD)
Fort Bragg, North Carolina

1. Introduction

a. Overview. Fort Bragg is located about 10 miles northwest of Fayetteville, North Carolina. Fort Bragg has been aptly named "Home of the Airborne" for it is here that the XVIII Airborne Corps, the 82d Airborne Division, and the famous Green Berets are located.

The mission of the Fort Bragg facility is to control, train and provide administrative and logistical support for all units assigned or attached.

The facilities and range areas of Fort Bragg are oriented primarily toward the training mission of TOE units. Of the more than 137,000 acres within the reservation, some 125,000 are allocated to maneuvers and firing ranges. Control of these ranges is by Post Range Control, with the ABNBD only designated exclusive use of a 250-meter square area for testing. This area is generally adequate for most Board range needs. Additional ranges are made available by the host installation on a space-available basis.

Fort Bragg has a satellite installation, Camp MacKall, located to the northwest or the Fort Bragg military reservation. Non-firing training operations are also possible on the several Sandhill Wildlife Management Areas.

The terrain at Fort Bragg, in general, is level to rolling hills with pine and scrub oak with a few areas covered by grass. The climate is rather mild with humid and warm summer seasons.

b. Generic Systems Tested. The Fort Bragg Post, being the host organization, controls the majority of test ranges and areas and is primarily oriented for training of the airborne units; therefore, they do not normally perform testing or evaluation of new or existing items. Indirect fire weapon testing can be accomplished up to ranges of 30 kilometers.

The ABN Board mission is to test airborne equipment and systems. The Board plans, conducts, and reports on these systems. Airborne tests pertain to equipment and systems which support the air dropping and transporting of troops, supplies, and equipment in USAF aircraft (including C-130, C-141, and C-5A aircraft) and in U.S. Army fixed-wing and helicopter aircraft. The Board was recently assigned the mission of unattended ground sensor testing. It also provides advice to other test agencies and to military and civilian developers on equipment and systems which are in the development phase. After completion of tests, the Board reports on whether an item or a system is suitable or is not suitable for Army use.

2. General

a. Military Units

(1) Army Units. The following list of Army units currently located at Fort Bragg provides basic capabilities and types of support.

(a) XVIII Airborne Corps

(b) 82d Airborne Division

(c) JFK Center and Institute for Military Assistance
5th Special Forces Group (ABN)
7th Special Forces Group (ABN)
95th Civil Affairs Group
2d Psychological Ops Group

(d) 12th Support Brigade

(e) 35th Signal Group
25th Sig Ops Bn
50th Sig Bn (ABNC)
327th Sig Sup Bn
426th Sig Bn (Combat)

(f) 18th Airborne Corps Artillery
2d Target Acquisition Bn/25th Arty
4th Bn/39th Arty (8 inch)
4th Bn/73d Arty (155mm Towed)
6th Bn/82d Arty (155mm SP)

(g) 269th Aviation Battalion
2 Assault Helo Co
1 Cargo Helo Co
1 Observation Co

(h) Nearby Government Installations
Pope Air Force Base, North Carolina
Camp MacKall, North Carolina
USMC Camp LeJeune, North Carolina
USMC Cherry Point, North Carolina
Fort Jackson, South Carolina
Fort Benning, Georgia

(2) Other Military Units. None.

b. Maintenance. The Board has a consolidated maintenance branch with two sections: the Maintenance Section and the Combined Shop. The Maintenance Section operates the Board Motor Pool and provides vehicle and maintenance support. It differs from ordinary motor maintenance sections due to the recovery missions and technical inspections it performs. Recovery missions refer to recovering air-dropped test items from drop zones. Technical inspections must be performed on all test and test support vehicles before, during and after testing. Vehicle density fluctuates constantly due to the number of test and test support vehicles borrowed from on- and off-Post units; however, the support base remains fairly constant. The Combined Shop Section has all types of woodworking, metal working, and blacksmithing equipment to repair test and test support equipment, to fabricate support items, and to perform limited maintenance of Board facilities. Three highly skilled civilian carpenters and machinists operate this shop.

The Board Aviation Branch has one UH-1H Helicopter and one U-8G used for administrative test support, and two T-28B (TROJAN) aircraft used for air-to-air photo chase missions. There are three authorized pilot positions: 1 Major (Branch Chief); 1 Warrant Officer; and 1 civilian, plus seven enlisted maintenance personnel. This Branch is co-located with other Post aviation units at Simmons Army Airfield.

Other maintenance on Post is supplied in the standard manner of Army unit organization and direct support by TOE units. Any higher levels necessary are then performed by Post General Support Maintenance.

c. Access.

(1) Air. Commercial air transportation is limited to one airline serving the area from Grannis Airport (runway length, 6,500 feet), 17 miles from Fort Bragg. Both Simmons Army Airfield (3,600-ft runway) and Pope Air Force Base (7,500-ft runway) are located about 3.5 miles from Board Headquarters.

(2) Water. Commercial docks for deep draft vessels are available at Wilmington, North Carolina, 90 miles away. The Cape Fear River is navigable to barges between Fayetteville and Wilmington.

(3) Rail. Railway tracks connect Fort Bragg with the Seaboard Coast Line, Cape Fear Railways, Inc., and Aberdeen and Rockfish Railroad Company. Spur connections for these companies are located at Fort Junction and Skibo, North Carolina. The Seaboard Coast Line provides passenger service with connections at Fayetteville about 12 road miles from Fort Bragg.

(4) Road. Road access to Fort Bragg is available by interstate 95 and U.S. 301, linking it to the national highway network.

d. Logistics Support Capability. The logistical support capability of the host and tenant organizations at Fort Bragg are adequate for supporting present operations. Increases of maintenance and logistical support required by outside users are probably tolerable without major problems. However, defined requirements are necessary for the comprehensive view of the maintenance/logistical capability that could be provided.

Housing, messing, and other personnel support requirements may be absorbable due to the nature of the size and types of Army units located on Post. The Board also has four old WW 11-type barracks and mess hall available for occupancy, if required.

e. Recurring Commitments. Throughout the year, Reserve and National Guard units utilize firing ranges and some maneuver areas on the weekends. The summer months are the least utilized. Presently no two-week training for these units is conducted at the Fort Bragg reservation. ROTC personnel that train at Fort Bragg number about 2,500 and are integrated within TOE units, therefore causing no scheduling problems, per se.

f. Special Operational Restrictions. Presently there are no special operational restrictions governing users of ranges and test areas. Normal operational restrictions and control for aircraft, range, and test areas are identified elsewhere in this document.

g. Facility Organization. Figure F-2 presents the organization chart for the Airborne Board at Fort Bragg.

h. Environment. The yearly precipitation for the Fort Bragg reservation totals about 121 cm. The precipitation distributed by months is as follows:

January	8.2 (snow 0.3 cm)	July	16.5
February	9.4 (trace of snow)	August	14.7
March	10.2 (snow 0.3 cm)	September	10.7
April	8.6	October	7.6
May	8.6	November	7.9 (trace of snow)
June	10.7	December	7.9 (snow 0.3 cm)
		TOTAL	121.0 cm (snow 1 cm)

The mean daily maximum temperature as measured at Pope AFB, Fort Bragg, varies between 12° and 19°C (Celsius) during the winter months (November-March) and between 23° and 32°C during the summer months (April-October); whereas the mean daily minimum varies between 0° and 4°C during the winter months and between 14° and 21°C during the summer months. The prevailing winds are in a southwesterly direction (225 deg) with a mean speed of 2-3 m/sec. Peak wind gusts up to approximately 25-30 m/sec occur quite often during all times of the year.

i. Topography. The terrain at Fort Bragg, in general, is level to rolling; the elevation varies between 55 and 165 meters with the maximum elevation occurring near the western portion of the reservation (McPherson Mountain). The soils are predominantly deep sands with some mixture of silt and clay, and are low in organic matter. The vegetation at Fort Bragg is predominantly pine and scrub oak with a few areas covered by grass.

j. Airspace Restrictions. Most of Fort Bragg is within restricted airspace area R-5311. Use of this airspace is stratified: R-5311A is for the exclusive use of Fort Bragg from surface up to, but not including, 18,000 feet mean sea level (MSL), and R-5311B is designated for joint use with FAA from 18,000 to 29,000 feet MSL. A portion of R-5311A has been relinquished to Pope Air Force Base. Any unit requiring use of R-5311B must inform Range Control at least one hour and thirty minutes prior to the requirement.

There is no restricted airspace over Camp MacKall or the Sandhills Wildlife Areas.

FAA Enroute Low Altitude Flight Information Map No. L-20 (Reference 2), Post Range Regulations Number 350-6, and References 3, 4, 5, and 6 will assist the reader for any further information or clarifications which may be necessary.

k. Power Availability. Commercial electrical power lines are marked on range map References 9, 10, 11, and 12 in the Bibliography. Power for the Board's sensor range is commercial 110V/220V, 60-Hz, with 50-kW load potential. The Board also utilizes 5 each 10-kW, 3-phase, 110V, mobile generators. One other important item is the availability of aircraft power, 400 Hertz, in the electronics lab.

Other mobile generators are available from the various Army support units for range use, if necessary.

l. Communications. Communications used by the Board, airborne units, and range installations are standard military equipments except for some commercial-type equipments used with sensor test systems. The Board uses both portable and/or vehicle-mounted radios of various types in a loan or in-house basis for the majority of their requirements.

Landlines for telephones are installed on most ranges. Range maps also indicate landlines.

3. Dimensions

a. Landspace. The Fort Bragg military reservation is comprised of 137,000 acres of landspace. This total area is divided into two groups: the Post installation, consisting of buildings, housing, etc., and the test areas, ranges, and impact areas. The majority of this landspace is allotted to this latter group.

(1) Test Area Contiguity. The areas designed for testing are not contiguous. The entire Fort Bragg range area may be used for tactical training. Limitations associated with the use of the Fort Bragg/Camp MacKall interconnecting corridor and the Sandhill Wildlife Areas include prohibition of live or blank firing or off-road vehicle movement.

(2) Easements. There are presently no easements in effect for any of the test ranges or areas. Forestry work and hunting are very low priority items and would never interfere with range usage. Airspace and normal operational restrictions are described in the Post Range Regulations, No. 350-6.

(3) Impact/Live Firing Areas. Firing ranges and impact areas are located only on Fort Bragg proper.

Gun positions for artillery and mortar firing may be located anywhere within Restricted Airspace Area R-5311, except as indicated below:

° Request for gun positions within the flight pattern for Pope Air Force Base will not be approved.

° Gun positions will not be authorized on established ranges, drop zones, or field landing zones, within 200 yards of a Ranger Station or within cultivated fields.

° Overhead fire from mortars is prohibited. Mortar positions selected on OP's will be located forward of or to the flanks of Survey Control Points so as not to deny the use of the SCP's to other units.

° Firing of the TOW missile, both inert and high explosive ammunition, will normally be conducted at only one location (OP 12). Firing will be at fixed targets only.

° The TOW missile, using inert ammunition, may be fired at moving targets on ARAV Range 79 for demonstrations only.

(4) Impact Zones. All artillery, tank, mortar, and recoilless rifle projectiles and all rockets, bombs, and missiles will impact in either MacRidge, Coleman, or McPherson Impact Zones.

The exact dimensions of an impact zone vary from day to day. The impact zones for indirect firing and the limits of fire for direct-fire weapons are prescribed in the Weekly Range Bulletin.

b. Airspace.

(1) Landspace/Airspace Relationship. All aircraft desiring to enter Airspace Restricted Area R-5311, with the exception of Air Force troop carrier aircraft conducting airborne operations directed by Headquarters, 317th Tactical Airlift Wing, must contact Fort Bragg Range Control and request permission to penetrate. Pilots will give Range Control personnel their aircraft identification, destination, and purpose of flight. Upon receiving requests, Range Control personnel will give pilots a safe route through the restricted area to the desired destination, when practicable and safe. Whenever possible Army aircraft will be flown along corridors directed by Range Control to a point as near their destination as possible.

For further information see 2.j., Airspace Restrictions.

(2) Easements. There are no easements except those already mentioned in 2.j., Airspace Restrictions.

(3) Manned Airborne Systems. Helicopter firing will normally be conducted on Ranges 63, 79, or 83. When sufficient justification warrants it, i.e., demonstrations, ORT's, etc., firing may be conducted from other locations.

Air-to-ground firing from high-performance aircraft may br conducted into the Coleman Danger Area. Due to interference with other training, requests for permission to fire from high-performance aircraft must be submitted to the Installation Range Officer 30 days in advance of the scheduled training.

(4) Unmanned Airborne Systems. Unmanned aerial targets, radio controlled ARCATS, or BATS, are provided by the firing unit. Firing at these aerial targets over the heads of troops is prohibited unless the personnel required to be in the surface danger area are protected by the minimum overhead cover prescribed in FM 5-15, Field Fortifications. Firing against target towed by manned aircraft is prohibited. Air Defense live-fire training against aerial targets will be conducted into Coleman Impact Area or from Range 50 into MacRidge Impact Area only. All weapons conducting live-fire training against aerial targets will be on a single firing line.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements (Type, Model, Accuracy, Frequency, Mobility). The Board has a "Trisponder" radio frequency (RF) position location system. It is an X-band line-of-sight system, uses round-trip times of RF pulses between fixed location interrogating stations and transponders carried by the maneuvering personnel or vehicles. The system will have an initial capacity of four transponders (expandable to eight) each of which weighs approximately fifteen pounds with batteries.

The accuracy of the system is dependent on geometry of the stations and the transponders; ten-foot accuracy is expected for a test area of 1,000 meters square. The individual interrogations are averaged to produce round-trip time measurements of 10 per second or one per second.

Position location of line-of-sight objects can be performed with the use of the Board's digitized output, K&E theodolites, and triangulation computations.

(a) Single Object. The above described "Trisponder" system and the digitized theodolites can provide position data on single objects.

(b) Multiple Objects. The above described "Trisponder" system can provide position data of up to four objects.

(c) Relative Positions (Miss-Distance). None used by the Board or Fort Bragg.

(d) Radar. AN/MPQ-4 mortar-locating radars are located at Fort Bragg: three with the 82d Airborne Division and four with the 1st Battalion, 25th Artillery.

(2) Airborne Elements

(a) Radar. None.

(b) Laser. None.

(c) Optical. Photographic methods are used by the Board to obtain position/time data of equipment and personnel exiting from aircraft and other tests of airborne and air-deliver items.

(d) Relative (Miss Distance). The Board uses cameras for obtaining data on airdropped equipment or personnel. When the aircraft is in the camera's field of view, measures of relative position can be obtained from the filmed data.

(e) Airborne-to-Ground Target Matching. None.

b. Timing

(1) Primary (Standard, Code). The Board has an IRIG-B time generator. It is part of the TDAS equipment installed in the TDAS data collection van. It will provide time data to control elements and to a mini-computer also installed in the van.

(2) Secondary. The Board has four stopwatches.

c. TV. TV instrumentation includes cameras, tripods, recorders, sync generator, monitors, projectors, and lenses. Lenses include zoom types.

The following is a listing of the TV equipment at Fort Bragg:

- 6 Video Cameras (TC-177 Piker, Fairchild). The TC-177 video camera is a basic camera with the operational type VF-177 viewfinder incorporated. There are no factory provisions for externally driving from a sync generator nor any provisions for remote control.

- 3 Recorders-Reproducers (IVC 800-S/M; IVC 800-AS/M). These are compact, portable, fully transistorized video tape recorders-reproducers for closed-circuit television applications. Set will record one hour of video and audio signals on an 8-inch reel of 1-inch tape.

- 9 Monitors, Video (RND 9 - 9"; SNA 9 - 9"; SNA 17--17"; UT23M - 23"). Monitors are transistorized, broadcast quality, video monitors designed for continuous operation in broadcast and industrial television applications. They are completely self-contained units which may be operated from (a) a line containing composite video and sync, or (b) separate lines, one carrying video and one carrying mixed sync.

- 11 Lenses, (TV-16 w/Control (Motorized) CC-3T; TV-16 Manual, Cannon; Mark 20, Zoomar 15-300mm; Mark XB, Zoomar 15-150mm; Extender, Zoomar 2X. Motorized lenses are the TV-16, Mark 20, and Mark XB. TV-16 Motorized and TV-16 Manual have a zoom range of 1-4.0. The Mark 20 has a zoom range of 1-20. The Mark XB has a zoom range of 1-10. Lenses are designed for vidicon camera use. The lenses can be controlled for zooming, focusing, and iris setting. Lenses are not designed for inclement weather conditions. Lens extenders are utilized for all lenses on hand.

- 7 Control Lenses (CC-3T, Cannon; Variospeed, Zoomar). The controls are designed for remotely operating the Zoomar and Cannon lenses. The units can be zoomed at a variable rate. The controls incorporate all voltages required for operation of the zoom, focusing, and iris of the applicable lens.

o <u>2 Microphones (649B, Electro Voice)</u>. Microphones permit recording of video and audio simultaneously or independently. One of these microphones would be required for the No. 2 audio channel on the video tape recorder. This audio track is strictly for narrations after the video signal has been recorded.

o <u>4 Audio Amplifiers/Speakers (620, Ampex)</u>. The amplifiers/speakers are utilized during the playback of a video and audio recording. These units are not necessarily restricted solely to video work.

o <u>3 TV Projection Equipment Pieces (TV Projector, TV Control, Alignment Tool)</u>. The projection equipment is capable of reproducing off-air signals, standard TV channels, and accepting video from a closed-circuit TV system. The major application would be for a conference room. Set can be utilized for monitoring electronic systems, instrumentation consoles, briefings,, and instructional purposes, from the concept of large screen projection (4' x 6').

o <u>7 Tripods (6312, Gibralter; VGM 200, Wooden Legs; 5450 Hercules (Studio)</u>. The 6312 is a heavy-duty tripod. Set is rated at 200 lbs. Can be utilized for operation of a video camera inside an environmental housing. The 5450 tripod is classed medium weight. Set is rated at 65 lbs. Set would be utilized primarily for indoor operations (studio-type). The VGM is designed for outdoor operations. There are ground insertion stakes on each leg.

o <u>6 Camera Mounts (5261, Hercules; PT-155 (Electrical); MDL 50, O'Conner (Fluid)</u>. The 5261 is required for operation with the 5450 pedestal. Has a 4" x 4" camera plate, adjustable handle for length and angle; pan and tilt has independent drag controls and fast lock. The PT-155 is an indoor, lightweight, motorized pan and tilt camera mount. Set is designed for remote operation. The MDL 50 is a fluid drive pan and tilt camera mount to be utilized with the VGM tripod.

o <u>2 Camera Mount Controls (PT-1500C) (Electrical)</u>. The PT-155C contains the power supplies required to operate the PT-1555, electrical camera mount. Set will tilt up and down ± 45 degrees and pan left and right 355 degrees. All functions are provided by the lever on the front.

o <u>2 TV Control Panels (TCP-2, Concord)</u>. The control panel is a combination switch/feeder and special effects generator. Has provisions for selecting any two cameras out of a combination of three, at any given time. Has four special effects functions.

o <u>1 Waveform Monitor (21 RM, Ball Bros.)</u>. This monitor is required in the evaluation of a composite television signal. The level of video, front porch, back porch, blanking, vertical interval, and equalizing pulses can be observed. Required for video recording and maintenance.

o <u>1 Battery Charger (Echo Science)</u>. This unit is designed to charge and test batteries 1501-0052. Set is capable of charging up to six batteries simultaneously at nearly the maximum charge rate. Batteries are used in portable video recorder.

° 2 Sync Generators (PSG-2, RCA). Self-contained, transistorized unit capable of producing the pulses necessary for the operation of studio and field type, or module operation. Set provides sync vertical and horizontal drive and blanking.

° 2 Distribution Amplifiers (Mark lX-A). The amplifier is designed for applications where there is a need for high quality television pulse signal distribution. The output is continuously variable from 3.5-4.5 volts in order that signal levels may be adjusted to standard distribution levels before the signal is applied to monitors, transmission lines, etc.

(1) Color/Black-and-White. Black-and-white only is available.

(2) Low Ambient Light Level Capabilities. None.

(3) Voice Channels. See next paragraph.

(4) Video Tape Recording Capabilities. As noted in the TV equipment listed in the last few pages, three recorders-reproducers (IVC 800-S/M; IVC 800-AS/M) are available. These are compact, portable, fully transistorized video tape recorders-reproducers for closed-circuit television applications. The sets will record one hour of video and audio signals on an 8-inch reel of 1-inch tape.

(5) How Presently Used. TV is presently used for both test monitoring and instuctive purposes.

(6) Designed Operating Environment. Available equipments are not designed for all-weather use of rough handling.

d. Photography.

(1) Motion Picture Capabilities. The Board has the following movie cameras:

° 3 Cameras, DB Milliken Model 5C, 16mm; 400 feet; 64, 128, 200, 400 fps; timing diodes; 28V DC

° 3 Cameras, DB Milliken Model 3C, 16mm; 100 feet; 64, 128, 200, 400 fps; timing diodes; 28V DC

° 5 Cameras, DB Milliken Model 54, 16mm; 400 feet; variable 4-400 fps; timing diodes; 28V DC

The Board also has lenses of various focal lengths to fit these cameras and four timing pulse generators to provide signals for the timing diodes of the cameras at 0.1, 0.01, 0.001, and 0.0001 second intervals.

(a) Processing. Both black-and-white and color film are processed at Fort Bragg itself at the rate of 4,000 feet per day (C5A Project equipment).

(2) Still Photography. The Board has four 4" x 5", ine 70mm, and two 35mm cameras equipped with lenses. Their Photo Lab's daily

processing capability is 200 black-and-white negatives, 4,000 black-and-white projection prints, and 1,000 black-and-white contact prints.

(3) Airborne Capabilities. The Milliken cameras listed under motion picture capabilities are used in "chase" aircraft to obtain photographic recordings of aerial testing.

e. Instrumentation Calibration Capabilities. The instruments of the Board are sent to Redstone Arsenal at 180-day intervals for calibration.

f. Other General Instrumentation.

(1) Telemetry. None.

(2) Meteorological. The Board has a Towner automatic weather recording system for installation in their data acquisition van. It will provide data via a teletypewriter in hard copy and punched paper form.

(3) Survey. The Post engineers perform surveys for both the Post and the Board. Third-order accuracy can be provided.

The Board has two K&E digitized output theodolites that can be used for survey purposes.

(4) Radio Frequency Interface (RFI). The communications equipment lab of the Board can perform RFI measurements in the lab area.

(5) Visibility (Light Level Measurements). None.

(6) Sound Measurements and Analysis. The Board has:

- 2 Sound Level Meters (General Radio Model 1551C). Used to measure audible sound levels at test sites of either ambient noise or event noise if applicable to the test. Model 1552B calibrator is on hand to ensure correct readings.

- 1 Sound and Vibration Analyzer (General Radio Model 1564A). Used to measure the amplitude and frequency of components of complex sound and vibration sources. Input devices on hand are Model 1560P4 microphone assembly and Model 1560P11B vibration pickup. Model 1557A vibration calibration is available for use with the 1560P11B pickup.

- 1 AN/UNH-10 Recorder-Reproducer Set, Sound. Battery-operated tape recorder; 5-inch tape reels; 3-3/4 inches-per-second tape speed; for field use when 110 VAC is not available.

- 2 Tape Recorders (one Ampex Model AG-500 and one Ampex Model AG-600). The AG-500 is a half-track manual recorder which operates at speeds of 7-1/2 or 15 inches-per-second. The AG-600 is a half-track stereo recorder. Three Speaker-Amplifiers (Ampex 622-4010070-01) are on hand for playback purposes. All units require 110 VAC for operation.

(7) Safety and Security Instrumentation. The Board uses a three-level light beam fence to enclose a 250-by-250 meter test area to monitor

unprogrammed entry to this area. Approximately 60 beam and detector units are used.

(8) Soil Conditions. Soil temperature is measured by the Towner System (see 4.f.(2), Meteorological Instrumentation.

g. Special Purpose Instrumentation

(1) Ballistic Data. No special purpose instrumentation. Photographic or TV recordings can be used for trajectory data of some projectiles or missiles.

(2) Environmental Chambers. None.

(3) Vehicle Performance. None.

(4) CBR Instrumentation. None.

5. Threats/Targets

a. Ground

(1) Electromagnetic. None.

(2) Weapons. The Board has no targets. The Post's range office has over 1,500 type M30A1 target mechanisms with approximately 1,000 installed on small arms ranges. These mechanisms elevate standard silhouette targets under remote control via wire and can be dropped on command or automatically when hit.

The Post's range office also has DART infantry target system equipment. Like the above M30 units, the target mechanism elevates a silhouette target on command, and can drop on command or automatically. They are battery powered and use a military band radio channel for the remote control signals. Easy installation is therefore attained, permitting rapid preparation of a range or changes of target position. Other system elements are six control transmitters and night firing equipment.

b. Airborne. None.

6. Data Handling/Processing

a. Data Storage and Retrieval Capabilities. Punch cards and magnetic tape and core (64K) are used for data storage, with the Board's 360/30 terminal.

The Board uses a Vanguard M-16CP/C-11P/A-11P film reader with X-Y measurement capability, frame count, and angle measuring screen; variable speed 5-30 fps; single frame advance; forward and reverse; film capacity of 1,200 feet of 16mm film. A Datagraphics Corporation Model 4P-026 is used with an IBM 026 keypunch for outputting the film reader data on punched cards.

b. Quick-Look Capabilities. The TDAS will provide a limited quick-look capability. See 4.a.(1).

c. Processing

(1) System and Model. The computer to be installed in the TDAS data collection van is a 16-bit mini-computer.

The Board also has a Hewlett-Packard Model 9810A programmable calculator with options 001 (111 data storage registers), 003 (2036- program step unit), and 004 (printer H/P 11219A). The system configuration also includes a plotter (H/P Model 9862A).

(2) Language. FORTRAN IV is used for the terminal. FOCAL and BASIC are the languages to be used with the mini-computer.

(3) Input/Output Options. The 360 system terminal has teletype and card reader inputs and card punch and line printer output.

The mini-computer in the TDAS data acquisition van has 11 digital input channels, a 40-channel multiplexed analog system, a teletype, and magnetic tape on disc input units.

This TDAS mini-computer can produce hard copy and paper tape outputs on the teletypewriter.

(4) Real-Time/Post-Test. The TDAS mini-computer is operated on line and the terminal system off line.

d. Distribution (Turnaround Time). Overnight is the normal turnaround time for the use of the terminal system.

e. Displays (Plotting Boards, CRT's, TV, etc.). None.

ANNEX F - BIBLIOGRAPHY

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5. Range Overprint, Southern Pines, North Carolina, 63d Engineer Co (Topo Corps), Fort Bragg, NC, Sheet 5154-111, Series V742; 1:50,000.

6. Range Overprint, Fayetteville, North Carolina, 63d Engineer Co (Topo Corps), Fort Bragg, NC, Sheet 5254-111, Series V742; 1:50,000.

ANNEX G

OPERATIONAL TEST INSTRUMENTATION GUIDE

US ARMY COLD REGIONS TEST CENTER

Fort Greely, Alaska

AD-A113 775 ARMY OPERATIONAL TEST AND EVALUATION AGENCY FALLS CH--ETC F/G 14/2
OPERATIONAL TEST INSTRUMENTATION GUIDE.(U)
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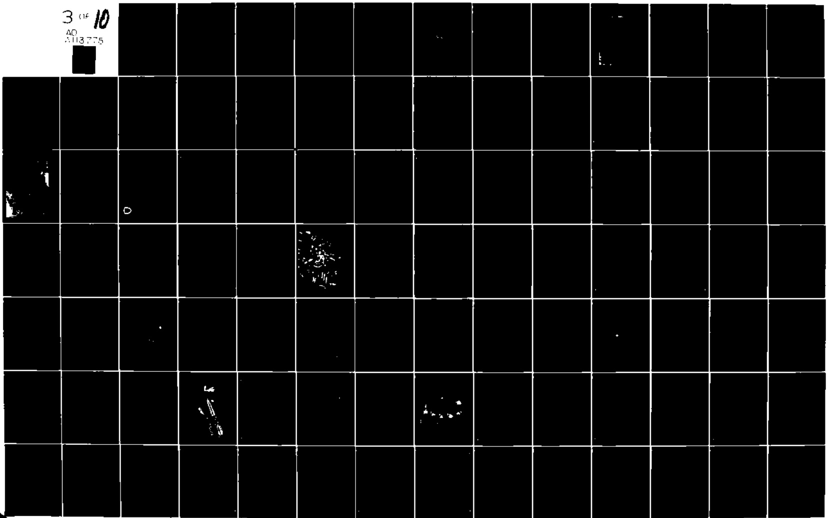

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ANNEX G

US ARMY COLD REGIONS TEST CENTER (CRTC)
Fort Greely, Alaska

1. Introduction

a. Overview.

(1) The US Army TECOM Cold Regions Test Center (CRTC) provides a natural year-round mountainous and cold-region testing environment, permitting operational tests to be conducted in a more realistic manner than would be possible in a cold chamber.

(2) The Cold Regions Test Center is an ideal facility to conduct cold regions man-materiel test. Extensive real estate, coupled with a remote, isolated locale, permits realistic, unhindered testing in a wide array of natural environments. CRTC instrumentation used to support cold regions testing is deemed adequate for the majority of current CRTC testing requirements. A continuing program to upgrade the instrumentation capability is given in the Five-Year Instrumentation Development and Acquisition Program (see reference 2 in the Bibliography).

b. Generic Systems Tested. CRTC tests nearly every Army system and item of equipment considered for employment in the arctic. CRTC supports a number of tests conducted by other agencies on a "safari"-type visit to CRTC. Such items as aircraft, missiles, wheeled- and tracked-vehicles, artillery, small arms, radar, clothing, field and personal equipment are tested at CRTC (see reference 5).

TECOM Regulation 10-1, dated 2 September 1976, assigns the following mission to CRTC.

Plan, conduct, evaluate, and report cold regions, mountain and northern environmental phases of development, and other type tests.

Employ the integrated testing cycle policies during development testing.

Provide technical information, advice, and guidance on test and evaluation matters to material developers, materiel producers, other services, and private industry.

Conduct other tests and evaluations as directed by the Commanding General, TECOM.

Provide support to Department of Defense, Department of the Army, and DARCOM for Cold Regions environmental test and evaluation services not included within the purview above, as directed by the Commanding General, TECOM.

2. General

a. Military Units

(1) Army Units. None.

(2) Other Military Units

(a) Northern Warfare Training Center (NWTC), an element of the 172d Infantry Brigade, conducts training in northern mountain and arctic operations, skiing, and riverine movement. NWTC also develops doctrine for northern operations and assists CRTC in testing items of equipment in NWTC areas of interest.

(b) The 172d Infantry Brigade, Fort Greely, acts as host support agency to CRTC.

b. Access (see figure G-1)

(1) Air. Allen Army Airfield (see figure G-2) at Fort Greely has hardtop runways, the longest of which is 7,500 feet. Eielson Air Force Base (14,520-foot runway) is located about 78 miles northwest of Fort Greely on the Richardson Highway. There is also a commercial airport at Fairbanks (10,300-foot runway).

(2) Rail. The Alaska Railroad runs between Anchorage, on the west, and Fairbanks, which is approximately 105 miles northwest of Fort Greely by highway. The Alaska Railroad also extends to connect with Eielson AFB.

(3) Road. Fort Greely is connected by paved, year-round trafficable roads with other points via the Richardson Highway and the Alaska Highway.

(4) Sea. None.

c. Logistic Support Capability.

(1) CRTC Logistic Test Support Division is composed of five branches and a Headquarters which provide support for the Center. Functions include direct support and general support maintenance for military standard and nonstandard prototype test and test support vehicles and equipment, all classes of supply support, ammunition storage and issue, property book management maintenance of a computerized equipment management/utilization program, facility engineering support, and explosive ordnance disposal.

(2) Recovery capabilities for wheeled- and tracked-vehicles include both 5-ton tactical wreckers, an M88A1 tracked tand retriever and two M911 tractors with M747 60-ton lowbed trailers. Mobile repair and fabrication facilities are available. Complete machine shop facilities are available to include metal turning lathes, 24-inch metal shaper, horizontal and vertical milling machines, 36-inch surface grinder, a radial drill press, a Norton #20 tool cutter grinder, a 16-inch do-all bandsaw plus standard accessory items. Welding capability includes arc, oxyacetylene, tungsten inert gas, metal inert gas, to include inner shield, mild steel, and aluminum welding. To ensure parts availability, maintenance of test items may require that CRTC be supplied appropriate maintenance parts packages.

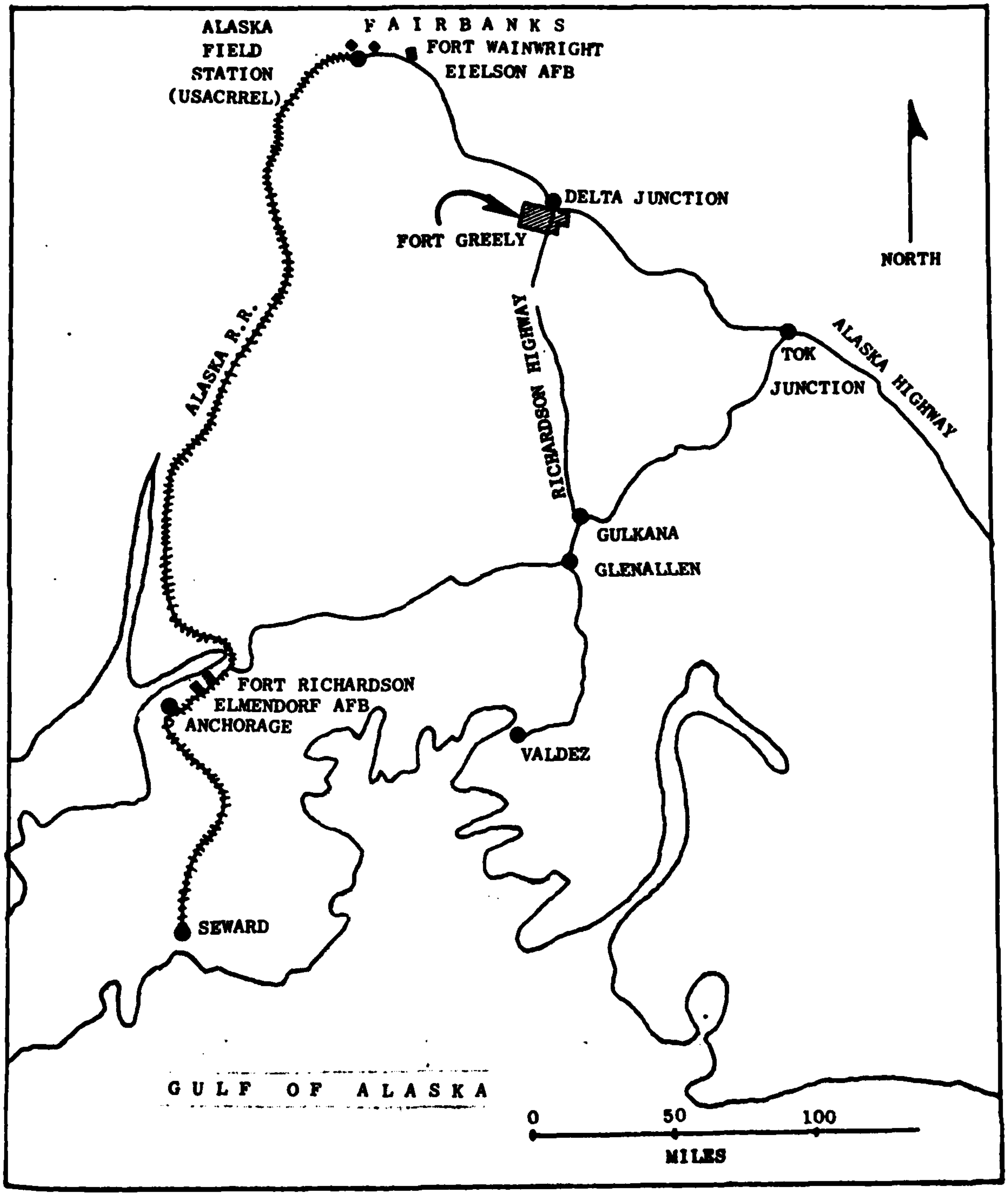
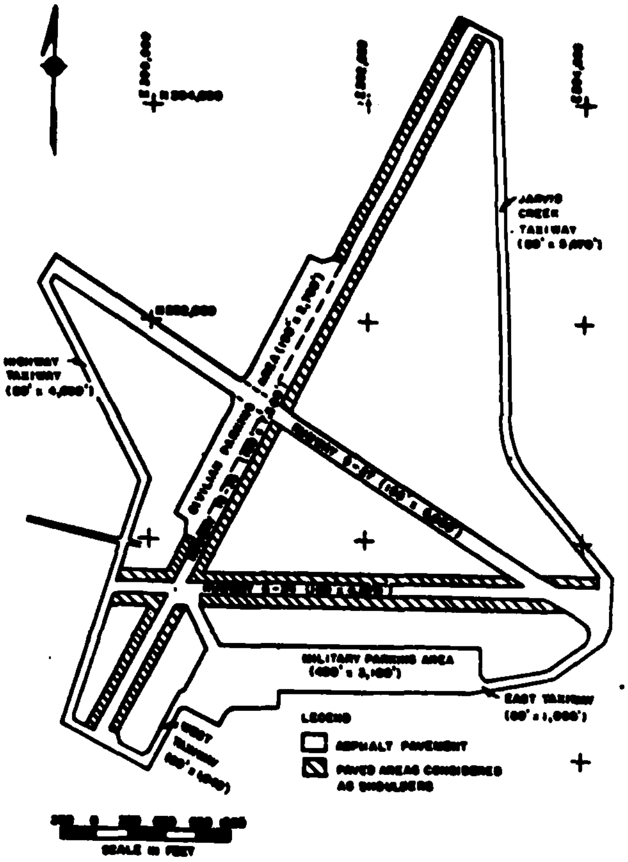


FIGURE G-1: Map Showing Location of Fort Greely, Alaska



CRTC utilizes the Allen Army Airfield (AAAF) at Fort Greely, which provides an all-weather air support capability. The uncontrolled airfield is jointly used by both military and civilian aircraft. The three runways are complemented by a 37,600-square foot hangar used solely for military aircraft. Civilian aircraft tie up at the nearby FAA Flight Service Station. Runways 18-36 and 06-24 are maintained for year-round use, while runways 09-27 are usable only during the summer months. Military JP-4 is available on call 24 hours a day. AAAF provides radio service on both UHF and FM, and full flight planning from 0730 to 1700 hours weekdays. Ground handling equipment is available for helicopters. Larger ground support equipment can be obtained on a temporary loan from Air Force assets to offload C-141 and C-5A aircraft.

FIGURE G-2: Allen Army Airfield, Fort Greely

(3) The Logistic Test Support Division performs general maintenance and minor construction of test and test support facilities, coordinates maintenance and repair of real property with the Post Engineer, coordinates land utilization beyond Fort Greely reservation boundaries, and administers the MCA Program for the Center. Heavy equipment available includes five D-7F bulldozers, three graders, three scoop loaders, three 5-ton dump trucks, tow 10,000-RT forklifts, fuel dispensing equipment, two 1,200-gallon tankers, two M911 tractors, two 60-ton trailers, and one 25-ton trailer. Heavy equipment capabilities include snow removal, road maintenance, construction of berms, bunders and ditches, transportation of heavy test and test support items, refueling in limited access areas, and grooming of ranges.

d. Recurring Commitments. None.

e. Special Operational Restrictions. None.

f. Facility Organization. CRTC is organized to provide a nucleus of testing expertise for the conduct of cold regions, mountain and northern environmental phases of development, and other type tests. The primary test elements of CRTC are the General Equipment Test Division and Weapons Systems Test Division. Direct test support is provided by the Technical Division and Logistics/Test Support Division. All other elements of the Center provide general support to the two test divisions.

g. Environment (Climate)

(1) Fort Greely, located near the junction of the Alaskan and Richardson Highways in central Alaska, is about 100 miles southeast of Fairbanks and 340 miles north of Anchorage. The small community of Delta Junction is located 5 miles from the post. It is located on one side of a narrow valley near the junction of two major Alaskan rivers. The Brooks Mountain Range to the north and the Alaskan Range to the south prevent the moderating effect on temperature of the Arctic and Pacific Oceans from playing a major role in the local climate.

(2) Cold weather at Fort Greely, as in most subarctic areas, is a transient phenomenon associated with clear skies and little or no winds. Periods of cold and extreme cold weather lasting from several hours to two weeks are interrupted by the onset of winds and associated warmer weather.

(3) Fort Greely has a dry climate. The average annual precipitation of the main post is only 38.7 inches of snow, less than 2.5 inches of water equivalent, which combined with summer rains, adds up to only 11.6 inches of water in an average year. However, the precipitation rate varies greatly within and in the vicinity of this large reservation. Within a 60 mile radius of main post are elevations ranging from 1,000 to 13,832 feet. Snow cover varies greatly by month, elevation, and locality and each sheltered valley can be different. The following table illustrates this point.

Snowfall Within the Tanana Valley

Elevation (ft)	Annual Precipitation (in)	Percent Snowfall
1,000-1,500	10 to 12	25
4,000	40	50
9,000	100	100

(4) Short, cool summers and long, very cold winters identify the climate of Fort Greely as subarctic in type - a type common to much of the high latitude boreal zone of northern North America, northern Eurasis, and other cold regions. Temperature extremes from 92°F (34°C) to -70°F (-57°C) (-75°F) unofficially recorded) have been recorded with 85°F (29°C) to -60°F (-51°C) representing a more typical annual temperature spread.

(5) A climatology chart of the official weather station located on the main post of Fort Greely is shown at Figure G-3. Because of the temperature inversion, wintertime minimum temperatures are strongly dependent on elevation and terrain conditions, as a result, lower temperatures and longer durations of lower temperatures are encountered on the CRTC ranges and outlying test sites than on main post. Although colder areas exist other than Fort Greely, no area that is within the United States, accessible, and available to the US Army exists for this purpose. The mean temperature for the main post, Fort Greely's 4 warmer months is 54°F (12°C) (mean minimums for these same months is 43°F (6°C). The mean annual temperature for the past 29 years is 26.8°F (-3°C). Depending primarily on the asbence of winds which affect main post, temperatures in the outlying test sites can be 10 degrees to 30 degrees colder than the main post. The Bolio Lake Test Site, for example, has averaged 32.4 test days (mimimum of 6-hour day) below -40°F (-40°C) and an average annual low of -59.2°F (-51°C). Wintertime temperature are strongly dependent on elevation, terrain conditions and prevailing winds. Lower elevations and enclosed valleys are the coldest areas. Located near 64° North latitude, very little solar radiation is received in the winter, and snow cover which normally persists from November through March reflects a large portion of the radiation received. Since there is a net loss of heat from the ground throughout most of the winter, the temperature trend is downward until approximately mid-February. This heat loss and the lack of cloud cover in the dry winter air combine to produce temperature inversion conditions during most of the winter. The numerous valleys located south and west of the main post tend to further concentrate this cold air, as it flows downslope and settles at the valley floor. Others allow the cold air to drain out and downward into the bed of the Delta River where the CRTC firing ranges are located. As a consequence of the prevailing winds blowing on the Fort Greely main post approximately 50 percent of the days during the winter months, the relatively calm conditions of Fairbanks, Alaska, provides that location with from 25 to 152 percent more test days of -25°F (-32°C) and lower than Fort Greely proper. However, the Bolio Lake Test Site compares favorably with Fairbanks in -25°F (-32°C) temperatures, and experiences approximately 48 percent more days with -50°F (-46°C) and 27 percent more days with -40°F (-40°C) minumums than Fairbanks.

CLIMATOLOGY CHART
Fort Greely, Alaska

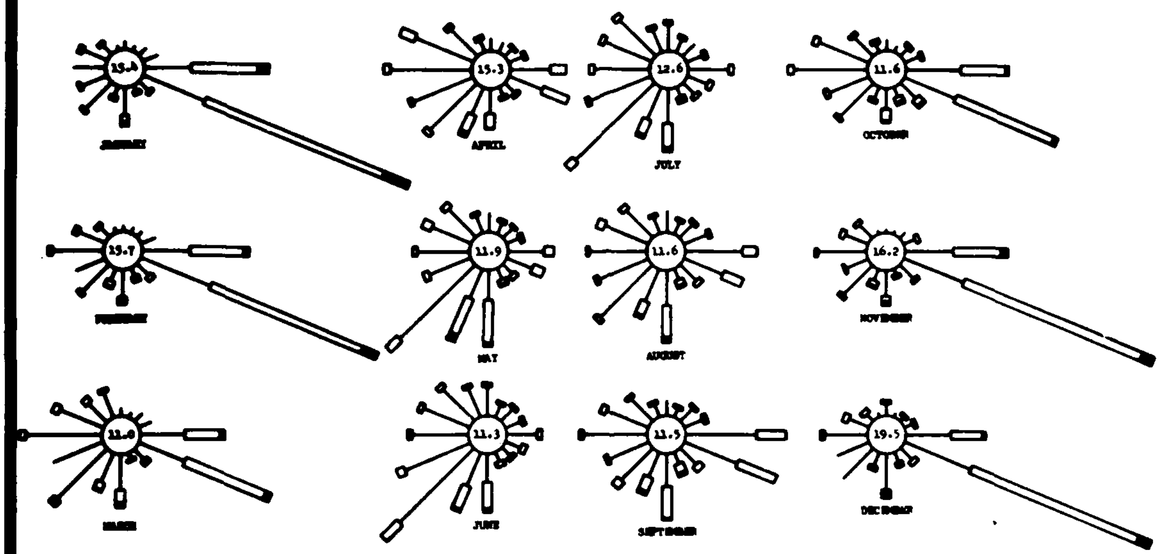
Month	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Years of Record
JAN	[illegible]	3.7	[illegible]	48	[illegible]	20
FEB	2.7	11.7	-6.6	[illegible]	-60	20
MAR	[illegible]	[illegible]	-0.5	[illegible]	-48	20
APR	[illegible]	38.5	18.4	72	-37	20
MAY	[illegible]	[illegible]	[illegible]	90	-6	[illegible]
JUN	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
JUL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
AUG	[illegible]	[illegible]	[illegible]	86	[illegible]	[illegible]
SEP	[illegible]	[illegible]	[illegible]	77	7	[illegible]
OCT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NOV	[illegible]	[illegible]	-4.4	[illegible]	-46	[illegible]
DEC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ANNUAL	[illegible]	[illegible]	[illegible]	[illegible]	-63	[illegible]

CEILING — VISIBILITY
(Percent of Time)

Month	[illegible]	[illegible]	[illegible]	[illegible]	Years of Record
JAN	3.8	8.0	12.3	75.7	20
FEB	2.5	6.9	9.6	81.0	20
MAR	1.8	6.1	11.3	80.8	20
APR	0.4	3.4	6.3	89.8	20
MAY	0.3	1.4	4.2	94.0	20
JUN	0.1	0.7	3.6	95.6	20
JUL	0.2	2.1	6.1	91.6	20
AUG	0.6	2.3	6.2	90.9	20
SEP	1.8	6.0	9.9	82.3	20
OCT	4.4	11.4	16.5	67.8	20
NOV	2.4	8.2	13.5	76.0	20
DEC	4.9	8.8	13.8	72.4	20
ANNUAL	1.9	5.4	9.4	83.2	20

SKY CONDITIONS
(Percent of Time)

Month	Clear	Scattered	Broken	Overcast	Obscured	Num. of Obs.
JAN	26.0	17.3	17.0	31.6	8.1	20
FEB	25.0	16.7	17.8	32.8	7.6	20
MAR	25.1	18.5	19.5	32.9	4.0	20
APR	17.4	20.7	25.2	34.0	2.7	20
MAY	10.8	21.0	30.8	36.8	0.7	20
JUN	5.7	21.1	35.8	37.4	*	20
JUL	6.6	18.8	31.0	43.0	0.4	20
AUG	7.9	19.0	28.7	43.2	1.1	20
SEP	10.5	15.5	23.0	48.0	2.8	20
OCT	12.7	14.8	17.9	45.9	8.8	21
NOV	22.6	16.6	17.0	35.4	8.4	20
DEC	22.2	17.0	18.1	34.2	8.5	21
ANNUAL	16.0	18.1	23.5	37.9	4.4	20



PRECIPITATION
(Percentage of Occurrence)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
RAIN	*	*	*	0.6	5.0	8.5	[illegible]	[illegible]	9.3	0.8	0.1	0.1
RAIN SHOWERS	0	0	0.2	0	1.4	2.4	2.7	1.3	0.3	0	0	0
FREEZING RAIN	0.1	0	0	0	0.1	0	0	*	*	*	*	*
SNOW	[illegible]	[illegible]	[illegible]	[illegible]	2.3	0.1	0	*	3.9	[illegible]	[illegible]	[illegible]
SNOW SHOWERS	0.1	*	0.1	0.5	0.9	0	0	0	0.1	0.1	0.1	0.1
SNOW PELLETS	0	0	0	0.1	*	0	0	0	*	*	*	0.1
SNOW GRAINS	0.1	0.1	0.1	*	*	0	0	0	0	0.1	0	0.1
[illegible]	*	0.1	0.1	*	0.1	0.1	0.6	0.6	1.7	0.1	0	*
[illegible]	0.1	*	0	*	0	0	0	0	*	0.6	0.3	0.1
[illegible]	1.1	0.7	0.2	*	0	0	0	0	0	0.1	0.5	1.5
[illegible]	0	0	0	0	*	*	*	*	0	0	0	0
[illegible]	0	0	0	0	*	0.1	0.1	0.1	0	0	0	0
[illegible]	20	20	20	20	20	20	20	20	20	21	20	21

* Less than 0.05 percent

[illegible]

[illegible]	[illegible]	3.6	5.5	3.0	2.5	T	0	T	0.9	7.1	6.4	5.9
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.55	.41	.48
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] 37.1 [illegible]

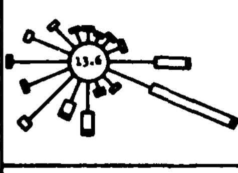
WIND ROSE LEGEND

Lengths of Lines Indicates Percentage Frequency, Percentage of Calms Given Inside Of Circles

0 10 20 30
PERCENTAGE FREQUENCY SCALE

0.0 1-12 MPH 13 - 31 MPH 32+
EXAMPLE

ANNUAL WIND ROSE



OBSTRUCTIONS TO VISION

Average monthly percentage of occurrence

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
FOG	3.2	3.6	3.4	2.5	1.3	0.7	1.4	1.5	3.8	7.3	4.9	4.4	3.2
GROUND FOG	0.3	0.2	*	*	*	0.2	0.1	0.1	0.4	0.2	0.2	0.2	0.2
ICE FOG	5.3	3.9	0.3	*	0	0	0	0	0.1	*	1.1	6.0	1.4
BLOWING SNOW	1.2	0.3	0.1	0.1	*	*	0	0	0	0.1	0.5	0.7	0.3
SMOKE	*	0.1	0	0	0	0.6	1.0	0.9	*	*	0.1	0.2	0.2
YEARS OF RECORD	20	20	20	20	20	20	20	20	20	21	21	20	20

* Less than 0.05 percent

WIND
(21 years of records)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVERAGE SPEED	12.7	11.6	8.7	8.5	9.0	7.8	7.1	7.8	8.6	9.2	10.5	[illegible]	[illegible]
EXTREME SPEED	75	104	96	67	[illegible]	63	[illegible]	93	73	86	[illegible]	[illegible]	[illegible]
DIRECTION	[illegible]	S	E	[illegible]	[illegible]	[illegible]	S	S	[illegible]	[illegible]	[illegible]	S	S

FIGURE G-3

(6) Generalizing, within the Fort Greely reservation, $0^{o}F$ ($-18^{o}C$) will be encountered by mid-October, $-25^{o}F$ ($-32^{o}C$) occurs from 15 November to 15 February and the lows are encountered between 15 December and 1 Februray. Temperatures as low as $-40^{o}F$ ($-40^{o}C$) have been experienced from late October to early April, but the effects of increased solar radiation and the longer days seriously limit the possibility. A summary of the average number of usable test days by temperature for the period 1961-1974 for three typical test sites is shown in the following table.

Temperature Summary

Available Test Days per Site*

Temperature	Fort Greely Proper	Georgia Range (Delta River)	Bolio Lake
$-25^{o}F$ ($-32^{o}C$) or below	26.9	37.9	49.1
$-40^{o}F$ ($-40^{o}C$) or below	7.7	24.7	32.4
Average Annual Low:	$-55^{o}F$ ($-46^{o}C$)	$61.4^{o}F$ ($-52^{o}C$)	$-59^{o}F$ ($-51^{o}C$)

*Includes both official and unofficial temperature data compiled by the ASL Alaska Met Team. All years on record are used and vary from 7 years for Georgia Range to 29 years for Fort Greely.

(7) Fort Greely, and in fact a major portion of the Tanana River Valley, are subject to periodic strong winds from either the south or the east-southeast. These winds destroy the inversion by mixing in warmer air from aloft, and also move the snow into forested areas and out of open areas. Snow, which is not shifted about by the wind, is also affected, as the wind greatly accelerates evaporation and heat transfer processes which produce a snow layer consisting of hard, dense lenses up to several meters in diameter embedded in masses of soft, weak, low-density snow. This condition is typical of arctic snow, and its existence at Fort Greely is quite useful in that it is available for test purposes. The snow found in wooded and other areas sheltered from the wind are typical of the soft dry subarctic snow.

(8) Fort Greely is in a discontinuous permafrost zone, and the permafrost is within 6 to 12 inches of the surface in many areas. The long summer days allows the ground ice (permafrost) to melt only in a shallow surface layer, creating marshy conditions that prevail for a relatively short time over wide areas. During this melting period, the ground beneath the surface remains impermeable and the melt water cannot readily escape. A grassland biochure develops on the saturated soil and its development is limited by the very cold climate. Humus developes in a well developed layer under these conditions. Considerable variations in composition of the tundra are seen and range from wet to well drained habitats. Dense spruce forests (Taiga) cover much of the areas overlying the permafrost.

(9) Four separate periods of glaciation have reduced the area in which Fort Greely is situated into a pitted outwash plain. Literally thousands of kettles (small depressions, most with ponds) are present. These range in size from a few dozen meters to scores of acres. Most of the areas around the kettles are marshy and hinder man/machine mobility. Some of the kettles may be fed by underground springs caused by percolation of melting of the permafrost.

(10) Where there is no permafrost the ground beneath the relatively thin veneer of humus consists chiefly of glacial till (unstratified drift). In the summer months this material is readily exposed on man-made clearings and roads. Fine dust and pitting materials are present and often prove detrimental to the longevity of vehicles. In the winter the till freezes into a conglomerate that resists most known mechanical forces.

(11) An interesting and often aggravating condition associated directly with the conditions of low temperatures and easily saturated air is the formation of ice fog. Primarily a man-made phenomenon, ice fog begins to form -30°F (-34°C). Usually it is caused by some combustion process, such as operation of gasoline or diesel engines, which introduces large amounts of water vapor and a host of condensation nuclei in the form of smoke and other small exhaust particles in the air. This produces saturation of the air in a very short time, and the excess moisture condenses from the nuclei to form ice fog. It can spontaneously form at temperatures below -40°F (40°C) if there is sufficient water vapor present to cause natural saturation as the temperatures fall. Ice fog is observed locally in the main Post area only about 16 days per year, but it represents a severe handicap as it occurs during the best testing weather, often restricting visibility to less than one-sixteenth of a mile.

h. Topography

(1) The terrain in the Alaskan interior is typical of arctic subarctic areas, varying from rolling tundra and wide forested valleys to towering mountains, glaciers, and treeless barrens. The Fort Greely area is characterized by discontinuous permafrost, low shrubs, stunted black spruce trees, and many streams and rivers, to large tracts of untraveled, virtually inaccessible (by conventional vehicular means) terrain. The area in the vicinity of the main Post has a variety of roads and trails providing a full range of trafficability study capabilities.

(2) Due to the difference in temperatures and climatic conditions between the summer and winter season, the relative importance of the climatic and the terrain conditions differ accordingly. During the winter, emphasis is placed on the thermal stress due to temperatures of lower extremes. In the conduct of summer testing, however, climatic conditions are of little importance except for their effect on the surface characteristics of the terrain. The durability and reliability data developed during winter months over ice, frozen ground, and varying amounts of snow cover, provide little indication of mobility through torrential streams, vast areas of tundra, and endless numbers of lakes, potholes, and swampy (muskeg) areas. Interior Alaska offers, at some time of the year, almost every form of terrain feature and conditions found in subarctic areas and CONUS, with the exception of desert areas. Further information is

available by referring to the topographic maps (references 7, 8, and 9) listed in the Bibliography.

(3) The surface and terrain features of the area are largely the result of glacial action, past and present. Many of the surface features are remnants of deposits left by glaciers that extended over this area in the past. Much of the surface material consists of layers of peat varying in depth from a few inches to many feet. Hundreds of small lakes and swampy lake beds dot large sections of the reservation. Extensive sandbars and other alluvial areas characterize the flood plains, and large areas of broken rock fragments cover the steeper slopes and summits of the highlands and hills.

i. Airspace Restrictions. Restricted airspace R2202 as listed in the Federal Register, provides safety to aircraft by restricting airspace from the surface to unlimited altitude. R2202 is listed on current sectional charts as being continuously restricted. Anchorage FAA will route IFR traffic through the restricted airspace only when CRTC has released it due to inactivity of ranges.

j. Power Availability. Limits central power distribution facilities are available at some of the range locations; however, the preponderance of power used for testing is provided by generators. The Center has six 100-kw generators, four 60-kw generator, one 15-kw generators, ten 9.5-kw generators, and four 1.5-kw generators available for test support.

k. Communications. A commercial non-tactical radio network operated by the Communications Section satisfies the largest portion of the Center's communications test support requirements. A powerful two-channel base station remotely located at a location 1,700 feet above the reservation provides reliable communications from a hand-held portable anywhere on Fort Greely back to Main Post or any of the test facilities. A large number of the hand-held portable radios are available for issue to test personnel, and the section is fully equipped with auxilliary equipment to handle any special requirements. Organization, direct support, and limited general support maintenance of up to company level tactical radio and wire equipment can be accomplished by the Communications Section repair shop. The section's wirement can provide commercial telephone or field phone service on or between any of the test facilities, as required. For those test requiring tactical radio support, AN/VRC-46 and AN/PRC-77 series radios are available for installation in any configuration.

3. Dimensions

a. Landscape

(1) Test Area Conguity. The Fort Greely reservation comprises a total of 677,000 acres. Of this total, most of this landspace is used for ranges, impact areas, and maneuver areas. By using the Fort Greely Range and Training Area SOP 360-1 (Reference 1 in the Bibliography) a more comprehensive review of these ranges is possible.

(a) Impact Area. The major firing ranges of Fort Greely (Lampkin, Mississippi, Texas, and Washington) can use the 141,440 acres of impact area, west of the east bank of the Delta River. This provides an impact area with a maximum unobserved range of 50,000 meters and all of this area is under restricted airspace allowing unlimited maximum ordnate for firing.

(b) Beales Complex.

1 The extensive facilities at Beales Complex can be effectively used to support several test activities at one time and serves as the headquarters for Weapons Systems Test Division. Seven general purpose buildings, the guards' quarters, two storage buildings, a small maintenance building, and a large "Star"-type maintenance building make up the compound; the large maintenance building can accommodate any tracked vehicle or artillery piece. Also available is a 1,100-gallon fuel staorage tank and a large ammunition storage area; this storage area is lighted and bermed, and contains 10 bunkers and numerous exposed storage yards.

2 Data communications and video transmission are accomplished using S-Band microwave equipment. A 95-foot microwave/RF communications relay tower is located approximately 6 miles from the cantonment area, allowing reliable telemetry, video and voice communications to over 90 percent of the Fort Greely range area.

(c) Arkansas General Purpose Range. This range has the capability of firing most weapon systems and all conventional explosives. Small indirect fire weapons (40mm) can be fired and impacted on the range. The range has a lighted 100 x 250 ft storage yard enclosed by a chain link fence and contains several security storage cages. Adjacent to the storage yard is a general purpose building and a small vehicle garage. The isolated location of this range makes it ideally suited for close observation of hit effects. Concrete bunkers movable warmup shelters and bombproof observation shelters are available at various firing points on the range. The range has two helipads and is ideally located for a helicopter rearmament point.

(d) California Pistol Range. This range has ten 15-meter firing points and ten 25-meter firing points with eight target frames and eight bobbing targets. It is designed as a standard Army pistol range and can accommodate the standard pistol courses.

(e) Colorado Known Distance Range. This range is designed for testing small arms direct fire weapons under carefully controlled conditions. A series of ten firing berms, 100 meters aparts, ends at the target area where ten pull type target mechanisms are emplaced in pits. Each berm has communications with the target pits, and the five berms closest to the target are supplied with 110V power. A 25-meter zeroing range is located adjacent to the main range; next to the 300-meter firing berm is a warmup/storage building.

(f) Georgia Direct Fire Range. This range is adaptable to all direct fire weapons. Track vehicle carcasses are spaced along the right side of the range as targets. The direct fire capability of this range is enhanced by a elevated firing berm that can accommodate two tanks or a larger number of smaller weapons simultaneously. The left side of the range has target berms at the 1000-,2000-, and 3000-meter lines, with heated personnel bunders at the end of each berm. Buried communications lines tie all the bunders to the control tower, from which the entire range is visible. The floodlighted firing area has a warmup shelter and electrical power for instrumentation. The range has a remote controlled moving target that can be controlled and engaged from all firing berms.

(g) Kentucky Range. This range is designed for testing small arms direct fire weapons and for M-16 marksmanship training foir ski-mounted troops. There are two 500-meter firing lanes with seven possible target positions in each lane. The positions are at 100, 200, 300, and 500 meters. The range is supported by two control towers with hit recording instrumentation.

(h) Lampkin Range. This range is the most extensive of CRTC's indirect fire facilities. This range has a large general purpose building with and attached control tower. The firing line has seven blast walls and six personnel bunkers (warmup shelters). This range has facilities on the firing line for the installation of muzzle velocity instrumentation. Near this range is a RAWIN site operated by the ASL Alaska Meteorological Team when upper air observations are required for ballistics calculations.

(i) Maine Range. (Maine Helicopter Field Harmonization Range). This range is designed as a helicopter (UGIM, AHIG) field harmonization range and rearming point. The range has two firing points/rearming points with hard targets 365.6 meters (400 yards) down range (south) to facilitate harmonization of helicopter weapons systems. Area A, behind the firing points is parking area for a command and control aircraft, other gunships, and range support aircraft. Three to four miles west of the Delta Creek are three target arrays on a magnetic heading of 281° from Sullivan Road House to a seven vehicle convoy, at 285° from the road house is a cluster of six vehicles and at 255° from the road house is a four vehicle convoy which are available for engagement by airborne weapons systems. The safety fan for Main Range is between 174° and 225° magnetic azimuth SOP for Maine Range firing after harmonization has been accomplished. The helicopter should depart firing point 1 and 2 to the south, roll out to the east and cross over Sullivan Road House from east to west and pick up a magnetic azimuth to one of the target arrays for their live fire exercise. Communications to control the range firing is through organic communications within the aviation unit using the range. Range firing will be controlled by the OIC from a C and C aircraft.

(j) Mississippi Range. This indirect fire range is complete with a general purpose building. This range features a firing position approximately 250 ft above the impact area, which enables observation of fire from the firing position. The firing position is a 300- by 800-meter cleared area that can be utilized for a helicopter rearm point.

(k) Tennessee 25-Meter Range. Tennessee Range is a six-point standard 25-meter firing range utilized to teach fundamentals of rifle markmanship. This range is utilized to determine compatibility of new items of clothing and equipment and its integration with standard or experimental small arms or cold effects on small arms fired in an extreme cold environment.

(l) Texas Range. This range is capable of being used to fire all types of large direct and indirect fire weapons as well as air defense missile systems. The large control tower overlooks a lighted concrete firing pad with six firing points with access ramps. Attached to the control tower is the range operations building with office or billet space. A shelter is attached to this building that houses the generators which provide power to operate the range. Adjacent to the firing line is a drone launching pad which can be used in conjunction with ground to air weapons systems. The 2500-meter range has large concrete bunkers on the right side of the 1000- and 2000-meter lines with small bunkers on the left side. Protected target lights, controlled from the range tower, are available at the center of the 1000-, 2000- and 2500-meter berms. Also available on the range are two general purpose buildings, latrine facilities, a large tracked vehicle maintenance building with inspection pit and ample room for ammunition storage.

(m) Washington Range. This range can easily accommodate any TO&E air defense missile battery and their associated target drone equipment. This range is isolated from the post and was designed for testing air defense weapons systems. However, the range is ideally suited for testing any type of direct or indirect weapons system or explosive.

(n) Bolio Lake Test Site. The Bolio Lake Test Site is a completely equipped multi purpose facility that can be used to support a variety of test activities simultaneously. The lighted, fenced compound includes five general-purpose buildings, a complete mess hall, billeting, a secure storage area, and a cold start laboratory. Cross-country vehicle trails and ski trails lead away from the compound. The Bolio Lake area, normally the coldest on Fort Greely is ideal for testing clothing, rations, individual equipment, and is an excellent staging area for field exercises or maneuvers.

(2) Easements. None.

(3) Impact/Live Firing Area

(a) Explosive Rounds. The various ranges may be used for live firing as indicated above.

(b) Inert Rounds. The aforementioned ranges may also be used for inert round firing.

b. Airspace

(1) Landspace/Airspace Relationship. Indirect Fire impact areas.

(2) Easements. (FAA high-altitude air routes). There is a commercial air corridor in the Fort Greely area.

(3) Manned Airborne Systems. Restricted Airspace R2202 is reserved for military use to unlimited altitude during test activities.

(4) Unmanned Airborne Systems. There are no special restrictions, but testing of artillery is limited to the ranges which are inside the restricted airspace (see para 3b(1), Landspace/Airspace Relationship).

(5) Area Surveillance. None.

TABLE G-1: DROP ZONES
FT GREELY, ALASKA

Reference: Map Sheet 3648IV, Mt. Hayes, D4 1:50,000

Bear Drop Zone - Is approximately 6 miles south of cantonment area at Ft. Greely, Alaska and is adjacent to and just east of the Richardson Highway. The DZ lies within grid coordinates WF 620780, WF 630740, and WF-620740. It is 1000 meters wide (E to W) and is 4000 meters long (N to S). This DZ features an unobstructed access from any direction and is easily accessible by wheel and track vehicles. The DZ is well suited and primarily utilized by TO&E airborne units within 172 Inf Bde for tactical jumps followed by tactical exercises.

Buffalo Drop Zone - Located approximately 2000 meters east of Allen Army Airfield at Ft. Greely, Alaska within grid coordinates WF 650964, WF 667970, WF 6668962, WF 660958, WF 663950, and WF 658947. The DZ is the best kept and most utilized DZ at Ft. Greely and can accommodate drops from any direction but with long axis (of approximately 2000 meters) from NE to SW (or SW to NE) and NW to SE (or SE to NW). The DZ is primarily utilized for personnel jumps and heavy equipment drops frm Air Force aircraft.

Fox Drop Zone - Five miles south of the cantonment area at Ft. Greely, Alaska, just east of the Richardson Highway. It lies within grid coordinates WF 624800, WF 636800, WF 635790, WF 630780, WF 626780 to WF 624780. The DZ can be approached from any direction but features a 2000-meter N to S (or S to N) and a 1000-meter E to W (or W to E) long drop axis. This DZ features an unimproved air strip and is typical dry arctic terrain. It holds snow well in the winter and is excellent for air drops from Army aircraft which can land for recovery operations. It has easy access by wheel and track vehicles on a year-round basis.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements

(a) Single Object

1 Event-time and space positioning data is obtained by using three positioned, synchronized digital theodolites. A real time video system is available for determining space position and height of burst for projectiles with terminal velocity under 1500 fps.

2 Weapon muzzle velocity is measured using either Doppler radar, a velocity coil system, or for small arms, ballistic screens.

3 Vehicle velocity is measured using a fifth wheel.

(b) Multiple Objects. None.

(c) Relative Positions (Miss-Distance). Marginal miss-distance information is obtained by using digital theodolites or aiming circles.

(d) Radar. Doppler radar as mentioned above.

(2) Airborne Elements

(a) Radar. None.

(b) Laser. None.

(c) Optical

1 Digital theodolites and aiming circles.

2 Cameras.

(d) Relative (Miss-Distance). Cameras (see 4.d), shuttered video.

(e) Airborne-to-Ground-Matching. None.

b. Timing. An IRIG-B timing system is available.

c. TV Equipment. Low light-level television system, including both disk and tape video recording is available. Shuttered video and near infrared cameras (for laser spot detection) are available. Video equipment can be mounted in vehicles with transmission of video signal by S-Band microwave.

d. Photography

(1) Motion Picture Capabilities

16mm variable frame 16 fps to 500 fps

16mm full frame to 4,800 fps

16mm 1/2 frame to 9,600 fps

16mm 1/4 frame 32,000 fps

35mm ballistic cynchro (Smear) camera to 120 ft/sec

(a) Data Capable of Recording. Zero time, spin rate, velocity, acceleration, pitch and yaw, fuze function and event time, impact attitude, metal parts security, etc.

(b) Designed Operating Environment. These cameras can be operated in temperatures as low as -60°F (-51°C).

(c) Film Developing Capabilities. Processing for all motion picture film is done by Elmendorf AFB, Anchorage, Alaska.

(2) Still Photography. Cameras include: Calumet View, Pentax Systematics, Rolleiflexes, Graflexes, and Crown Graphics.

(a) Data Capable of Recording. Used for test documentation (e.g., equipment performance reports).

(b) Film Developing Capabilities. Processing and printing of black and white and color is performed by the CRTC Photo Laboratory.

(3) Airborne Capabilities. Air-to-air and air-to-ground coverage can be obtained with hand-held cameras (twelve 120mm/220mm lens) up to 500 fps. Cameras have successfully been mounted on the outside of aircraft in environmental boxes.

e. TMDE Calibration Capabilities. The CRTC Calibration Facility is housed in an environmentally controlled modular laboratory. The lab provides precise temperature (20°C, ±1°C) and humidity (10 - 50%) control for the section's standards and comparison instruments. The Center's calibration technicians use standards that are traceable to the National Bureau of Standards to insure that accuracy of all instruments used for test support. The section has the capability of calibrating not only organic CRTC equipment, but also any special purpose instrumentation equipment that may be provided by a test sponsor. For that equipment requiring standards not available at CRTC, the calibration section maintains direct coordination with the extensive calibration facilities at Elmendorf and Eilson Air Force Bases, Redstone Arsenal, and Yuma Proving Ground. The section has the capability of calibrating instruments used to measure electrical parameters, pressure, temperature, time, length, and mass. Detailed information on calibration parameters, equipment, and accuracies will be furnished upon request.

f. Other General Instrumentation

(1) Telemetry. 62-channel PCM at 0.5 mHz rate, using S-Band microwave transmitters with decomutation at main post site.

abandoned gravel and dirt roads, trails within grassland, tangled brush,

(2) Meteorological. The requirement for accurate and timely meteorlogical data needed for the conduct of arctic tests is met by the ASL Alaska Meteorological Team attached to CRTC (see Reference 5 in the Bibliography). The MET Team is staffed and equipped to provide the Project Officer with complete weather data for the entire course of this test. The Teams' trained observers provide accurate short-term forecasts to the Center, enabling test personnel to utilize the maximum amount of available testing conditions. The MET Team operates several semipermanent sites on Fort Greely, each capable of providing data on temperature, windspeed and direction, relative humidity, barometric pressure, precipitaion, solar radiation, and other parameters as required. MET observers and equipment are also available for assignment to remote sites to provide data on temperature, windspeed and direction, barometric pressure, humidity, and precipitation. Upper-air observations can also be provided by the team to generate both synoptic soundings for forecast and research purposes and ballistic meteorological messages for artillery.

(3) Survey (Capability and Status)

(a) The following survey control points are available on the Fort Greely reservation:

31 1st order

2 2d order

102 3d order

(b) The survey section has strictly artillery surveying capabilities. It can extend 4th order control from the higher order points to any area of the reservation.

(4) Radio Frequency Interference/Electromagnetic Compatibility. None.

(5) Visibility (Light Level Measurement). Two photometers, one micro-candela heaf for measuring extremely low ambient light levels, and two illumination meters, one laser wavelength output meter, laser (Nd YAG) reflected energy meter.

(6) Sound Measurement and Analysis. Available equipment includes sound level meters and impulse meters.

(7) Safety and Security. A heated facility is utilized for storage of all instrumentation. Safety and security requirments have been satisfied based on recent inspections.

(8) Soil Conditions. None.

g. Special-Purpose Instrumentation

(1) Ballistic Data

(a) Available instrumentation permits measurements of muzzle velocity, chamber pressure, rate of fire, height of burst, fuze function, and impact point.

(b) Impact point measurement is presently performed using the aiming circles or digital theodolites (see 4a(2)(c), optical Airborne Elements) or video position system.

(2) Environmental Chambers. The 18-foot by 40-foot calibration facility is environmentally controlled for instrument maintenance and calibration purposes only; it is not an environmental test chamber. One 28-inch wide by 30-inch deep by 34-inch high chamber capable of operation from -100°F is available at CRTC.

(3) Vehicle Performance

(a) The entire Fort Greely reservation east of Delta River is available for use as a vehicle test course, the type of terrain covered limited only by the test area have been developed for use by test personnel, as appropriate. The longest course is the 33-Mile Loop with stretches of secondary roads, cross-country trails, muskeg, and creek fords. The loop is marked with mileposts, and two helipads have been constructed at its more remote portions. The 11-Mile Loop is also composed of secondary roads, with a larger proportion of cross-country trails and muskeg; and this loop is also marked with mileposts. The Donnelly Loop has 11.6 miles of secondary road portions restricted to wheeled vehicles. A 9-mile cross-country tank trail leads to the Tank Range from the Richardson Highway. Also available is the Vehicle Slope Test Area, with slopes from 10 to 60 percent.

(b) Instrumentation available for vehicle performance evaluation permits rough measurement of drawbar pull on smaller vehicles (NTE 20,000 lb), speed, acceleration, braking, starter cranking current, heater airflow, noxious fumes, vehicle temperatures, noise, and fuel consumption.

(4) Chemical/Biological/Radiological Instrumentation. CRTC performs surveillance testing of CBR protective equipment and other tests of CBR equipment, utilizing agent simulents as required. No CBR instrumentation is available at CRTC.

(5) Other. An infrared scanner mapper is available for heat loss and temperature distribution measurements of clothing and shelters. A precision IR radiation thermometer is used for absolute temperature measurement.

5. Threats/Targets

a. Ground

(1) Electromagnetic. Portable laser radiometer equipment is equipment for detection and measurement of near IR laser energy.

(2) Weapons

1 Numerous tracked-carcasses are positioned on Texas Range and Georgia Range.

2 A remotely controlled moving target system is available and possesses the capability of speed up to 15 miles per hour for 800 meters and can be remotely controlled at ranges up to 10 miles.

(3) Radiological Environment. See 4g(4), CBR Instrumentation.

(4) Other. None.

b. Airborne. None; however, Texas Range is equipped with a drone launching pad.

6. Data Handling/Processing

a. Data Storage and Retrieval Capabilities. The Computer Facility's ancillary equipment includes tape, disc, and card storage facilities, and a system for Rapid Collection and Analysis of Test Data (RCAD). Equipment includes telecommunications capability, floppy disks, remote control of instrumentation equipment, and instrument scanning capability.

b. Quick-Look Capabilities. The CRTC has a quick-look capability depending on volume and scope of work and turnaround time is normally the same day. Some real time capability is inherent in the RCAD system.

c. Processing

(1) System and Model. CRTC has an IBM 4331 that, although dedicated primarily to business systems, is capable of supporting a variety of users via terminal. CRTC also has an IBM 1232 Optical Mark page reader which is a rapid, efficient means of reducing the time needed to convert data to a computer-recognizable format. The RCAD system utilizes four Hewlett-Packard (HP) 9845 B/C model computer and three HP System 85 computers which can operate in a stand-alone or interconnected system.

(2) Languages. ANS COBOL, FORTRAN G, PL1 and BAL are available. The HP Systems operate in HP external BASIC and/or HP assembly languages.

Reference Documents

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ANNEX H

OPERATIONAL TEST INSTRUMENTATION

US ARMY TROPIC TEST CENTER
Fort Clayton, Panama
or
APO Miami 34004

CONTENTS - ANNEX H

LIST OF FIGURES

ANNEX H

US Army Tropic Test Center

Fort Clayton, Panama

1. Introduction

a. Overview. The US Army Tropic Test Center (USATTC) is a TECOM activity tenanted at the US Army 193d Infantry Brigade (Panama), Fort Clayton, Panama. The Canal area represents a cross-section of environmental conditions found in the humid tropic areas of the world. It is located at approximately 9° north latitude and 80° west longitude (figure H-1).

Fort Clayton is located on the Pacific slope of the Continental Divide. The terrain consists of predominantly low hills covered by semievergreen forest. This terrain is suitable for a variety of projects that require isolation but not much space. Many long-term exposure tests requiring frequent inspectons have been and are still being conducted here. For projects requiring the use of Army aircraft facilities, a 193d Infantry Brigade (Panama) aviation maintenance company is available at Howard Air Base. Fort Sherman and vicinity, an area on the Atlantic side of the Continental Divide, is covered predominantly by moist evergreen forests with some mangrove, palm, and reed swamps.

b. Generic Systems Tested. USATTC has test and evaluation capabilities for wheeled, tracked, and special purpose vehicles; armament and individual weapons; ammunition and explosives; electronic, avionic, and communications equipment; aviation, air delivery equipment, and aircraft weapons subsystems; chemical equipment; construction, support, and service equipment; general supplies and equipment; and missile and rocket systems.

Capabilities include test and methodology support for all aspects of tropic testing. Disciplines addressed on a recurring basis include: mechnical engineering, electrical engineering, climatology, operations research, materials engineering, chemistry, human factors engineering, hydrology and soils, botany, microbiology, and computer sciences.

2. General

a. Military Units

(1) Army Units

193d Infantry Brigade (Panama)--with:

4th Battalion, 10th Infantry
4th Battalion (Mech), 20th Infantry
3d Battalion, 5th Infantry

193d Combat Support Battalion

210th Aviation Battalion

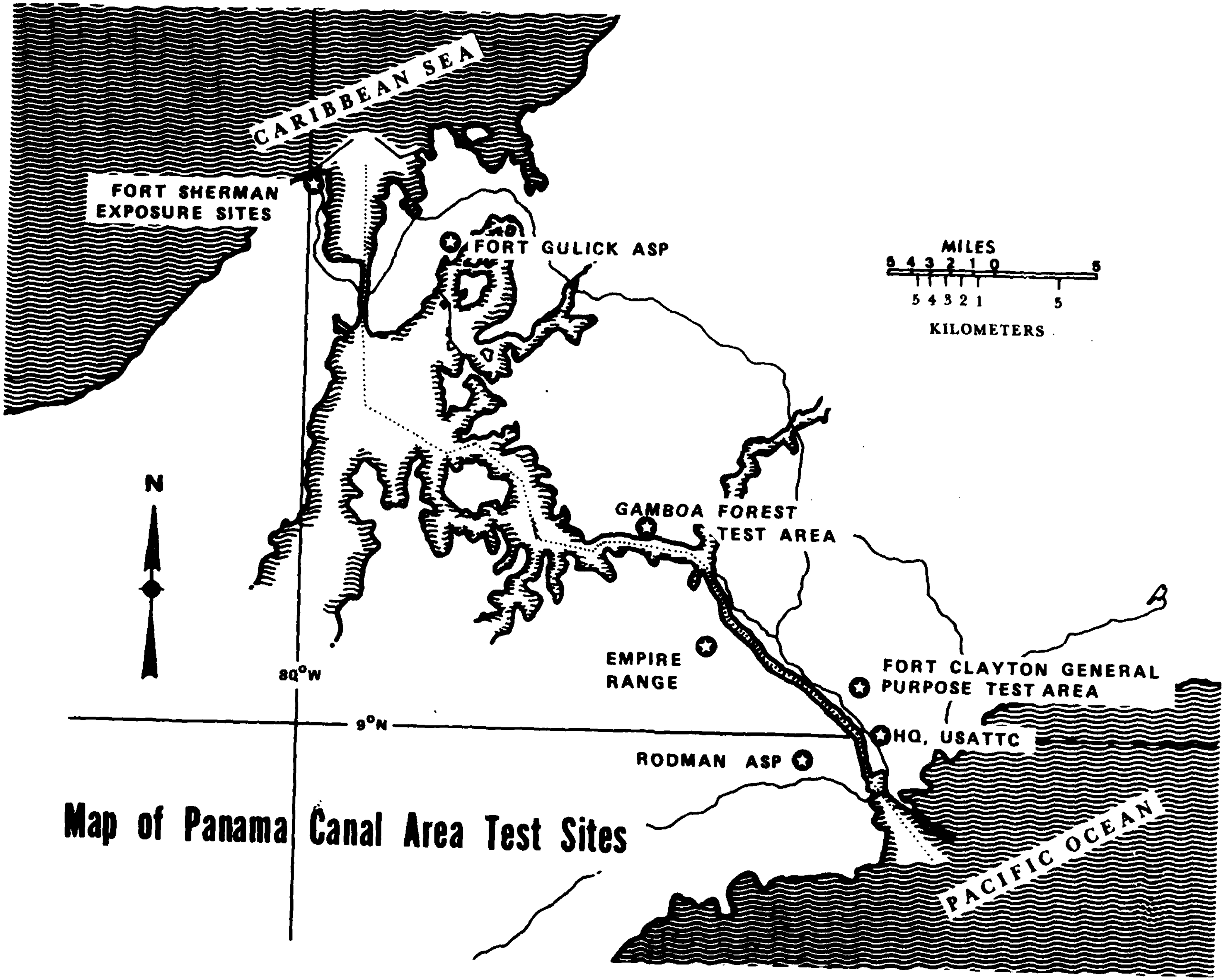

Figure H-1. Fort Clayton, Panama, and Vicinity.

Law Enforcement Activity
3d Special Forces Battalion,
7th Special Forces Group (Airborne)

Jungle Operations Training Center

(2) Other Military Units

US Southern Command (USSOUTHCOM)

US Air Forces Southern Air Division (USAFSO)

US Naval Station, Panama Canal (USNAVSTA PANCANAL)

b. Maintenance Capability. The maintenance support facility is located in the Corozal area of Fort Clayton, approximately one-half mile (1 km) from USATTC Headquarters. It has shops and work areas for maintenance of vehicles, generators, and other large support equipment.

c. Access

(1) Air. The Military Airlift Command provides air transportation from Charleston Air Force Base, South Carolina, to Howard Air Force Base, Panama. Both Pan American World Airways and Braniff International have direct commercial jet flights from CONUS to Panama City, Republic of Panama. Flights arrive at Tocumen International Airport from New York, Washington, Miami, New Orleans, and Houston.

(2) Water. Commercial United States flag vessels arrive from every major United States port.

(3) Road. The two-lane, trans-Isthmian, Boyd-Roosevelt Highway runs between the Pacific and Atlantic sides of the Isthmus.

(4) Rail. The Panama Railroad runs between the Pacific and Atlantic terminal facilities of the Panama Canal area.

d. Logistical Support Capability. The USATTC Headquarters and Headquarters Company (HHC) is located in Building 21, Corozal. The 125-man tropic, garrison-type barracks houses the locally deployed troop complement and offices. HHC provides supply and administrative support for all permanently assigned and TDY personnel.

e. Recurring Commitments (ROTC, Reserves). USATTC has no recurring commitments for obligated support to ROTC or Reserve units. However, it is Command policy to help and contribute limited, nonmonetary support to individuals associated with ROTC and Reserve units in fulfillment of the individual's unit obligations; i.e., active duty for training. Some USATTC civilian staff members are active in local Reserve units.

f. Special Operational Restriction. None.

g. Facility Organization. Figure H-2 shows the organizational chart for USATTC.

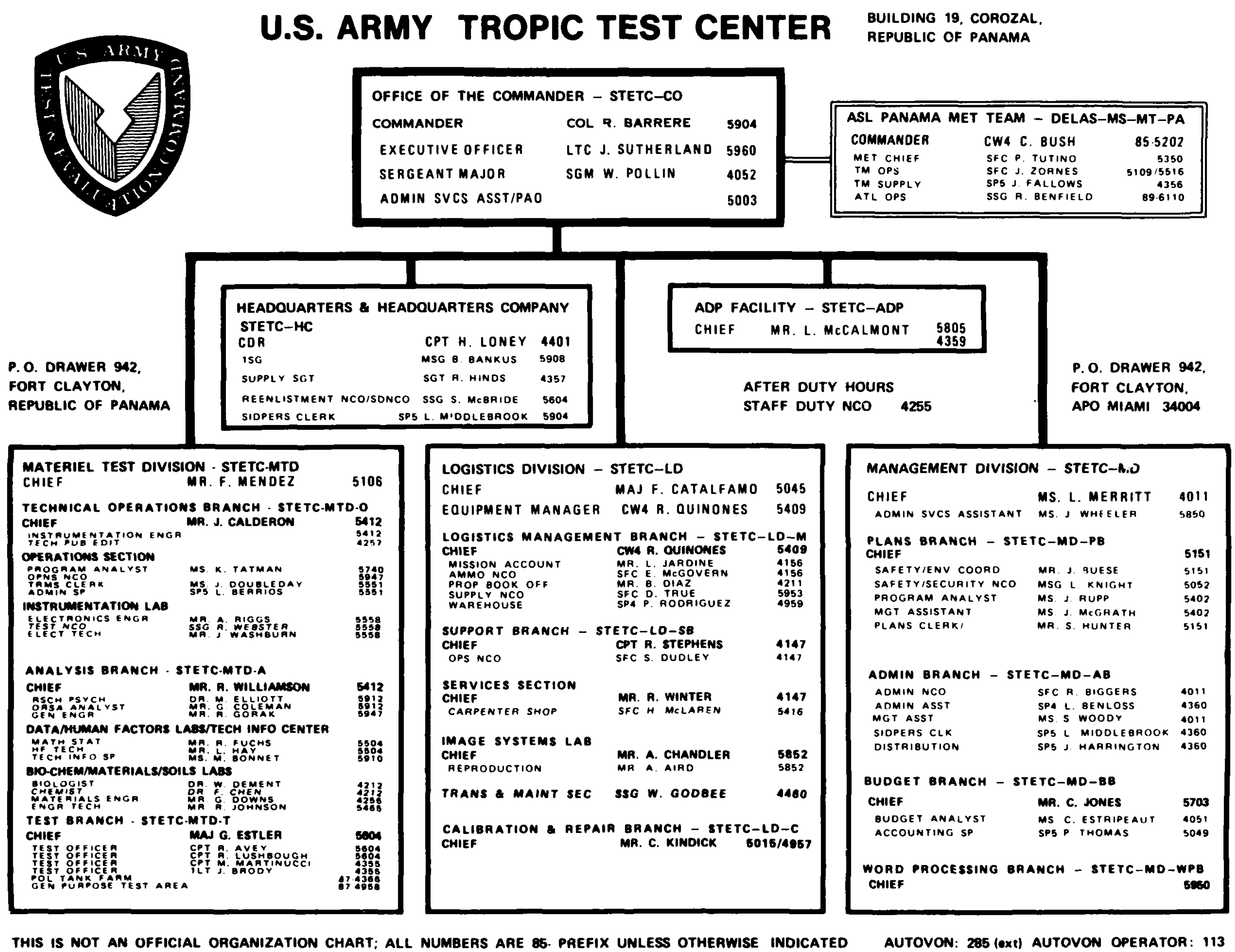

Figure H-2. US Army Tropic Test Center Organization.

h. Environment (climate). The Canal area bisects the Isthmus of Panama at approximately 9° north latitude. The Canal is approximately 55 miles (89 km) long. Although the Canal area is relatively small, there is a marked difference between the environments of the Atlantic and Pacific sides. Major differences include amounts of rainfall and vegetation. Two seasons prevail in the Canal area: the wet season (8 months) and the dry season (4 months).

(1) Atlantic Side. From approximately the center of the Canal area northwest to the Atlantic Ocean, average annual precipitation generally exceeds 95 inches (241 cm). Even during the "dry" season, this area averages an inch or more rain per month. Daily temperatures range from about 85°F (29°C) during the afternoon to about 75°F (24°C) in the early morning hours. Relative humidity is high, reaching 95 to 100 percent for several hours nearly every night. Relatively dense forests are widespread throughout the area. Trees are predominantly broadleaf deciduous species. The top of the forest canopy ranges from 90 to 125 feet (27 to 38m)

(2) Pacific Side. From approximately the center of the Canal area southeast to the Pacific Ocean, precipitaion decreases from its maximum to less than 70 inches (178 cm) per year at the coast. Normally, less than 3 centimeters of rain per month falls during the 2 driest months. Daily temperatures are higher than on the Atlantic side, exceeding 90°F (32°C) during the afternoons with early morning temperatures dropping below 70°F (21°C) on some occasions. Relative humidity is fairly high, reaching 100 percent nearly every night, but somewhat lower during the dry season. Broadleaf forests are widespread with a larger percent of deciduous trees than the Atlantic side. Tree growth is less dense causing more dense tangle and undergrowth. The top of the forest canopy ranges from 60 to 110 feet (18 to 34 m).

Reference No. 1 in the Bibliography gives an in-depth coverage of the USATTC environment.

i. Topography. Several different types of terrain and topographic conditions are present in the Canal area. Section 3.a.(3) presents detailed topography descriptions for each USATTC test area.

j. Airspace Restrictions. Airspace is controlled by the Republic of Panama. USATRC coordinates requests for use of airspace with local US and Panamanian agencies.

k. Power Availability. At remote test sites where line power is not readily available, USATTC provides portable generators of varying capacities.

l. Communications. A telecommunication network to allow radio/telephone communications between Headquarters, annex sites, and temporary test sites is available.

3. Dimensions

a. Landscape. As discussed in the overview, USATTC controls certain test areas and shares other training areas with the 193d Infantry Brigade (Panama). Each available area is discussed further below.

(1) Test Area Contiguity. See figure H-1.

(2) Easements. Not applicable to USATTC. Land easements are controlled by the 193d Infantry Brigade (Panama) Facilities Engineer and do not affect the testing mission.

(3) Impact/Live Firing Areas. The Army's Empire Range and the Air Force's R-611 Range are located on the Pacific side of the Panama Canal. Approximately 90 percent of this area is uninhabited and covered with tropic semievergreen forest. Contiguous to the south is an extensive tropic grassland area making it possible to operate in several tropic conditions without excessive logistics requirements. USATTC uses these two ranges for tests involving airdrops and firing of live ammunition and explosives. Ground-to-ground firing at Empire Range is limited to a maximum of 13,123 feet (4,000 m) and explosive detonations are limited to a maximum of 40 pounds (18 kg). The Army's Pina firing ranges, located on the Atlantic side of the Isthmus at Fort Sherman, are also available. For testing larger caliber weapons, missiles, and rockets, overwater firings (up to 70 nautical miles (130 km) downrange) can be conducted at Pina Beach and Battery McKenzie (Atlantic area). The latter firing point is under the exclusive control of USATTC. Small arms, medium and heavy weapons, and light artillery pieces are tested at the Pina Light Artillery Range, with 16,404 feet (5,000 m) maximum range. Most of the ranges offer varied terrain and vegetation conditions.

The Gamboa test facility consists of approximately 2,500 acres (1,012 ha) near the midpoint of the Isthmus. The area has a predominance of broadleaf evergreen trees, some semievergreen trees, and a limited amount of marshland and grass areas. This facility is useful for a variety of experiments which require isolation and exclusion of unauthorized personnel during tests, and offers mature, dense jungle. It can be used for communications and surveillance testing, vehicle testing, battlefield illumination tests, jungle visual studies, acoustic studies, and atmospheric sampling studies. The manpack portability course, located in this area, is used to evaluate the psychophysiological burden of new equipment undergoing service testing. It is composed of a permanently marked course designed to be representative in vegetation and terrain to other tropic rebions. A Physiological Telemetry System is available for performance measures of subjects involved in test and research projects. In addition, a laser-rifle fire simulator range is used to test for accuracy before and after load carrying. A land navigation course also has been developed.

The Fort Clayton General Purpose Test Area, situated in an outlying area on the Fort Clayton military reservation, consists of approximately 40 acres of fenced, lighted, and guarded tropic semideciduous forest, and open field areas. This facility provides a natural environment to support time-based exposure and demolition tests on small items. A 4,000-square foot Butler building provides a weatherproof and secure storage and work area.

Vehicle mobility areas consist of natural terrain sites at various locations on both sides of the Canal area. These sites were selected for controlled mobility tests and provide a variety of terrain types, physiography, soil characteristics, and vegetation. They include abandoned gravel and dirt roads, trails within grassland, tangled brush, forest with varying amounts of undergrowth, and swamps. There are several secondary courses which can be used to test vehicle performance in other types of terrain.

The Rodman and Fort Gulick ammunition test sites are located in Brigade ammunition supply points on the Pacific and Atlantic sides of the Isthmus, respectively. They consist of fenced-in, secure areas with open-sided sheds for long-term exposure testing of rocket motors, missiles, fuses, and other munitions.

b. Airspace

(1) Landspace/Airspace Relationship. Landspace in military reservations is controlled by the US Southern Command. Areas outside of military reservations are controlled by the Panama Canal Commission or the Republic of Panama. Airspace control is exercised by the Republic of Panama in coordination with the military services.

(2) Easements. Not applicable to USATTC.

(3) Manned Airborne Systems. Not available at USATTC.

(4) Unmanned Airborne Systems. Not available at USATTC.

(5) Area Surveillance. Not available at USATTC.

4. Instrumentation (Reference 2 of Bibliography gives detailed descriptions.)

a. Space Positioning and Velocity Vector

(1) Ground Elements. None.

(2) Airborne Elements. None.

b. Timing

(1) Primary (Standard, Code). The timing signal used for calibration purposes is received over a VLF receiver Tracor Model 599K and FS 323 frequency standard.

(2) Secondary. None.

c. Television Equipment (number and type of systems, components)

(1) Color or Black/White. A color and black/white closed-circuit television system is available for documentation of test events.

(2) Low Ambient Light Level Capabilities. Low-light and extended spectral sensitivity capabilities exist.

(3) Voice Channels. Single-voice channels are available with the system in use.

(4) Video Tape Recording Capabilities. A video tape recording capability exists for normal and low light level conditions and for field use.

(5) How Presently Used. The system is used to record test events in the field, with emphasis on the human factors aspects of testing and videometrics. Manpack portability testing has been documented extensively. Munitions performance measurements are also made with video instrumentation.

(6) Designed Operating Environment. The USATTC systems are off-the-shelf, commercially available systems that are designed to operate indoors or outdoors with some rain protection, but can be battery- or line-powered. Results to date are satisfactory.

d. Photography. Still and motion picture (16 to 400 frames/sec) coverage of tropic environmental test work is available. The photographic laboratory is equipped with still and motion picture cameras, flash equipment enlargers, and automatic film developing apparatus.

(1) Motion Picture Capabilities (type, number, etc.)

(a) How Presently Used. Sixteen-millimeter motion picture coverage is used for documentary-type test support. Motion picture time-lapse range is one frame each 0.2 seconds to one frame per hour.

(b) Designed Operating Environment. The system is designed to operate indoors and outdoors with some rain protection required.

(c) Film Developing Capabilities. No in-house capability is available. Processing is obtained through Eastman Kodak Company in Panama at a 48-hour normal turnaround time.

(2) Still Photography. Color negative/positive and black and white emulsions are processed at USATTC. Additional capability is available through the Kodak Company at a 24-hour normal turnaround time.

(3) Airborne Capabilities. None.

e. Instrumentation Calibration Capabilities

(1) Calibration and Repair Branch. An environmentally controlled enclosure at Building 6, Corozal, houses the Calibration and Repair Branch. Approximately 85 percent of all USATTC instruments are calibrated by this facility. The remaining items are calibrated by the Precision Measuring Equipment Laboratory at Albrook Air Force Station and the US Army Missile Command, Redstone Arsenal, Alabama.

Specific capabilities include:

Parameter	Range	Accuracy
Frequency	0 to 500 mHz	2.5 pp 10
Potential	DC 0 to 1,111.11 volts	$\pm$0.01%

	AC 10 Hz to 10 mHz	±0.05%
	10 to 100 mHz	±1.5%
	100 to 450 mHz	±3.0%
Current	DC 1 ua to 5 amps	±0.01%
	AC 10 ua to 5 amps	±0.1%
Resistance	0.1 to 11.1 ohms	±0.03%
	1,111,111.1 to 111,111,111 ohms	±1.0%
Distortion (AC)	5 to 600 Hz	±0.1%
Mass	0.5 to 73 kg Class 5-1 wts	100%
Tachometer-Calibrator	0 to 5,000 rpm	±1.0%
Temperature	32°F to 450°F (0°C to 237°C)	±1.0%
Humidity	0 to 100%	±1.0%

f. Other General Instrumentation

(1) Telemetry. None.

(2) Meteorlogical. The US Army Atmospheric Sciences Laboratory Meteorological Team is part of the Atmospheric Sciences Laboratory, White Sands Missile Range, New Mexico. The Team's Headquarters is located in Building 21, Corozal.

The Team's mission is to provide specialized meteorological services in the Canal area in support of US Government research, development, testing, and evaluation activities. Data Provided by the Team include.

- Standard surface observations
- Ozone concentrations
- Winds aloft-pibal, radiosonde, rocketsonde to 220,000 feet (67 km)
- Solar radiation--eppley, net change, total hemispheric
- Micromet-temperature, humidity, precipitation
- Wet bulb globe temperature

(3) Survey (capability and status). Standard surveying instruments, including transits, chains, rods, and other general equipment, are available.

(4) Radio Frequency Interference/Electromagnetic Compatibilty. A radio interference measuring set, AN/URM 85, is available.

(5) Visibility (light level measurement). Light intensity measuring instruments provide a capability for measuring light levels in the range of 10^{-3} to 10^{9} footcandles (.01 to 1.076 x 10^{10} lm/m^2).

(6) Sound Measurements and Analysis. Sound and vibration measurements can be made in the range of 2.5 to 20.0 kilohertz. Analysis can be made in all-pass, full-octave, 1/3-octave, and 1/10-octave bands. Amplitude levels can be measured from 0 to 180 decibels. Equipment is portable and battery-operated. Screening of test subjects' hearing ability can be accomplished with a laboratory audiometer.

(7) Safety and Security. USATTC will advise on specific safety and security matters through its Security Officer (see Organizational Chart).

(8) Soils Conditions

Soils Laboratory. This 600-square-foot (56 m^2) laboratory contains equipment and instrumentation required to support USATTC test and research missions. It contains the following equipment:

(a) Soil Sampling System. The Soil Sampling consists of Hvorslev and San Dimas samplers, soil augers, and associated equipment for obtaining samples of disturbed and undisturbed soil.

(b) Soil Strength Measurement System. The Soil Strength Measurement System is made up of components such as a cone penetrometer, unconfined compression machines, sheargraphs, and remodeling equipment. The components of this System can provide an index of the trafficability characteristics of soil.

(c) Topographic, Transit-Level Measuring System. A topographic, transit-level measuring system, instrumented with altimeter, clinometers, compasses, and an alidade, plane table, and stadia rod combination, is available. Slopes and topography are the principal surface measurements that can be made with this system. The system also affords a capability for test site layout and preparation of topographic maps.

Physical and chemical analysis equipment consists of standard soils laboratory instruments such as balances, drying ovens, pressure membrane extractor, soil centrifuge, pH meter, solu-bridge calorimeter, and flame photometer. The principal analyses made with this system are Atterberg limits; soil moisture at various water tensions; nitrogen; major and minor element levels; phosphorus and potassium levels, base saturation, cation exchange capacity; organic matter content; reaction; conductivity; specific gravity; texture (grain-size-distribution); and soil density.

Parameter	Range	Accuracy
Moisture	0 to 100%	±5%

Parameter	Range	Accuracy
Shear	1 to 30 psi (7 to 207 kPa)	±5%
Altitude	-1,000 to 6,000 feet (-305 to 1,829 m)	±5%
Soil Compression	0 to 500 psi (0 to 3,447 kPa)	±3%
Atterberg Limits	Plasticity, liquid, and plastic limits	Various

g. Special Purpose Instrumentation

(1) Ballistic Data. Muzzle velocity radars and high speed cameras are available.

(2) Environmental Chambers. None.

(3) Vehicle Performance. Instrumentation available is limited to measurements of vibration, pressure, temperature and strain, and a tape recording system.

(4) Chemical/Biological/Radiological Instrumentation

Chemical-Materials-Microbiological Laboratory. This test support facility consists of a chemical laboratory equipped with atomic absorption, infrared, visible light spectrometers, gas chromatography, pH meters, and other analytical instruments. They are used to make qualitative and quantitative analyses of chemical compounds as they affect materials deterioration in the tropic environment.

Parameter	Range	Accuracy
Ozone	0.001 ppm to 1 ppm	±2% full scale
Nitric Oxide/Total Oxides of Nitrogen	0.004 ppm to 2 ppm	±2% full scale
Total Sulfur/Hyfrogen Sulfide/Sulfur Dioxide	0.005 ppm to 1 ppm	±2 full scale
Dissolved Chloride	1 ppm to 75,000 ppm	±0.5 ppm
Vis-UV Reflectance	205 to 770 nm 1% to 100% of standard	±5 nm ±1%
UV-Vis Abosorption Spectra (inorganic/ organic compounds)	205 to 770 nm	±5 nm

Parameter	Range	Accuracy
IR Absorption Spectra (organic compounds)	200 to 4,000 cm^{-1} 0.01% to 100%	4 cm^{-1} $\pm$0.005%
Flame Emission Spectra (metallic ions)	190 to 852 nm 1 to 1,000 ppm	0.5 nm $\pm$1%
Atomic Absorption Spectra (metallic ions)	190 to 852 nm 0.5 to 1,000 ppm	0.5 nm $\pm$1%
Fluorescence Spectra (inorganic/organic compounds)		
Gas Analysis	1 ppm to pure	$\pm$0.5 ppm
pH	0 to 15 pH units	$\pm$.005 pH units
Weight	0.01 to 1,200 gm	$\pm$0.01 gm
Melting Point	25 to 350°C	$\pm$o.1°C
Particle Size	0.20 to 25 micron	$\pm$0.1 micron
Gas Flow	10 ml/min to 13 l/min	$\pm$0.5%
Pressure	10^{-6} to 1 torr (10^{-4} to 133 pa)	$\pm$1%
Refractive Index	1.40 to 1.70 index units	0.00003 index units
Solution Conductance	0.1 to 10 micromhos	$\pm$1%
Viscosity	0.2 to 75,000 centipoises (2 X 10^{-4} to 75 pa-sec)	$\pm$0.1%

The materials testing area includes the capability to perform hardness, compression, tensile, and breaking strength tests; nondestructive tests such as ultrasonic, eddy current, and x-ray analysis of a wide range of materials used in Army materiel items; and metallurgical analyses.

Parameter	Range	Accuracy
Tensile Strength	0 to 1,102 lb (0 to 500kg)	$\pm$0.5%
Folding Endurance (MIT)	Unlimited	$\pm$0.5 fold
Radiography	Up to 1-in (3 cm) steel	$\pm$2%
Water Vapor Transmission	1 oz/100 in^2/day (25 gm/645 cm^2/day)	$\pm$0.02 gm/100 in^2/day

Parameter	Range	Accuracy
Corrosion Weight Loss	Unlimited	±10 mg
Abrasion Resistance	Unlimited (weight loss)	±10 mg
Metallographic Examination	Microscope up to 1,500X	Magnification
Rockwell Hardness	Any	±1 point
Strain Gage Stress Analysis	Up to 2,000 microstrain	± mc

The Microbiological Laboratory is equipped with microscopes, incubators, and incidental equipment to isolate and identify fungi and some bacteria found on materiel test items and components.

(5) Other. A Mobile Data Acquisition System, mounted in air-conditioned vans, is used for collecting, recording, and relaying data from remote sites.

The Human Factors Laboratory consists of a 1,200-square-foot (11 m^2) area used to support human factors test methodology investigations and to obtain human factors engineering measurements and analysis in support of USATTC's testing program. Instrumentation used includes: multichannel tape recorders, preamplifiers, sound measuring, and analysis equipment; shock and vibration measuring equipment; eye testing equipment; audiometric testing equipment; hand and eye coordination test equipment; carbon monoxide measuring equipment; and others. An air-conditioned, sound-proof area is available to support a wide range of human factors testing.

Parameter	Range	Accuracy
Light Intensity	0 to 10 Fc full-scale deflection (0 to 108 lm/m^2)	±5.0%
Time Interval	0.1 sec to 15 hours	±1.5%
CO^2 Concentration	20 to 1,000 ppm	±2.0%
Potential	AC 0 to 500 volts DC 0 to 10 amps	1.0% 3.0%
Current	AC 0 to 300 amps DC 0 to 10 amps	0.5% 3.0%
Distance (Range)	8 to 1,500 ft (2 to 457 m)	2.0%
Magnetic Tape Recorders	30 Hz to 15 kHz	2.0%
Body Length Measurement	0 to 7 ft (0 to 2,000 mm)	0.1%

5. Threats/Targets

a. Ground. None.

(1) Electromagnetic. None.

(a) Realism. None.

(b) Destroyable/Nondestroyable. None.

(2) Weapons

(a) Firing Realism. None.

(b) Scoring Capability. None.

(c) Destroyable/Nondestroyable. None.

(d) Physical Realism. None.

(3) Radiological Environment. None.

(4) Other. None.

b. Airborne

(1) Electromagnetic. None.

(a) Realism. None.

(b) Destroyable/Nondestroyable. None.

(2) Weapons

(a) Firing Realism. None.

(b) Scoring Capability. None.

(c) Destroyable/Nondestroyable. None.

(d) Physical Realism. None.

6. Data Handling/Processing.

a. An Automatic Data Processing Facility contains an IBM 4331 computer with 1-megabyte memory. Using the Virtual Machine concept of the 370 series, the machine is capable of serving multiple users at one time. Devices attached to the computer are: six cathode ray tubes (CRTs) with deyboards, two low-volume printers, one high-speed printer, four dispacks, and one twin-drive magnetic tape unit. Stand-alone capabilities and remote job entry to the 360-65 computer at White Sands Missile Range (WSMR) are used to support USATTC automatic data processing.

b. The Word Processing Branch is equipped with a Wang System 25 with three CRT stations and two printers. The Mag Card II is also compatible with the Wang System 25 through a Mag Card reader. The Wang System 25 is a software system with a 0.5-megabyte memory capability. The system also contains a telecommunications capability which allows communication with other ports of entry into the Advanced Research Projects Agency Network.

ANNEX H - BIBLIOGRAPHY

Reference Documents

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2. Instrumentation Development and Acquisition Plan, US Army Tropic Test Center, APO Miami 34004, March 1980.

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Reference Maps

4. DOD, Flight Information Publication, Enroute Low Altitide, Caribbean and South America, #L1/L2, Defense Mapping Agency Aerospace Center, Flight Information Office, Latin America.

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ANNEX I

OPERATIONAL TEST INSTRUMENTATION GUIDE

DUGWAY PROVING GROUND
DUGWAY, UTAH

CONTENTS - ANNEX I

LIST OF FIGURES

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ANNEX I

DUGWAY PROVING GROUND
Dugway, Utah

1. INTRODUCTION

a. Overview

(1) Geographic Location. Dugway Proving Ground (DPG) is located in the west central part of Utah, approximately 67 air miles southwest of Salt Lake City. The Dugway installation is comprised of a tract of land, approximately 52 miles east-to-west and 36 miles north-to-south, situated in the southeast corner of the Great Salt Lake Desert. The greater portion of the reservation is located in the Dugway Valley. The administration and quarters area (English Village) are located in Skull Valley. Most of the area is approximately level, with a few widely scattered sand dunes surrounded by mountains. Figure I-1 indicates the surrounding area.

(2) Mission

(a) Test and Evaluation Mission. Plan, conduct, evaluate, and report the results of development and developmental type tests, in accordance with integrated testing cycle policies, to assess the military value of chemical weapons and chemical/biological defense systems (CW/BD) as well as flame, incendiary, and smoke munitions systems. Provide advice, guidance, and support and/or facilities to materiel developers, materiel producers, other services, and private industry. Conduct other tests and evaluations as directed by the Commanding General, TECOM.

(b) Research and Development Mission. Plan, schedule, and conduct approved joint operational tests. Support CW/BD testing for Department of Defense (DOD) or other Federal agencies as directed by the Commanding General, TECOM. Provide advice and state-of-the-art interim answers to current problems and proposed defensive measures for DA Project AD-553, Technical Assessment of Foreign Biological Threat. Serve as and manage DOD joint contract point for all chemical and biological defense test and technical data for DA Project DO-49, Joint Chemical-Biological Contact Point and Test. Provide a basis for development of new operational and logistical concepts for the employment of tested systems.

(c) Installation Management and Operations. Manage and operate the installation in accordance with DOD Directive 3200.11, other applicable regulations, and as otherwise directed by the Commanding General, TECOM. Provide administrative, technical, and logistical support necessary to sustain the assigned research, development, test, and evaluation mission, and to tenant organizations as required. Perform other services as directed by the Commanding General, TECOM.

b. Generic Systems Tested. DPG has technical and managerial experience in planning, coordinating, executing, and reporting upon large-scale smoke, chemical, biological, and meteorological field tests, using safari techniques in any environment at remote locations. The DPG testing facility is equipped with a variety of laboratories, targets grids, sampling systems,

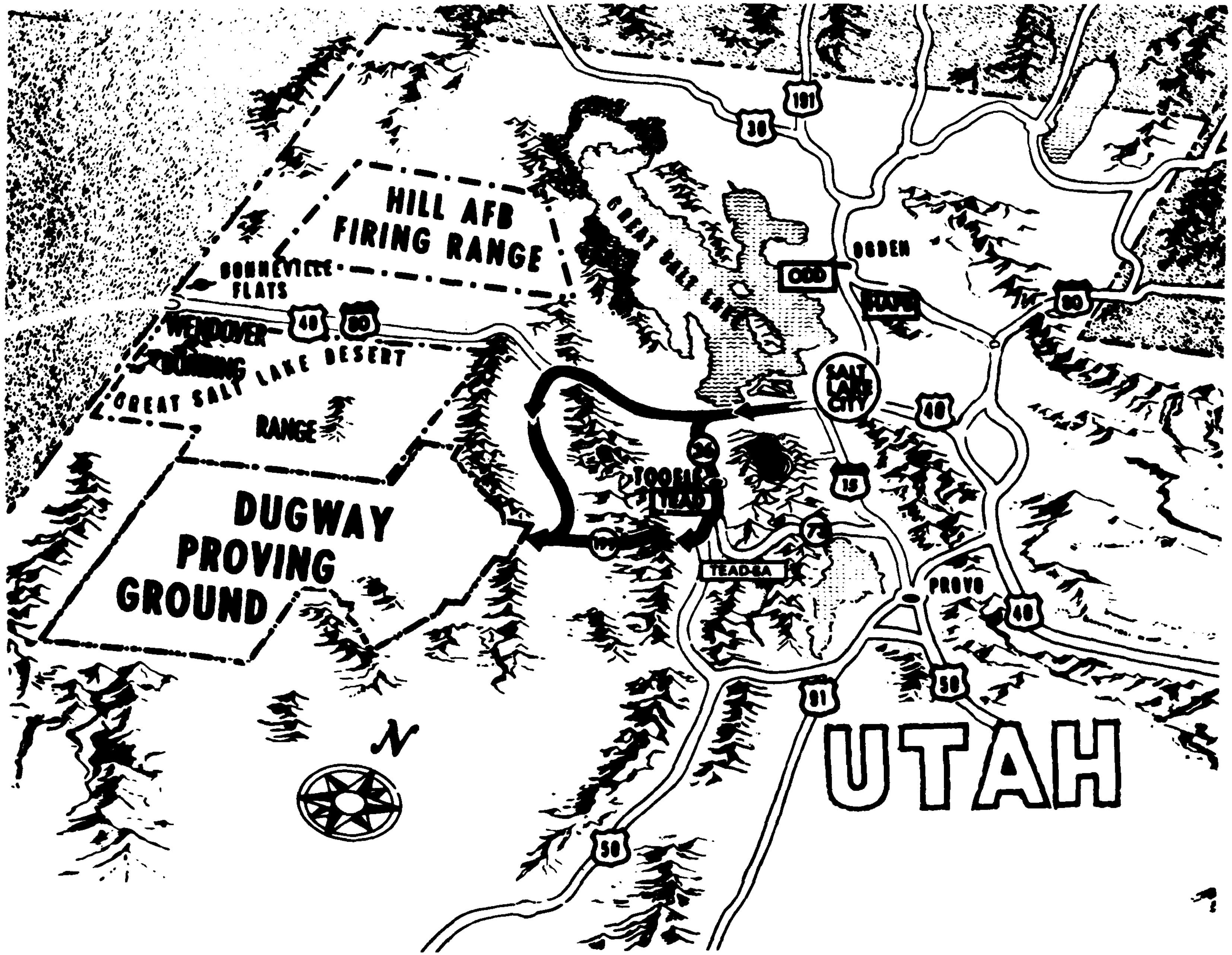


Figure I-1. WEST-CENTRAL AND NORTHWEST UTAH physical and munitions testing instrumentation, meteorological data gathering systems, electronic and photographic tracking systems, telemetry and instrumentation data transmission systems, data processing systems, and related elements to support testing.

In addition, emphasis has been placed on increasing the instrumentation to monitor safety in a wide land and airspace and to support testing of the following types of systems:

- Artillery and guided missile systems (large scale)

- Mobile equipment tests and evaluation (tanks, trucks, all terrain vehicles (ATVs))

- Aircraft (manned and unmanned)

- C^2 and C^3 systems

- Environmental pollution work (ecology and epidemiology, tracer work, waste disposal, toxicology, surveillance, etc.)

- Planning and conduction of approved tests on chemical biological defense systems

2. GENERAL

a. Military Units

(1) Army Units. DPG is staffed by approximately 787 Department of Army civilians and military personnel. There are 17 civilian professionals with doctorates and correspondingly greater numbers with masters of science and baccalaureates in science. Additionally, military personnel constitute a significant scientific and technical resource.

DPG has professional personnel trained in chemistry, biochemistry and toxicology, the life sciences (microbiology, ecology, epidemiology, zoology, biology, physiology), engineering, meteorology, mathematics, statistics, operations research, physics, and other fields. In addition, many skilled workers are employed at the proving ground, including those responsible for gathering and analysis of electronic and photo-optical data; maintenance of test grids; calibration, maintenance and repair of instruments and electronics; heavy and instrument machine shops, plumbing, welding, sheet-metal, and carpentry shops; maintenance and repair of motor vehicles; operation, maintenance, and repair of communications systems, and others.

(2) Other Military Units. Nearby military installations and facilities include the following:

(a) Hill Air Force Base - approximately 120 road miles (80 air miles) northeast of DPG

(b) Tooele Army Depot - aproximately 30 road miles northeast of DPG

(c) Defense Depot Ogden - approximately 10 road miles northwest of Hill Air Force Base

(d) Defense Depot Ogden - approximately 900 square miles, adjacent to DPG and extending northward.

(e) Utah Test and Training Range.

b. Maintenance. The field test grids, associated buildings, communications, power systems, etc., require performance of routine and preventive maintenance. The roads that service the test areas must also be maintained. Within the technical and test areas, there are approximately 460 miles of hard-surfaced roads, approximately 240 miles of graveled and dirt roads, and approximately 15 miles of unsurfaced and unimproved dirt roads. Generator repair facilities and a large ni-CAD battery charging f[illegible]y are available at Avery Technical Center.

c. Access

(1) Air. Michael Army Airfield located in Ditto Technical Center, has facilities for all jet and propeller-type aircraft and provides support for technical test aircraft. Runway dimensions and surfaces are 13,125-by-200-foot paved with 600-foot overrun on each end and equipped with emergency chain arresting gear; 4,278-by-100 foot dirt improved; and 4,182-byi-150-foot dirt improved. Additionally, there is a 75-foot wide lighted paved taxiway, a 300-by-300 foot decontamination pad and a 900-by-250-foot lighted paved ramp which contains tie down facilities capable of parking 20 aircraft. Limited hangar space is available. Routine weather briefing, flight services, communications, fire protection, and general airfield services are available. In addition, approximately 80 air miles northeast of Dugway is Hill Air Force Base. There is also the commercial airfield in Salt Lake City.

(2) Rail. Dugway does not have direct rail line connections. Railroad freight may be received on sidings at Timpie Junction or St. John station about 35 miles away.

(3) Road. Freight services are provided by truckline from Salt Lake city terminals.

d. Logistic Support Capabilities

(1) Logistic Support Capabilities. Housing is available with all necessary community support (including health clinic and medical services). Logistic supply activities are found at Fries Park. Accommodations for assigned personnel are located within English Village.

(2) US Army Health Clinic. The Health Clinic, in English Village, is under the command and control of Fitzsimmons Army Medical Center, Denver, Colorado. It is an outpatient-care facility staffed with US Army medical personnel, and equipped with limited diagnostic and treatment facilities. Services are available to all active duty and retired millitary personnel and their families. Additionally, civilian personnel and their families residing on post are eligible for health care at the clinic. When patients

need special attention beyond the scope of the Health Clinic, they are referred to US Air Force Hospital, Hill AFB, civilian medical facilities in Salt Lake City, or Fitsimmons Army Medical Center, depending upon the urgency and nature of treatment required.

(3) Base Support and Supply. DPG logistics avtivities include all the puglic utilities and services characteristic of a modern community. An installation Consolidated Property Accounts supports the total DPG test and base operations mission located in Fries Park area. DPG is satellited to Tooele Army Depot for property disposal functions. When air shipment (by government air) is employed, pretest loading and post-test unloading can be accomplished at Michael Army Airfield.

(4) Ammunition Storage. Complete ammunition storage, handling, and operating facilities are provided with the test facilities. This includes magazine storage, components-holding buildings, agent transfer facilities, safety controls, and assistance and administrative control of the testing facilities to assure security for the customer's test items.

(5) Weapons Provided. 105mm, 155mm, and 8-inch howitzer; 4.2 inch, 81mm and 60mm mortars; and .30 and .50 caliber small arms (including machine guns) are provided.

e. Recurring Commitments. None

f. Special Operational Restrictions. As a result of the national policy change on biological warfare, all offensive biological testing has been terminated. However, the testing of biological defensive material has continued.

Public laws have constraints on testing lethal chemical agents but do not prohibit open-air testing. The continuing need for field testing forced the further development and expanded use of simulants.

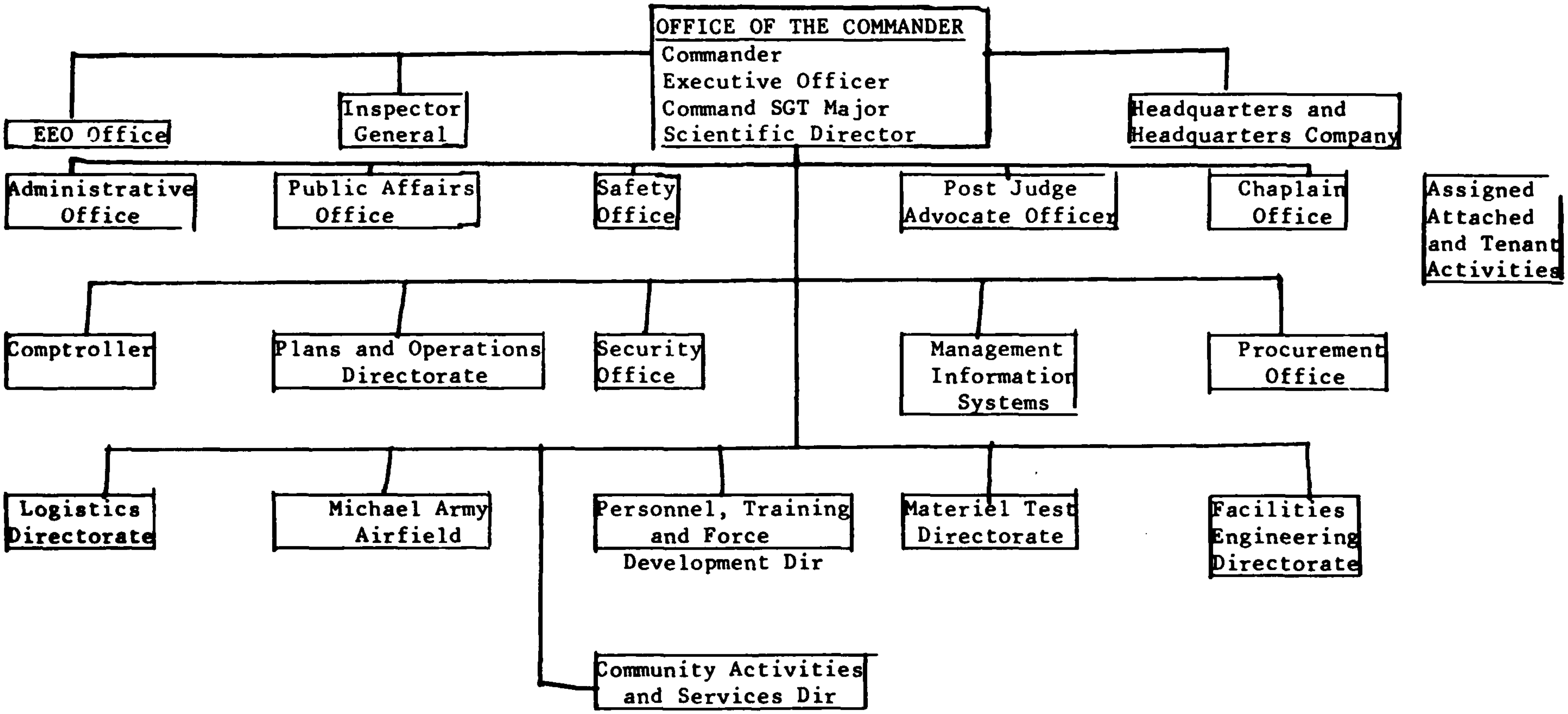
g. Facility Organization

(1) DPG Organization. See Figure 1-2.

(2) Plans & Operations. The Plans & Operations Directorate is staffed by select military senior scientific and technical mission requirements pertaining to field testing, technology, methodology, analytical studies, instrumentation meteorology, environmental quality enhancement and related tasks, which require allocation and utilization of resources. The Plans & Operations Office is the focal point where all waorkload is programed and where execution of the technical and support activities is monitored. Mid and Long-range conceptual planning, coordination with other services and commands on planning joint operations, methodology, test facilities development, instrumentation, communications, and other specialty management functions are carried out under the cognizance of this office. This office serves as the single point of contact for all incoming mission requirements.

(3) Materiel Test Directorate. This organization is responsible for substantially all technical work performed by the proving ground,

FIGURE I-2. DUGWAY PROVING GROUND



including preparation of test plans; analytical studies and reports; technical support for all testing and conduct of tests; development and execution of chemical, biological defensive and meteorological research; environmental studies, and other tasks.

(4) Joint Contact Point. Unique to DPG is the mission assignment of establishing and maintaining a repository for all available scientific and technical test data in the fields of chemical warfare and biological defense; i.e., a Joint Contact Point. To accomplish this task, a staff of operational research analysts provide requesting agencies with CB information. General information requests for CB information retrieval system wherein document records from which bibliographic data have been extracted and placed on magnetic tape for retrieval. More specialized information requests require use of weapons effects modeling techniques including large scale CB simulation models for estimation of CB systems effectiveness in addition to complete literature search, data analysis, and summarization.

(5) Administration. A small staff provides the normal administrative support. This support includes mail service, records management, classified document control, publications management, forms management, and correspondence management.

h. Environment (Climate). In practical sense, there are bit twp seaspms at Dugway Proving Ground--summer and winter. Breaks between the two seasons occur roughly in March/April and September/October. The mean elevation is approximately 4,350 feet above sea level. Prevailing winds are generally from the northwest during the day and from the southeast at night. Most of the surrounding area is high desert; hence, the air is usually quite dry, allowing for good visibility. Average annual precipitation is about seven inches.

Summer afternoons are quite hot with maximum temperatures averaging 94^{o} during July, the warmest and driest month. In the summer, precipitation consists of rainshowers and thunderstorms which appear on an average of four times. Along with the high winds (50 mph or more), blowing dust and sand reduce visibility substantially and cause damage to exposed surfaces, such as paint and glass.

January is the coldest month at DPG with an average minimum temperature of 15_{o}F and an average maximum of 38^{o}. The highest incidence of snowstorms occurs in March with snowfall averaging over four inches.

Storms have short duration and visibility exceeds ten miles during more than 95 percent of the year.

i. Topography. DPG has a wide range of terrain features from expansive and level salt flats to rugged and rocky mountains. The installation is situated at the southeast corner of the Great Salt Lake Desert and extends to parts of the Dugway and Skull Valley. Most of the area is more or less level, with widely scattered sand dunes. The Stansbury Range and Onaqui Range are to the east, and the Simpson and Dugway Ranges to the south. Deep Creek Range and Dutch Mountain are to the west. The Cedar Mountain Range forms the northeast boundary of the installation. Little Granite Mountain, Camel Back Ridge, Wig Mountain and Granite Mountain divide the installation into minor areas. The entire area was at one time covered by waters of the prehistoric Lake Bonneville, when only the peaks of the mountain ranges listed above extended out of the water. Figure I-1 indicate the surrounding area.

j. Airspace Restrictions. DPG is the using/proponent agency for two restricted airspace areas, R6402 and R6407, which generally cover the Dugway testing area. Through mutual agreement with the FAA, Salt Lake City, ARTCC, and Commander, 6501 Range Squadron, Hill AFB, Utah, the restricted airspace of DPG and neighboring restricted airspace of the Utah Test and Training Range (UTTR) are used on a shared basis for military RDT&E and training operations. Airspace scheduling is a joint effort by DPG/6501, and air traffic control is managed by the USAF 299 Communications Squadron, Hill AFB. Table I-1 lists the various airspaces of DPG and the 6501 Range Squadron.

k. Power Availability. Commercial power is available at several grid and test locations. To provide power to operate samplers, conditioning chambers, photographic equipment, etc., in other areas, portable generators and 12-volt nickelcadmium batteries are used.

(1) Gasoline and Diesel Generators. There are 64 generators, ranging in size from 5kw to 100 kw in use in the test area. These generators are moved from site to site as dictated by the test program. The quantity of generators by type and kw capacity are:

Quantity	Capacity	Type
10	100 kw	Military Standard (Mil Std)
3	100 kw	Commercial
1	60 kw	Mil Std
4	60 kw	Commercial
3	45 kw	60-cycle Mil Std
3	45 kw	400-cycle Mill Std
10	25 kw	Commercial
18	10 kw	Mil Std
5	10 kw	Commercial
5	5 kw	Commercial

(2) Nickel Cadium Batteries. Depending upon sampling requirements, many remote sampling stations may be required. Optimum placement of sampling stations differs widely, depending upon the type of information sought. These differences preclude the use of permanent or fixed location of sampling stations and, because of this and distances involved on some grids, it has been feasible nor economical to wire in all stations. As a result, a rugged, reliable power source capable of withstanding severe environmental conditions was required. A 12-volt, 70-ampere-hour nickel-cadmium battery has provided this source. To charge the large number of batteries required (up to 2,000 on some tests), a unique battery-charging and maintenance facility was disigned and constructed. This facility can charge up to 1,000 batteries per 24-hour work day in three shifts. In normal operation, approximately 300 batteries are charged per day. Batteries returned from the field (on special trailers) are placed in the

Table I-1. Restricted airspace

Number	Proponent Agency	Altitude	Time	Appropriate Authority[a]
R-6402	DPG, Dugway, UT	to FL580	Continuous	FAA, Salt Lake City ARTC Center or area FSS Cdr, DPG, Dugway, UT
R-6405	6501 Range Squadron	to FL580	Continuous	FAA, Salt Lake City ARTC Center or area FSS Cdr, 6501 Range Squadron, Hill AFB, UT
R-6406A	6501 Range Squadron	to FL580	Continuous	FAA, Salt Lake City ARTC Center or area FSS Cdr, 6501 Range Squadron, Hill AFB, UT
R-6404B	6501 Range Squadron	to FL580	Continuous	FAA, Salt Lake City ARTC Center or area FSS Cdr, 6501 Range Squadron, Hill AFB, UT
R-6407	DPG, Dugway, UT	to FL580	Continuous	FAA, Salt Lake City ARTC Center or area FSS Cdr, DPG, Dugway, UT

[a]Surface to FL110: Military Restricted Airspace. FL110 to FL580: Joint-Use Airspace with Exchange between military and civil use arranged by the 299 Communications Squadron, Hill AFB, and FAA ATCC, Salt Lake City, Utah.

charging room. Three trailers, each with 50 batteries, can be charged at a time.

l. Communications. DPG utilizes all standard means for transmission of voice communications, data timing, control, and other types of electromagnetic intelligence through a complex of radio network and fixed plant facilities. The telephone fixed plant uses wire and cable facilities to serve the telephonic needs of DPG and provides the means of unclassified information flow between active operation points. A telecommunications center located in English Village serves AUTOVON, Western Union, and AUTODIN customers. All range instrumentation systems are serviced by mobile vans. Aircraft and navigational aid facilities provide for flight control from Michael Army Airfield. Mobile radio facilities are provided for field operation, range safety, and physical range security. Telephone service is provided through Salt Lake GSA switchboard on a local exchange.

3. DIMENSIONS.

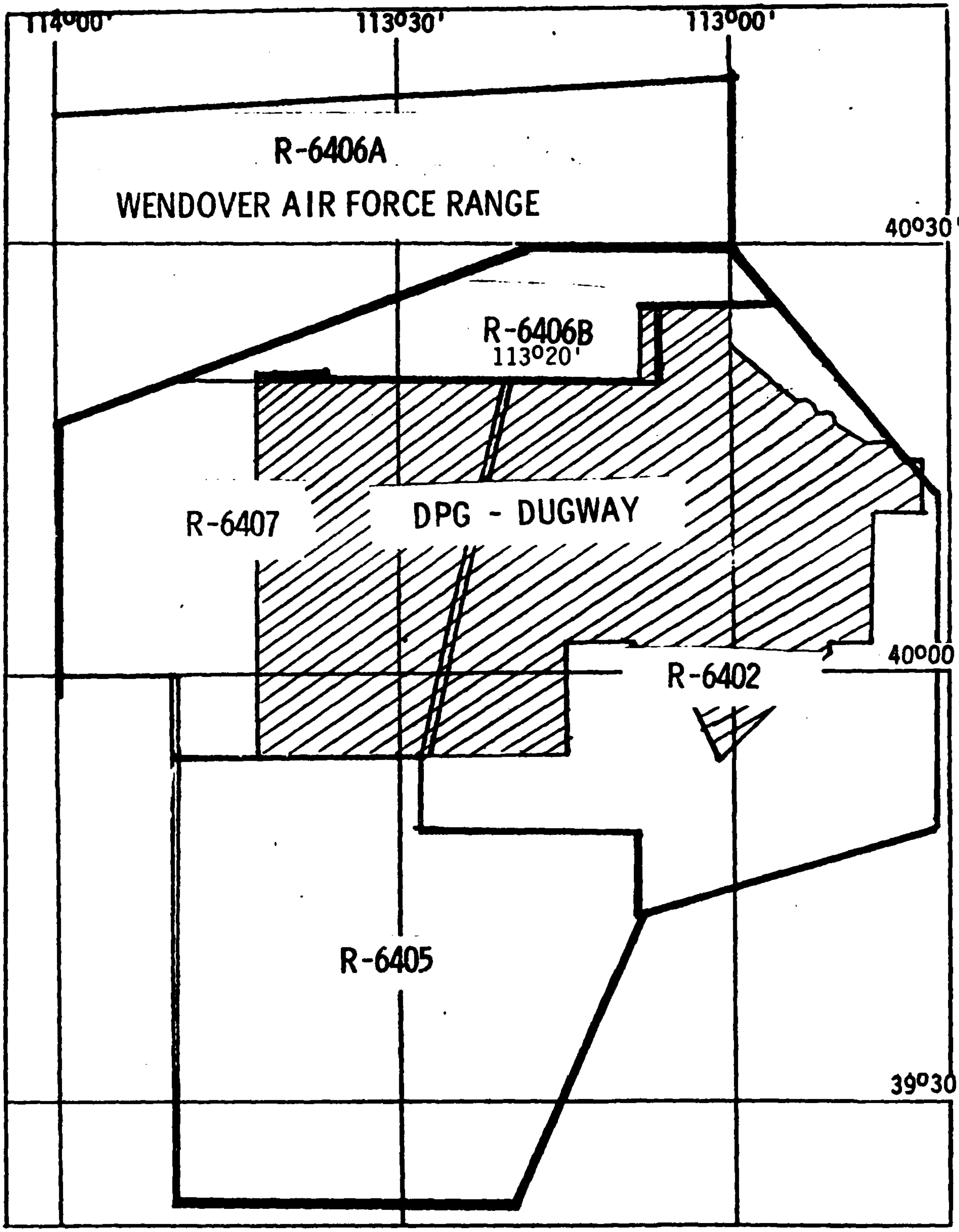
a. Landscape

(1) Test Area Contiguity. Figure I-4 indicates the test ranges, instrumentation, grids, and impact areas of Dugway Proving Ground.

(a) Sampling Grids. Through the years, numerous testing grids have been established to accommodate the testing of chemical and biological weapons systems. As a result of the ban on biological offensive weapon systems and constraints on open-air testing of chemical agents, some of the grids have been abondoned or deactivated, only seven being maintained at present. These grids (Figure I-4) provide a capability to test munitions filled with binary simulant (and agent, if permission to test is obtained), chemical and biological detectors and alarms, and to characterize and evaluate spray systems being used for military or non-military purposes (e.g., insecticide, fertilizer dissemination). Sampling grids and artillery ranges are virtually tailor-made for tests with smokes and obscurants, chaff, or any other airborne materials. Renewed interest in various obscuring materials is fairly recent. DPG, however, has experience in conducting visual screening tests, from single munitions to large-area screens developed by smoke generators.

The smaller sampling grids are circular, and the large grids are laid out along a generally northwesterly-southeasterly axis. The purpose is to give the tests the greatest possible independence from wind direction. Circular grids can be used regardless of wind direction when other factors are suitable, with fairly dense vertical sampling. Very large grids cannot be constructed in a circular pattern, for the related reasons of economics and area requirements. However, their orientation essentially parallels that of the prevalent winds, as described in the section on climatology. In this way, test cancellations because of unfavorable wind directions are minimized. The sizes of the various grids differ drastically. Small grids are chiefly designed for single point sources. The larger grids are suitable for multiple-point or line-source releases and aerial spray operations, and for any testing where the aim is large-area coverage.

1. Tower Grid. Tower Grid (Figure (I-5), nine miles southwest of



Cross-Hatch = Land Boundary

Figure I-3. Restricted airspace

Ditto Technical Center, centers upon one munition impact point. The grid is used for field testing and evaluating the firing of chemical simulant filled munitions and projectiles, and point-source dissemination systems, from small bomblets containing a few grams of simulant agent to complete systems releasing hundreds of pounds. The facility is equipped with a lighting system for work after dark and serves for collecting the aerosol, evaluating travel, diffusion, and decomposition; obtaining photographic coverage of test events; and recording meteorologic conditions under which munition function took place. A 50-foot artillery tower and a 300-foot rocket tower are incorporated into the facility. This grid has been completely modernized.

Each of the 3,120 sampling positions has capacity of 12.5 liters per minute. The vacuum is distributed to each grid position by underground vacuum lines from a central vacuum source incorporating four vacuum pumps. Each of the sampling positions is wired for indexing of samplers using 115 volts. Commercial power supplies power for all grid functions. In line with the flexible design of this and the other grids, verticals are not fixed but can be moved or removed as necessary, and sampling density can be varied as needed.

The artillery tower is a structural steel tower, 50-feet high, on which a 155mm howitzer or a 105mm howitzer may be mounted for firing into the sampling arrays. At a distance from the base of the tower is a sand-filled pit into which shells impact. This impact point determines the center of each grid. The rocket tower is a steel frame-work tower, 300 feet high, with an elevator shaft enclosed by the sides of the tower. Tube-type launchers are used to fire rockets into the impact pit.

2. West Vertical Grid. Located 15 miles west-northwest of Ditto Technical Center, is circular, with sampling stations in a circular pattern 27 to 2,640 yards from the center of the grid. The 27-yard circle, considered the dense array of the grid, consists of a vacuum system and 21 vertical risers which provide capability to sample in a vertical plane at 1-meter intervals for 42 meters. The vacuum capacity suffices to provide 12.5 liter critical flow at all sampling stations.

The radius circles are wired for 220-volt, three-phase power and require individual motor-vacuum pump assemplies at each station in use. Power is supplied by 30-kw generators, which are towed to the portion to be used and attached to the network. The vertical risers accommodate dual sampling, heated sampling boxes (to permit sampling with fluids susceptible to freezing).

The west vertical grid is used for point-source dissemination of biological simulant agents to study various defensive systems, such as biological agent alarms. Great flexibility is achieved on this grid, because advantage can be taken of any wind direction within 360°, which is further facilitated by the fact that vertical risers can be moved along circular rails.

3. Downwind Grid. The grid (Figure I-7) is constructed at the Dugway Valley on a southeast to northwest center line and extends northwest for 13 miles. The grid is three miles wide at the southeast end and nine

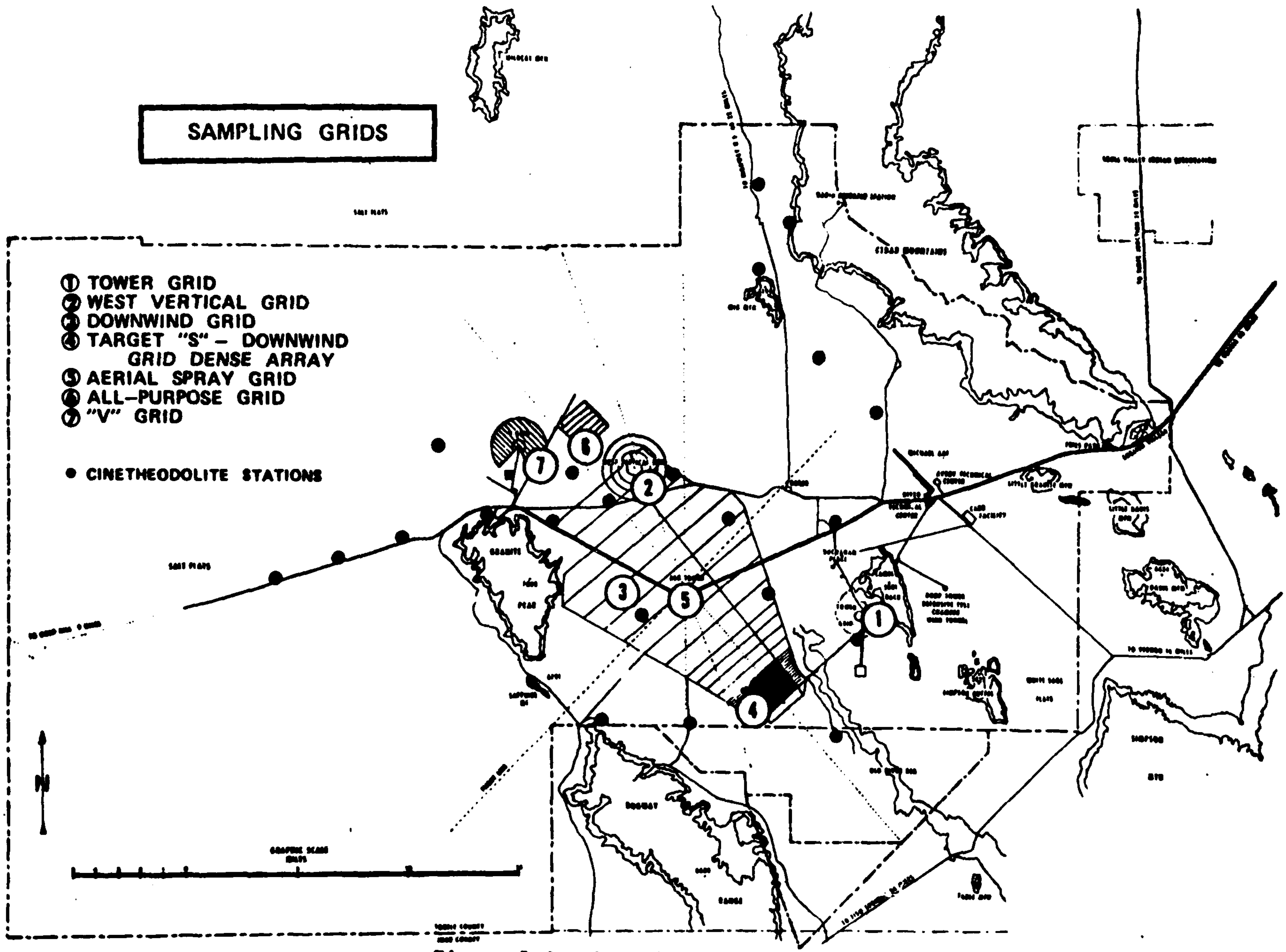


Figure I-4. Sampling Grids

miles wide at the northwest end. The dense array, on the south boundary of the proving ground is commonly called the "Target "S" grid. Total area covers more than 80 square miles. This grid is used for aerial spray and multiple point source testing of agents and simulants. Permanent meteorological telemetering lines are installed to the 100-foot tower in the dense array. The 100-foot tower on Bravo row (1-1/4 mile northwest of the center tower) and four two-meter stations on the corners of the dense array.

Up to 2,000 radio-controlled portable samplers are used on this grid, with a flow-rate capability of 12.5 liters per minute critical flow, as no permanently installed power or vacuum facilities ar available. Sampling stations on the grid are surveyed and installed as required by specific test programs.

At 300-foot intervals, roads provide access to the dense array. The downwind sampling roads are spaced at 1/2-mile intervals for the first two miles and one-mile intervals for the remaining nine miles.

4. Downwind Dense Array ("Target 5" Grid). "Target S", 15 miles southwest of Ditto Technical Center, forms the dense array of the downwind grid. The grid area is approximately one mile square, with three downwind sampling circles having radii of 1, 1-1/2, and 3 miles each.

Portable, remote-controlled or manually operated sampling devices are used on the grid. Sampling stations, surveyed and installed in accordance with program requirements, may include devices for either biological or chemical sampling.

Figure I-8 shows a characteristic grid set-up involving the dense array and area to Delta Road (Figure I-8) 9, 180 feet along the grid centerline toward the northwest, and an identical set-up extending toward the southeast, to be used in southeasterly or northwesterly wind flow, respectively. Sampler spacing and configuration are highly flexible, permitting adaption of the grid to meet specific testing requirements and are by no means limited to those shown.

5. Aerial Spray Grid. The aerial spray grid (Figure I-9), 12 miles west of Ditto Technical Center, consists of three grids with a common vertex. From a 318-foot vertical sampling tower at the vertex, three radial sampling lines, 20° apart, extend northwest to from the north array; similarly, three lines extend southwest to form the west array. Seven lateral sampling lines, parallel to the dissemination lines and across the radial lines, extend 40 miles on the north array; four lateral sampling lines extend to 15 miles on the south and west arrays. Figure I-9 illustrates the grid array of the aerial spray grid, indicating the basic grid, extended downwind sampling stations, peripheral sampling stations, flight lines and meteorological stations.

The sampling positions are at 1/4-mile intervals on the radial lines out through 15 miles and at one-mile intervals on the inner four lateral lines. The positions on the three outer lateral lines are at 5-mile intervals, four 100-foot sampling towers are 1/2, 2, 6, and 10 miles from the vertex on the central radial of each array. Sampling on each of the 100-foot towers is accomplished by a vacuum line installed in 10-foot

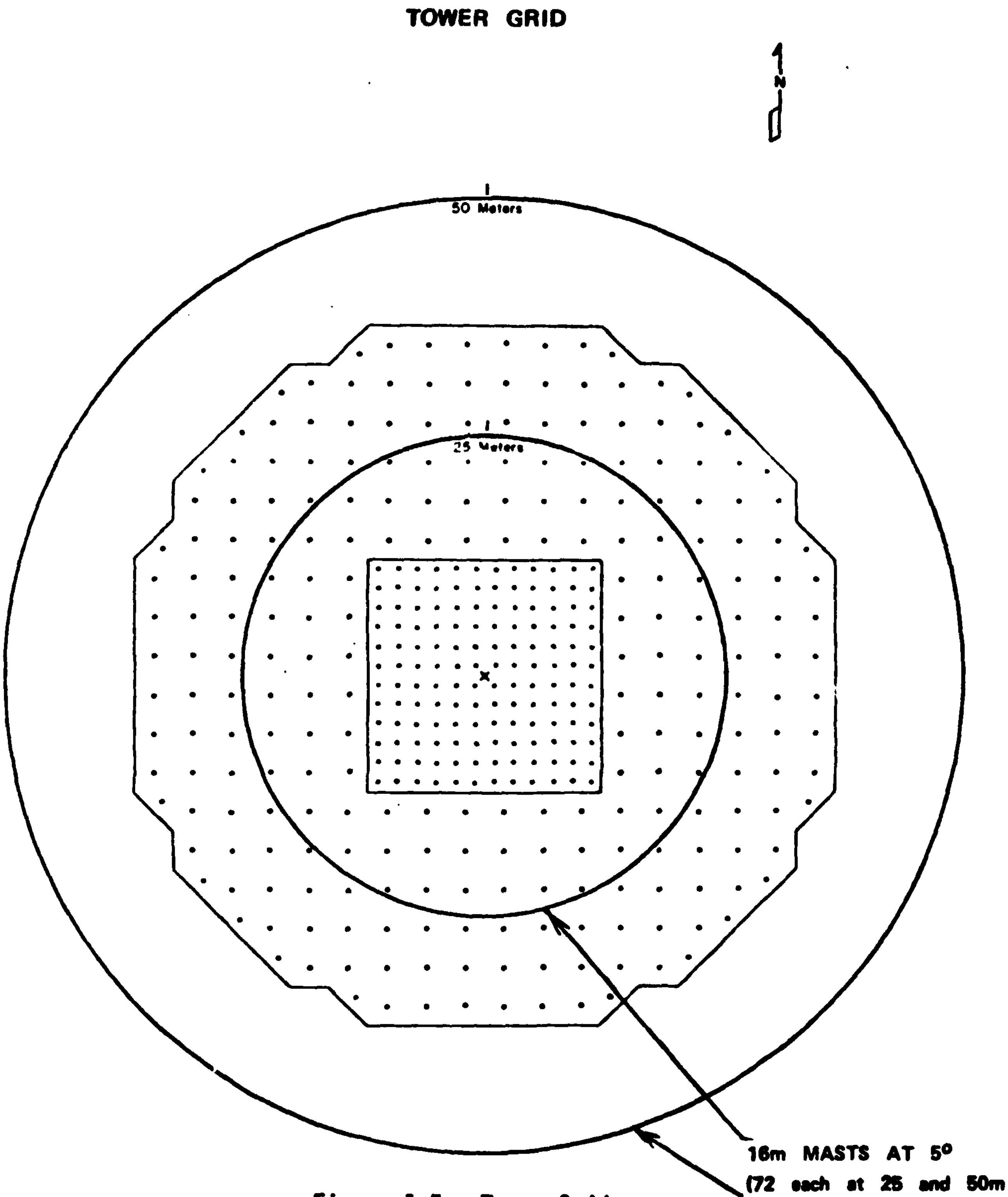
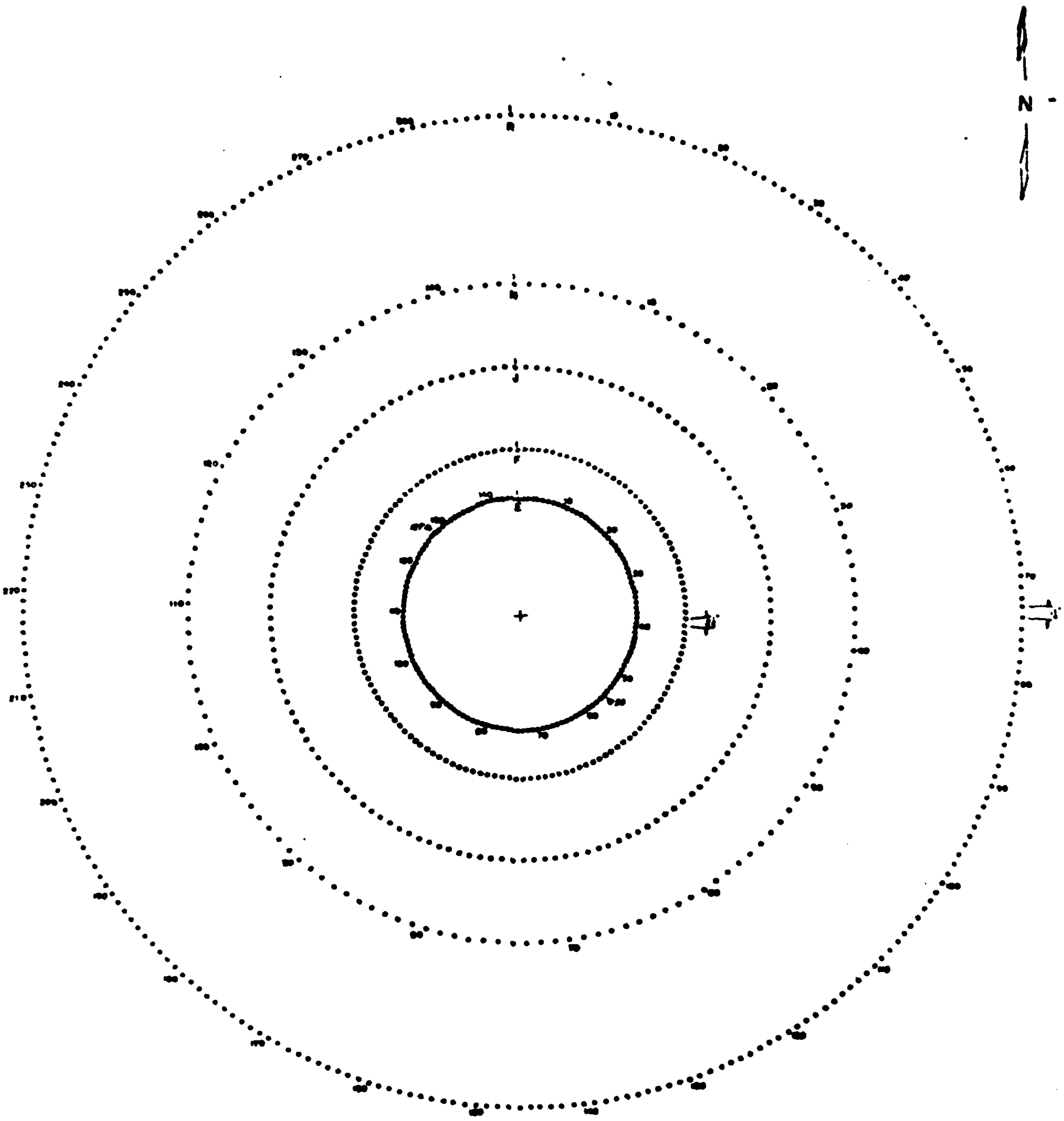


Figure I-5. Tower Grid



+ GRID CENTER
△ 16-METER METEOROLOGICAL MAST
○ HORIZONTAL SAMPLING POSITION

NOT TO SCALE

CIRCLE	RADIUS		ANGULAR SPACING BETWEEN POSITIONS
	METERS	YARDS	
E	75	[illegible]	2° 30'
F	[illegible]	[illegible]	2° 30'
J	[illegible]	[illegible]	2° 30'
[illegible]	[illegible]	437.4	2° 30'
R	[illegible]	[illegible]	1° 15'

Figure I-6.
West Vertical Grid

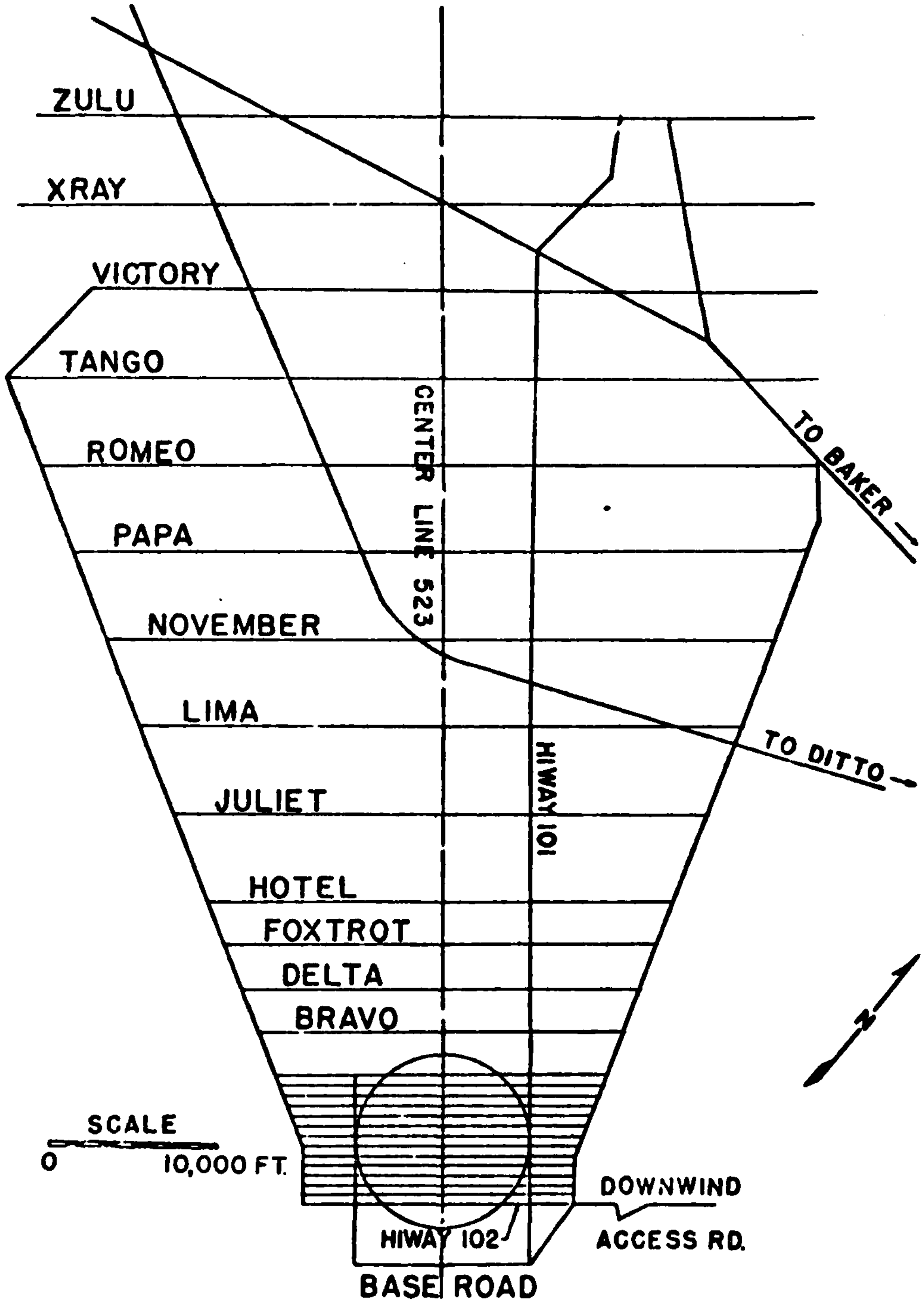


Figure I-7. Downwind grid

sections and raised by cable to the top. Samplers are placed at 15-foot intervals.

The 318-foot tower is rectangular, 6.5 by 8.5 feet. Two 5-hp, 87-cfm pumps provide vacuum through a pipe, which rises to the 318-foot level. On the tower are 93 vacuum ports for sampling. Vacuum ports with double valves for duplicate sampling are at 2-meter intervals starting one meter above the tower base, with single ports at 2-meter intervals starting 2 meters above the tower base.

The 100-foot towers are triangular, 18 inches a side. Vacuum is supplied by a 5.1-cfm pump. Horizontal sampling at each position on the laterals and radials is provided by the B/C sampler.

There is a balloon site at each of the 100-foot towers. Balloons may be used for extended vertical particulate sampling at every 35 feet from 135 to 975 feet, but are not currently available.

There are five flight lines for aerial releases on the aerial spray grid. Two are on each side of the 318-foot tower, with true azimuth headings of 045° and 225°. Two are west of the tower (azimuth of 090°, 270°, and 300°). An additional flight line has been added on the northeast side ot the tower (azimuth 200°, 119°). Portable generators provide power for the tower vacuum pump, tower lights, and balloon hoists. Batteries provide power for the remainder of the grid and flight lines.

The grid may be used for testing biological or chemical agent simulants from aerial line releases with manned aircraft or drone systems. The grid is designed to provide data on efficiency of aerial spray devices, aerosol decay and downwind travel of the aerosol cloud produced. Some limited cloud behavior information is also obtained through horizontal and vertical sampling.

6. All-Purpose Grid. This grid provides the capability to test bombs and artillery projectiles dynamically dropped or fired at operational ranges, and has been used for tests of various binary projectiles. It consists of a 1,000 foot dense array (containing up to 1722 samplers) bisected by a line of 53 (100-foot) vertical sampling towers with sampling capability at five-foot intervals (total 21 samplers per 750, 1,000, 2,000, and 5,000 meters from grid center are set up to the southeast and northwest of the grid to permit utilization of prevailing daytime, nocturnal, pre- and post-frontal winds. Flow rate capability is 6-liters per minute critical flow on verticals and 12.5 liters per minute on all horizontal stations. A typical sampling array is seen in Figure I-10, arranged for southeasterly winds. Others can be made, as necessary, including bi-directional arrays. A diagram of the range employed in dynamic firing of artillery rounds for impact on the all-purpose grid is shown in the following section on artillery and ballistic ranges.

7. "V" Grid. The "V" grid (Figure I-12) is 23 miles west of Ditto Area. It was constructed in a circle, making it particularly suitable for testing chemical simulants when information on droplet size and distribution is needed as generated by point-source systems.

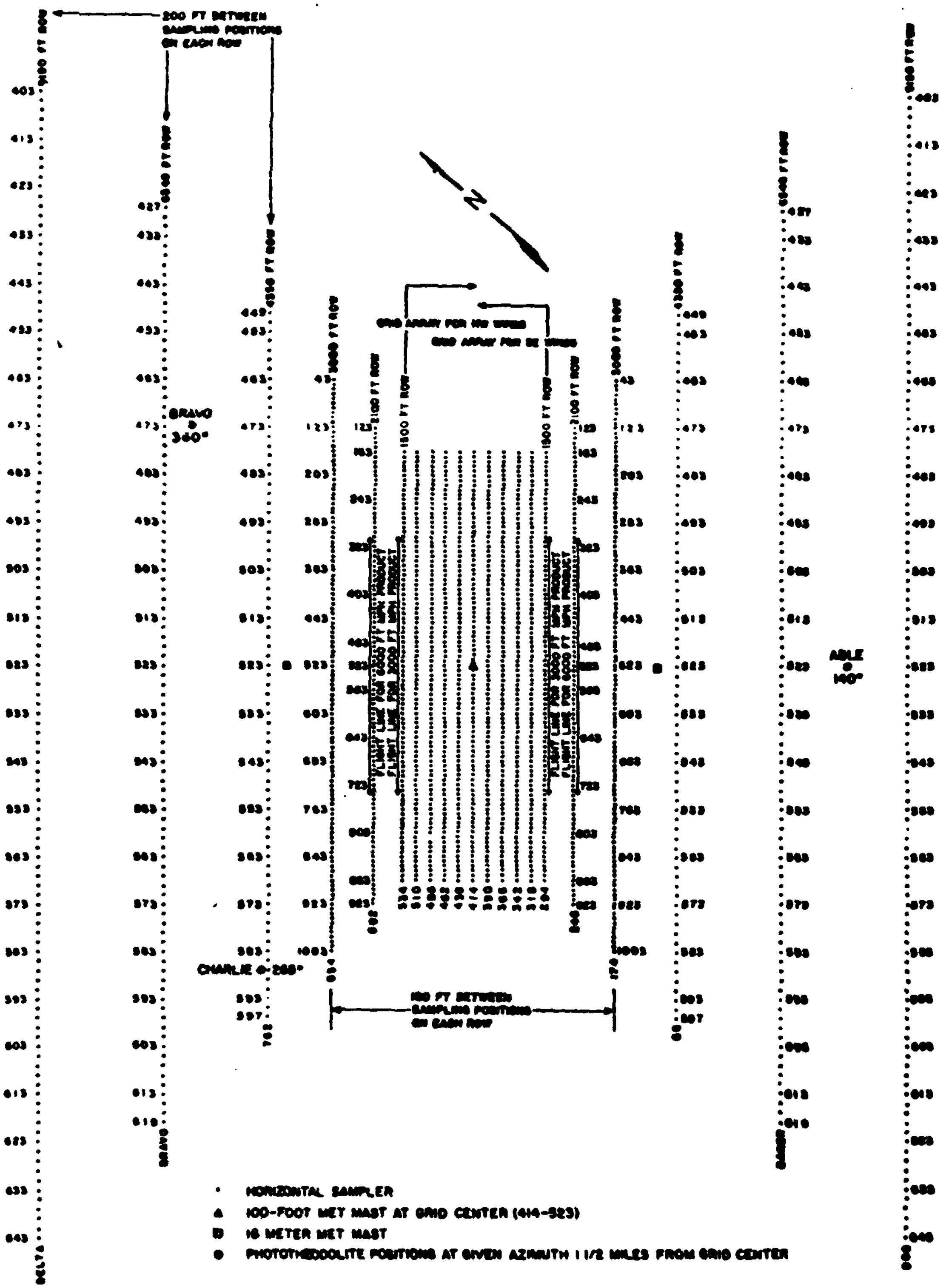


Figure I-8. Typical grid set-up on dense array

Although not currently used, the grid remains functional. The principal installations associated with this grid are the operations area, agent grid, meteorological instrument positions, photo and munitions personnel barricade, and cold and hot access road networks.

The grid has a dense array 100 yards square, with samplers positioned every two yards. Sampling towers are 120 feet high, in an arc with an 88-yard radius.

Beyond the dense array are eight arcs ranging from 125 yards radius from the grid center. Each of these arcs are wired for 220-volt, three-phase power. The 500-yard arc has 117 vertical samplers, 30 feet high, with a sampling station every five feet on each mast.

Munitions may be functioned from a 60-foot high "A" frame for simulated airburst by suspending the target firing round into it, or by utilizing the rocket-launch tower.

A special hard-target grid also has been constructed within the "V" grid proper. It consists of 18 open and 18 half-closed two-man foxholes in a dense array with an 85 yard radius. The hard-targets grid contains 316 sampling positions on 10-meters centers.

(b) Artillery and Ballistics Ranges. DPG has been involved in extensive artillery, rocket and mortar testing throughout its history. To accommodate the longer ranges of modern weapons and propellants and to obtain required data, relocation and extensive improvements have been made on the German Village and West Granite Peak firing ranges (Figures I-13 and I-14). The proving ground has excellent capabilities for testing artillery. The range system (Figure I-15) is devised to provide the maximum acquisition of ballistic data from each test. Velocities, pressures, trajectories, impact, functioning, rate of descent, malfunction evaluation and telemetry of data from instrumented rounds, are primary data services offered. One of the main advantages of the range is that test items may be impacted and recovered. Minimum damage is sustained by test items impacted and recovered. Minimum damage is sustained by test items impacting in the soft soil, and this permits close examination of hardware for the effects of firing. Also, the sparse vegetative cover makes location of fired items very simple. Firing and impact points are on virtually the same elevation, so that distances from firing point to impact pointt are true distances, requiring no corrections. Additional ranges, e.g., for even longer distances than presently achievable, can be established within DPG and, if necessary, utilizing landspace of the bombing range upon coordination with the controlling organization.

1. German Village Range. The primary range, southwest of Ditto Technical Center, consists of 3 prepared gun positions which will accomodate present US Army artillery weapons (self-propelled and towed), smear and tracking camera facilities, firing bunker, ammunition-conditioning chamber pads, radar position and survey instrument observation points from which range, deflection, and functioning data can be obtained from 1,000 to 30,000 meters with growth potential to 60,000 to 65,000 meters. The firing position is fixed, with an underground electrical distribution and had wire data acquisition system. Power is provided by portable electric

AERIAL SPRAY GRID

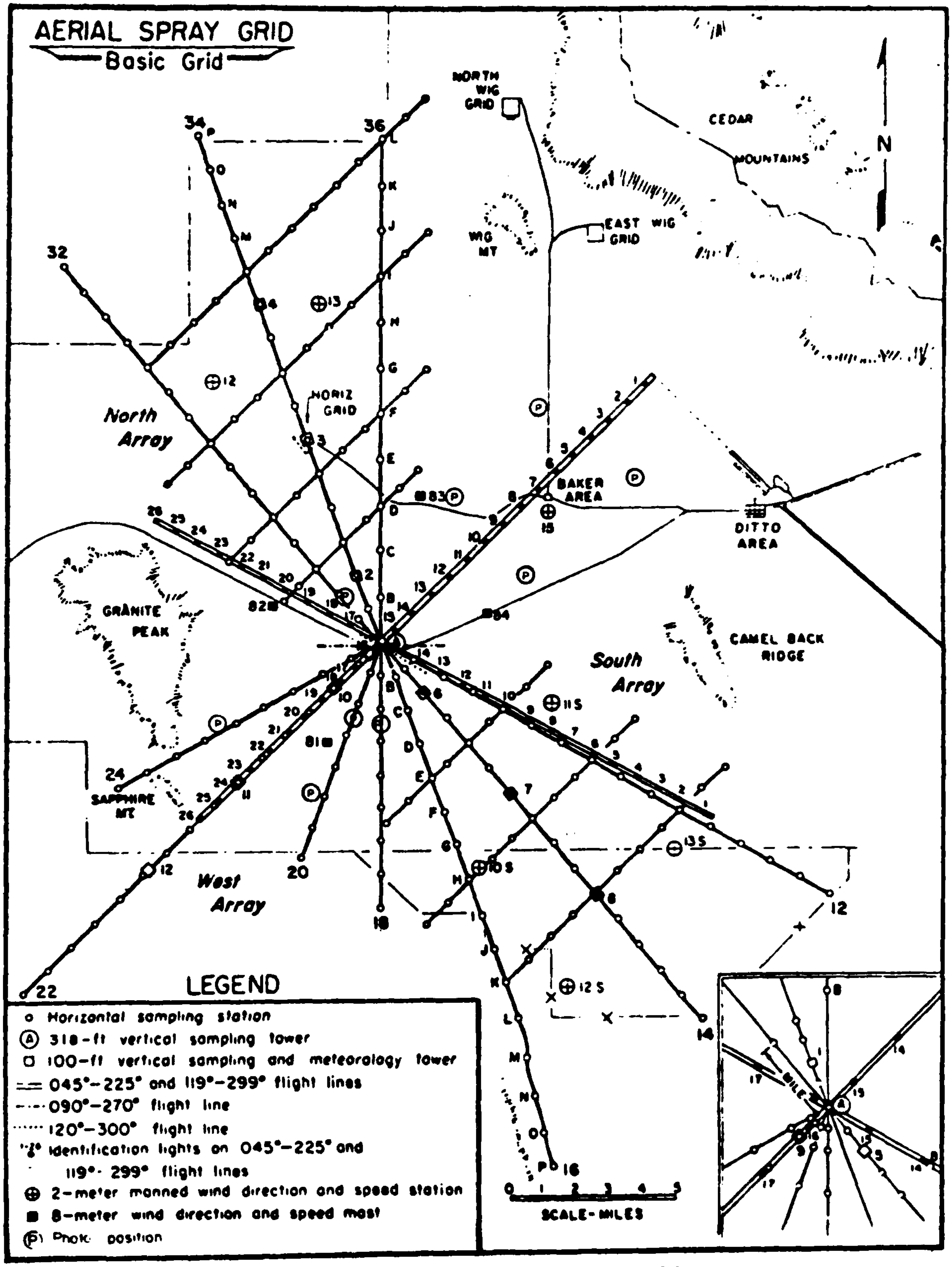


Figure I-9. Aerial spray grid

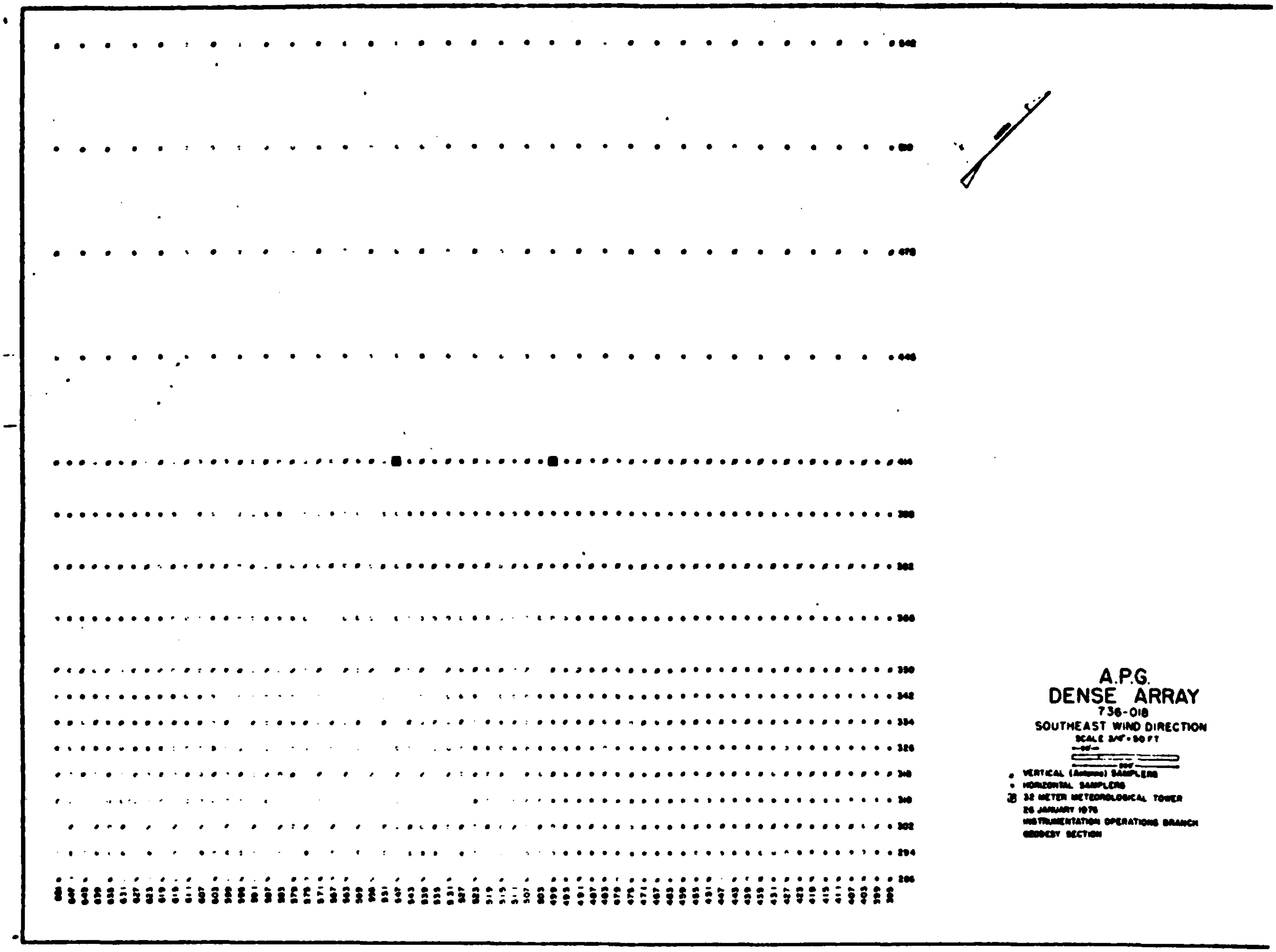


Figure I-10. A.P.G. dense array

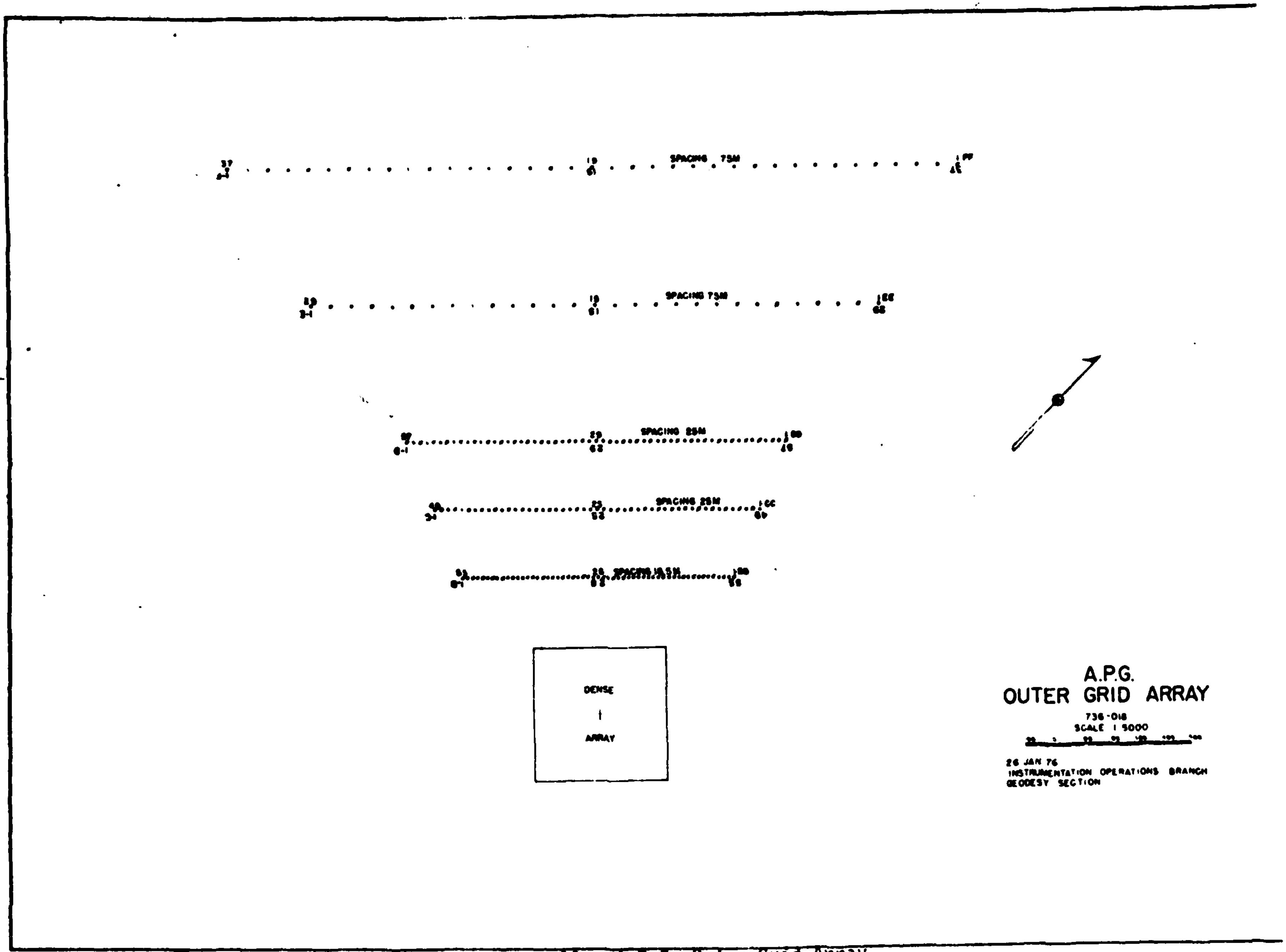


Figure I-11. A.P.G. Outer Grid Array

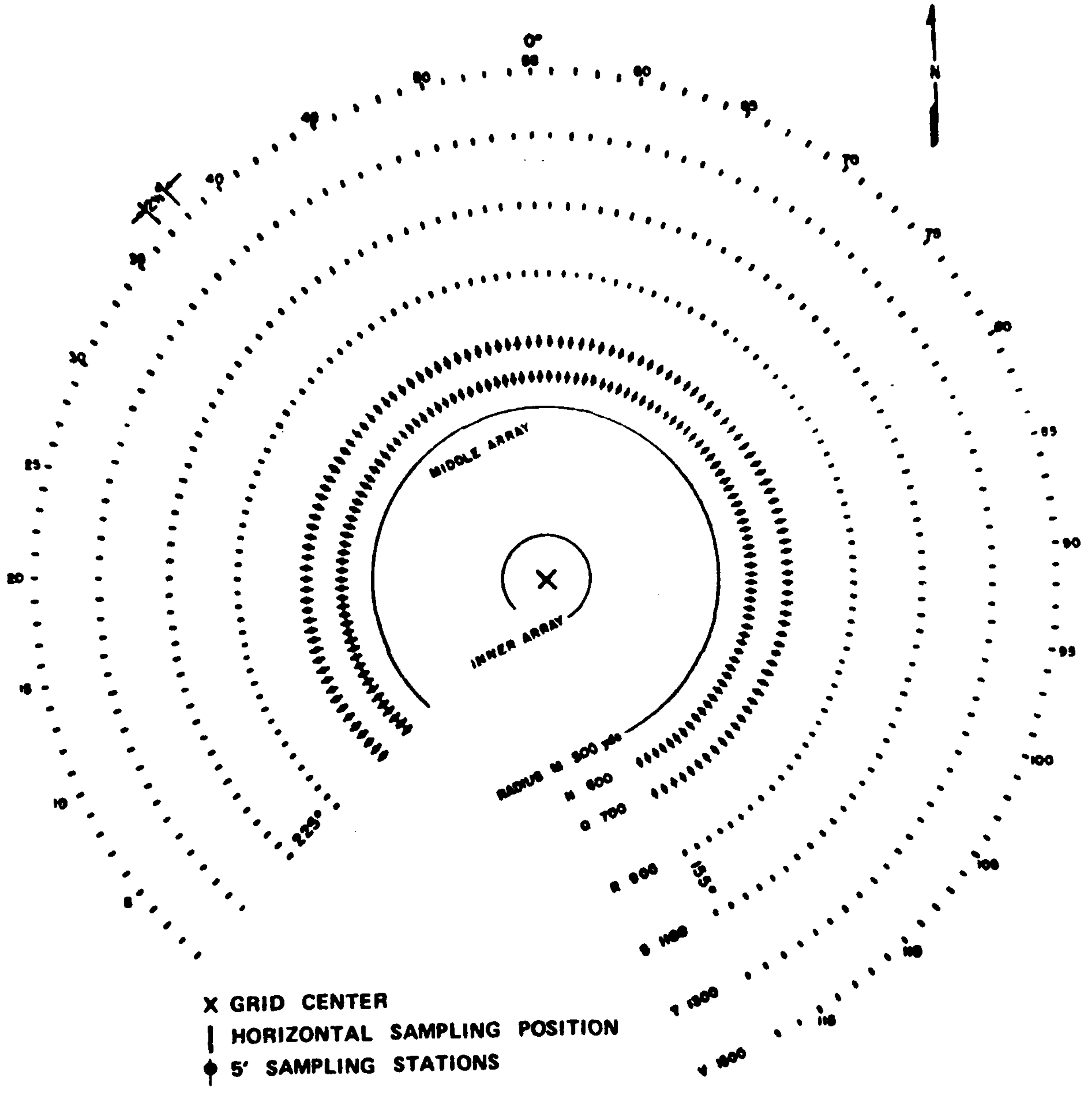


Figure I-12. V-GRID OUTER ARRAY

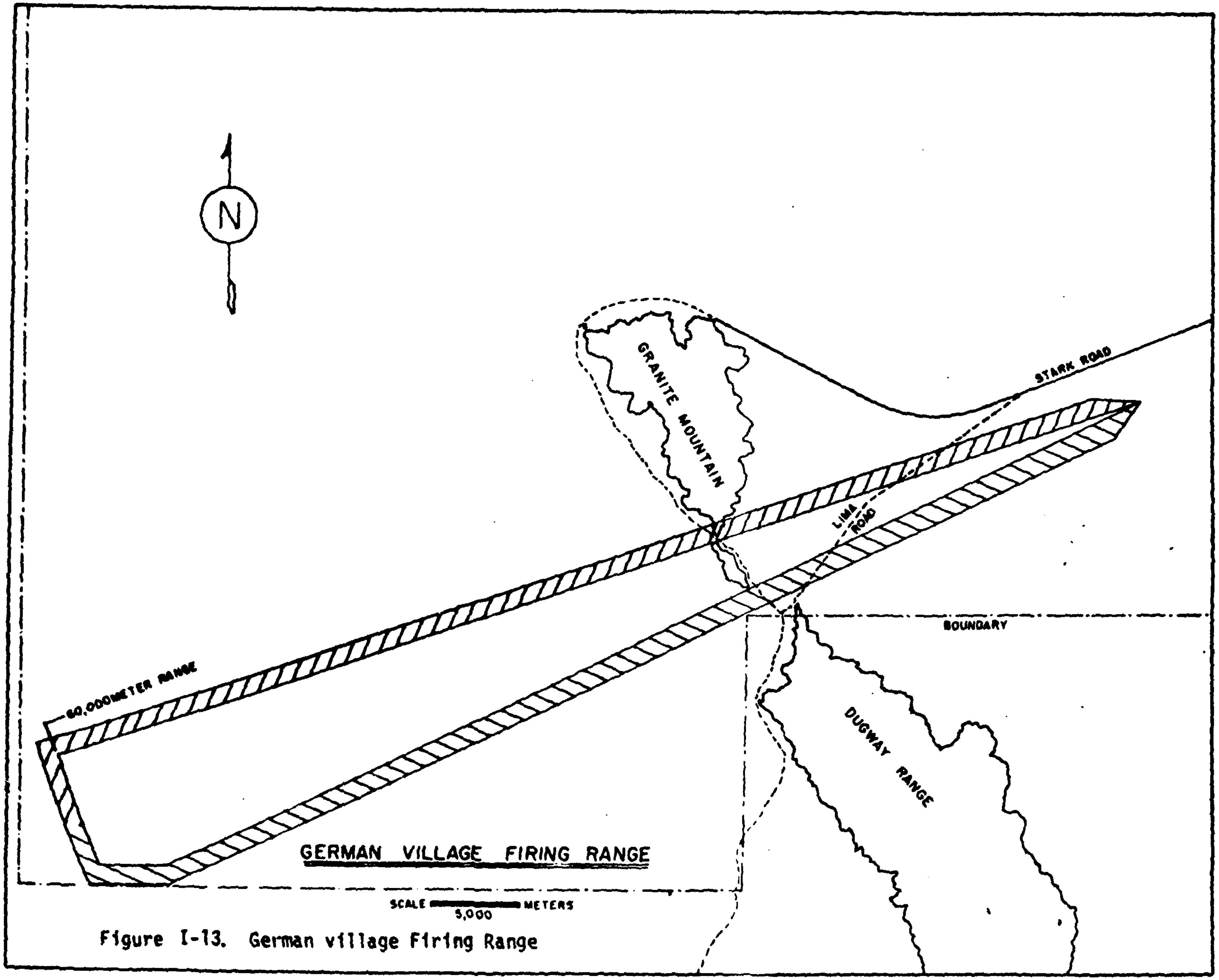


Figure I-13. German village Firing Range

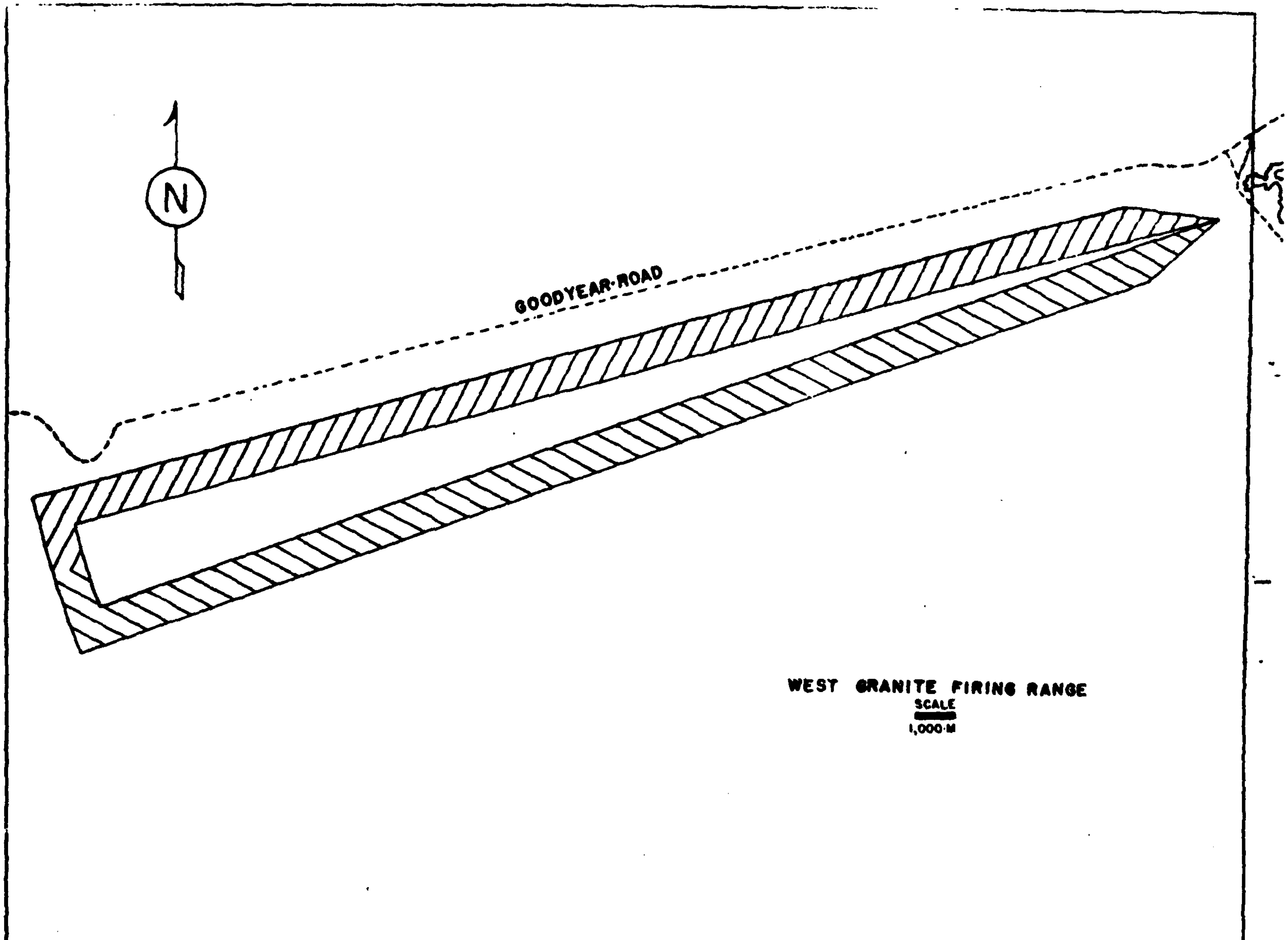


Figure I-14. West Granite firing range

generators. Planned improvements to this facility include extension of commercial power to the firing point and hard wire communication and data transmission lines alongside the line of fire. Many of the artillery firing programs require recovery of projectiles for metal parts integrity and functioning information. The nature of the soil along the firing line through 30,000 meters facilitates recovery. Every attempt has been and will continue to be made to keep this range clean, thus minimizing hazards during downrange evaluation and recovery.

2. Mortar Range. This range (Figure I-16) provides fixed mounts for 4.2-inch, 81mm and 60mm mortars, each equipped with velocity towers and remote-firing equipment. It is about 400 meters from the ammunition assembly area, facilitating high production levels. The range is wired for complete vocal control of all points, and access is limited for safety. Impacts from 0 to 7,000 meters are on cleared ground with complete downrange triangulation coverage. Recovery is in silt and clay, affording minimum impact damage to components. Production on this range has reached 480 rounds of illuminating projectiles per day, manned with 10 men including ammunition supply, proof director, gunners, and down-range observers. Time and malfunction data are collected.

3. Howitzer Range. Less than 3/4 mile from the assembly facilities, this range (Figure I-16) is likely a production range. Two velocity towers and two concrete firing bunkers are connected by wire to three downrange stations for complete communication with all operational stations for complete communication with all operationsl stations. The storage and assembly office is also in full telephonic contact with the range. This range extends to about 15 km, but the best impact area for recovery is at 11 km. In general, the soil is suitable for undamaged recovery, although much of the terrain is eroded and has some vegetation which may interfere with the location of impact points. Firing rate is lower than the mortar range, primarily because of the bulkiness of the larger caliber weapons and longer flight times.

4. APG (All Purpose Grid) Firing Range. For dynamic firing of artillery projectiles involving dissemination and sampling of the dispersed payload, the APG Firing Range (Figure I-17) is employed; the all purpose grid serves as the impact area and sampling grid. The range has surveyed gun positions for various firing distances. Maximum distance is 16,000 meters (including self-propelled guns. Survey, photographic and radar data acquisition can be provided, including smear photography, spatial coordinates for airburst, etc., projectile tracking, time of flight, velocity, height of trajectory, in addition to dissemination and source characterization and cloud data.

5. Hand Signal Range. The hand signal range consists of a metal firing bunker with a special vertical firing fixture in the center of the test grid, with two barricaded mirror position finders on the base line 600 feet apart from the center and three transit positions 1,000 feet from the center position 90° apart.

The mirror position finders consist of a piece of high grade plate glass mounted horizontally in a well constructed wooden frame. The glass is 5/16 inch thick, etched in centimeter squares over an area 60 by 60

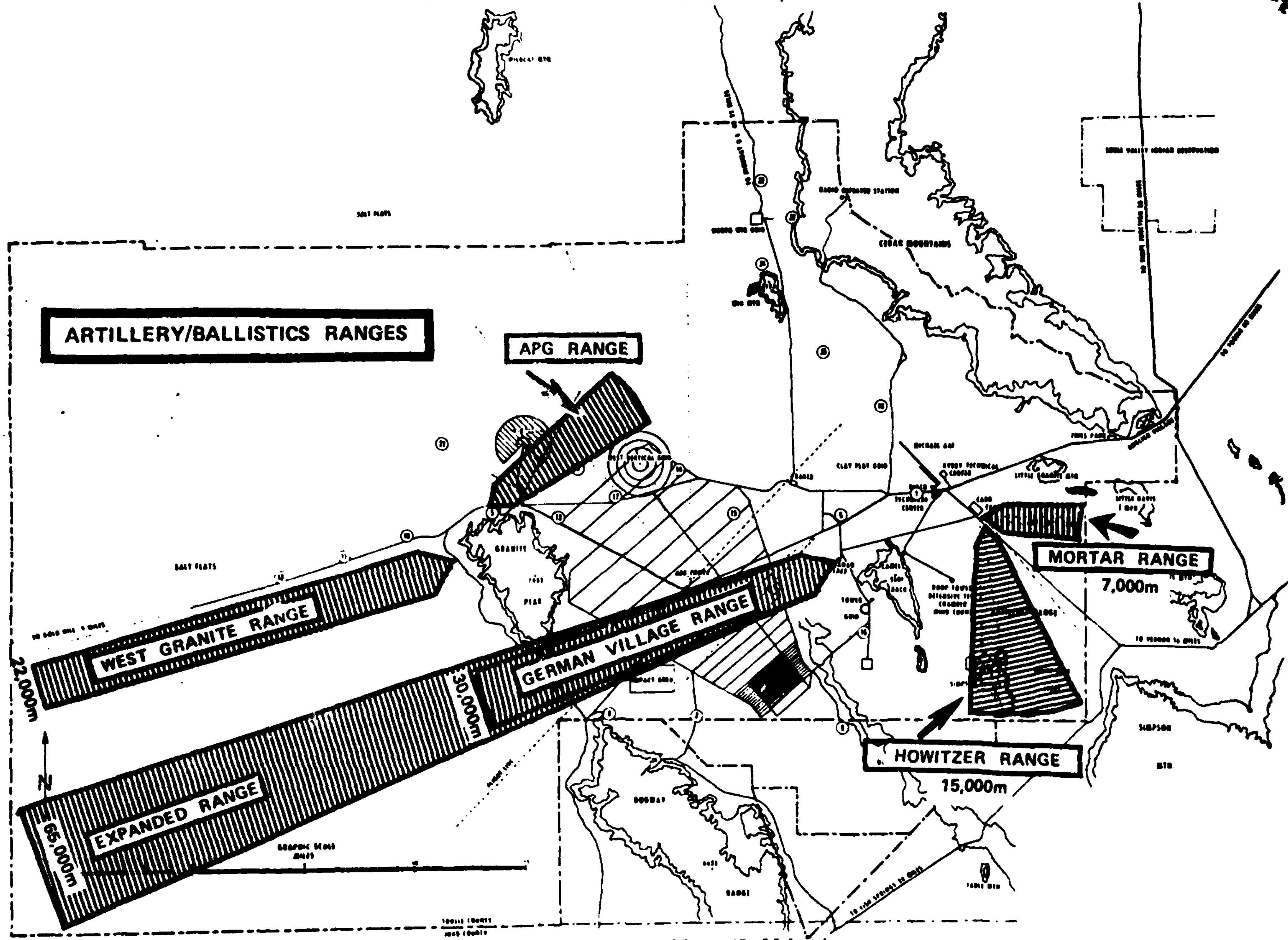


Figure I-15. Artillery/Ballistics ranges centimeters on the bottom surface. The entire bottom surface of the glass is silvered. The mirror is leveled in the horizontal plane, and by means of an alidade, the etched lines on the glass are made parrallel to the base line. Observations are made by sighting through a peepsight or aperture. The aperture stand is of special design, consisting of a heavy cast from base. Observations sighted through the aperture are plotted on the mirror at the point at which the functioning image occurs.

Two mirrors are used for determining the function altitudes and deviation from vertical of ground signals. The mirrors are placed at the ends of the base line, with one center grid line of each mirror being continuation of the base line. The aperture stand is placed at the zero grid line.

The transit positions are used to compute functioning altitude and deviation from vertical or erratic functioning signals that are off-scale on the mirror position finders.

(2) Easements. Remoteness from heavily populated areas provides for safety and security of technical and sensitive tests. The land are surrounding DPG is not suitable for commercial, industrial, or agricultural development; hence, the probability of encroachment is remote.

(3) Impact/Live Firing Areas. Impact areas are shown in Figure I-13.

b. Airspace. See Section 2-j.

4. INSTRUMENTATION. The DPG testing facility is equipped with a variety of instrumentation to support testing.

Separate areas are designated for designated for various activities. These are identified as follows:

- Avery Technical Center. Located in this area are extensive generator repair facilities and a large nickel-cadmium battery charging facility.

- Baker Laboratories. Biological defensive facilities, ecology and epidemiology laboratories, limited animal rearing and holding facilities, and decontamination buildings.

- Carr Facility. Munition firing range, munitions assembly, handling and storage facilities and environmental test equipment.

- Ditto Technical Center. Materiel test, docontamination, meteorological, photographic, calibration and instrumentation facilities, chemical laboratories, and operational administrative offices. Michael Army Airfield adjoins and comprises part of Ditto Technical Center. An emergency power plant serves these facilities during periods when commercial service is interrupted.

- English Village. Administrative activities including Post Headquarters, main post support facilities, community housing and attendant

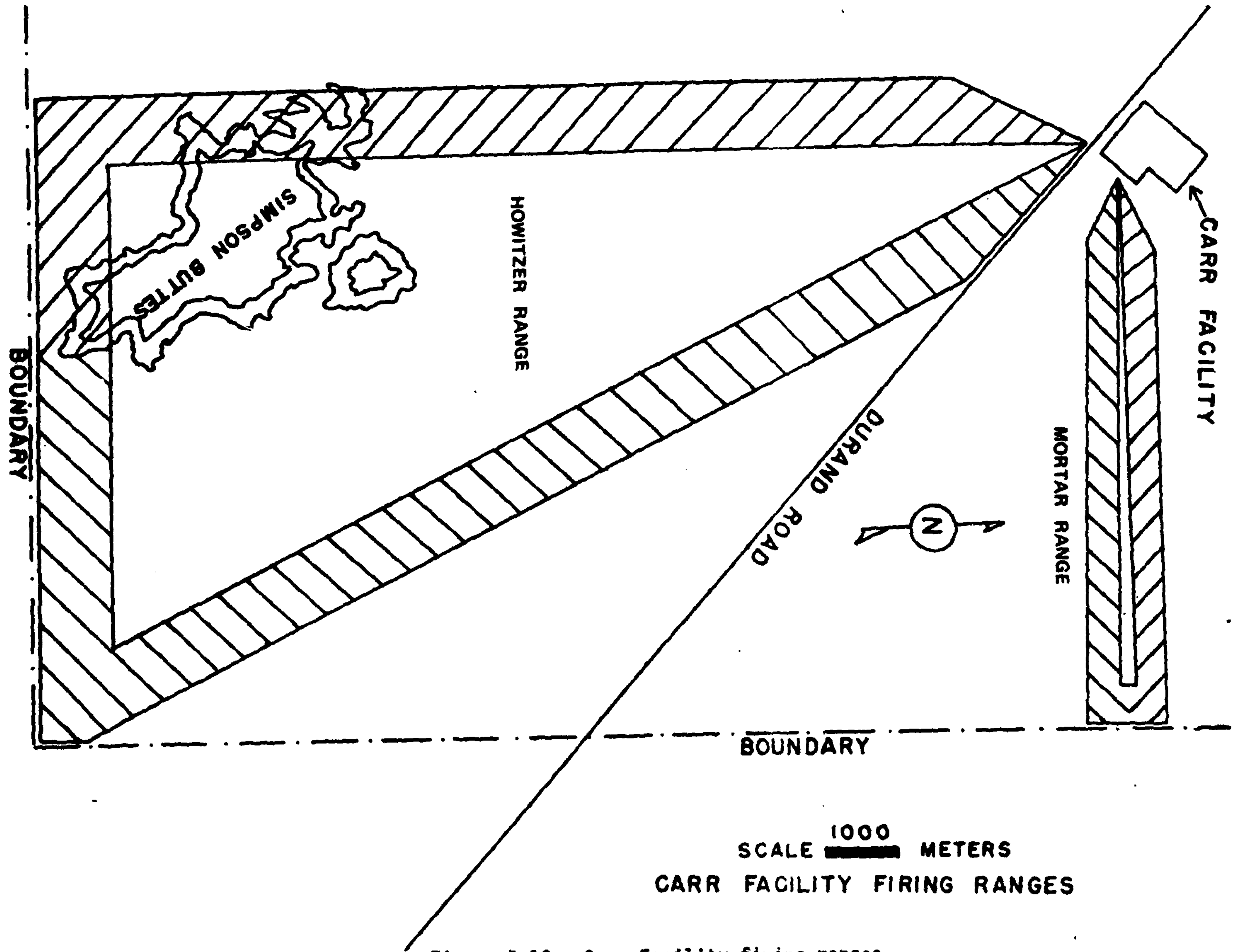


Figure I-16. Carr Facility firing ranges

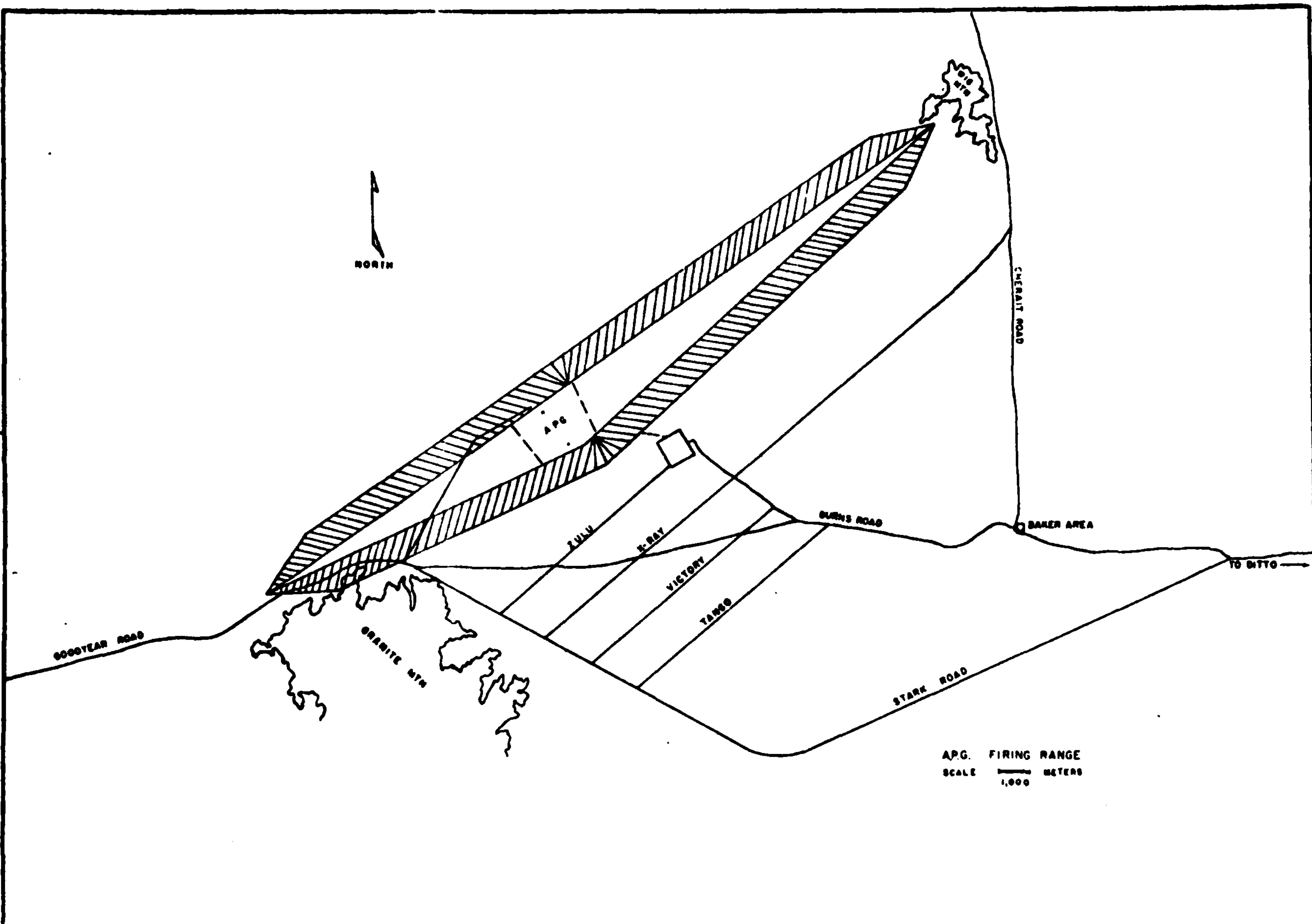


Figure I-17. All-purpose grid firing range

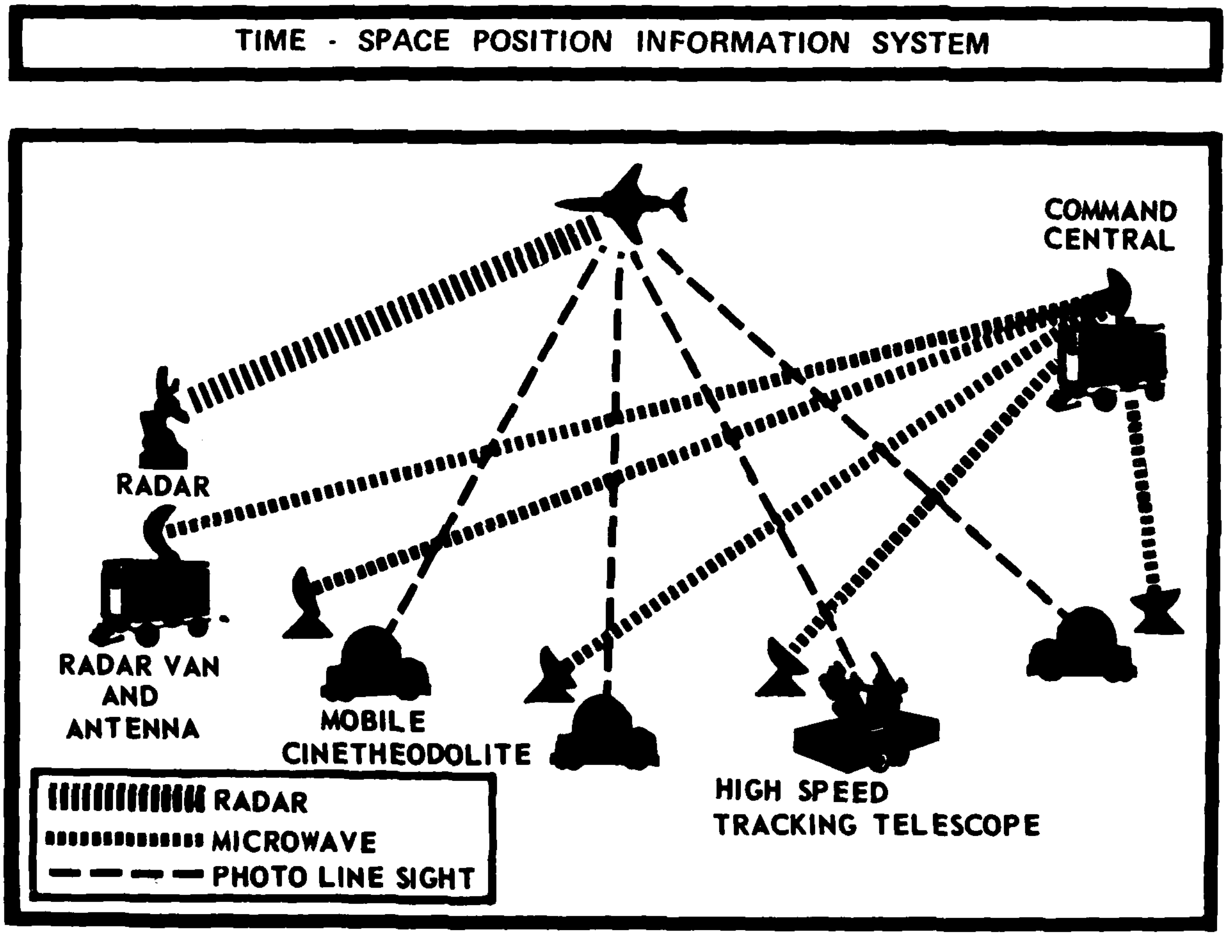


Figure I-18. Time-space-position information system activities. Included are the US Army Health Clinic, Technical Library, schools for grades one through twelve.

- Fries Park. Logistics supply activities.

A variety of field test areas, instrumented grids, and ancillary test sites and support facilities essential to the DPG mission execution exist in addition to the above facilities.

a. Space Positioning Velocity Vector

(1) Ground Elements

(a) Radars. The electronic tracking facilities at DPG comprise three units: the M33 Radar and the Nike-Hercules radar system. In addition, an MPQ35 Surveillance Radar is available for range control and range safety.

The Nike-hercules system is being refurbished. When it is fully operational, it will provide plotting information at the radar site. The system uses pulsed radar capable of ranging to 75 kilometers and may be used for tracking ballistics and high-speed aerial targets. The tracking data are displayed on a 30-inch plotter in X vs Y and Y vs Z axis. The ultimate goal for the system is to digitize the azimuth and elevation system to provide 0.25 mil accuracy with a maximum range of 150 kilometers.

Physical Description	Technical Capability
M33 Auto Track Radar, self-contained radar that provides plot and time information at the site.	The antenna position is read into an analog translator that drives a 30-inch plotter in X vs Y and X vs Z axis. Time plotted using an IRIG H signal in the pen lift circuit to blank the trace momentarily, each second. Unit can track over a 20-kilometer range with accuracies down to 50 feet.

(b) Laser. None

(c) Optical

1. High Speed and Ballistic Cameras. See paragraph 4.d

2. Tracking Mounts. See paragraph 4.d

(2) Airborne Elements. None

b. Timing. The integrated range timing system consists of the master station, transmission system, receivers and synchronized time-code generators. The system has the capability of generating inter-range instrumentation group (IRIG) timing formats A, B, E, and H with a drift of less than 5 microseconds per day. Such accuracy is essential for determining time-events. IRIG B format is generated by the master station and the 40.2 MHz transmitter. Range time is broadcast on 40.2 MHz to the total range area. This simplex network is used to provide time information to all field instrument systems using time for data purposes. Where other formats are required, a synchronized time-code generator is synchronized to the received IRIG B and regenerates the other formats. The DPG time system is used by the entire range complex. The master generator is checked with WWV signals daily and is equipped for synchronization with LORAN broadcasts.

c. Television. DPG has two video systems used for field tests.

(1) Tracking Mount TV. Two tracking mounts are equipped with video recording systems. The video cameras use the same lenses available for conventional film cameras. A monitor and video recorder are installed on each tracking mount. The system is used primarily on artillery trials where the play back capability is very useful in providing "quick-look" information before proceeding with the next trial.

(2) Remote Observation System. Two television systems are available for viewing hazardous operations such as vibration testing or cook-off testing of artillery rounds. Each system has a remotely controlled video camera, cable, monitor, and control panel. The control panel can remotely control pan, tilt, focus, zoom and iris.

d. Photography. Nearly all tests executed by DPG require photographic instruments or documentary coverage. The photographic laboratory in Ditto Technical Center is equipped and staffed to support the technical test program and other photographic needs of DPG. It has over 10,000 square feet of floor space, 30 interior rooms used as darkrooms, processing room, film reading rooms, for other technical functions, and for administrative functions. Separate facilities exist for storage of large equipment for field equipment maintenance. The photographic laboratory has specialized capabilities in spatial coordinate determination, velocity, and trajectories studies, high-speed photographic analysis, aerial photography, microphotography, attitude and event measurements, pictorial records, and commentation movies. Normal and routine Post and Command administrative photographic needs are also satisfied. A complete in-house capability exists for the attendant processing, editing, analyzing, data reduction, duplication, printing, and other essential photographic services. The technical capabilities of individual photo instruments in use at DPG and typical systems applications are presented in Table I-2. The extent of any combination of photo instrument support from the list is limited only by personnel resources (i.e., the same personnel are employed in the setup of instruments, operation of equipment during tests, assembly of film and data records, film processing, and data interpretation). Time of data delivery indicated is based upon having enough personnel available to permit normal procedures. Thus, during high workload periods, the time required for data delivery would become greater than that indicated. An inventory of $3,000,000 of photographic and support equipment is available for use. The preponderance of that amount is invested in optical instrument systems used to provide data. Features of the principal systems are as follows:

(1) Tracking Mounts. Two high-speed tracking mounts are used to obtain engineering surveillance motion-picture footage of test items. These mounts are equipped with very long focal-length lenses and can support a variety of camera recording systems. They provide very detailed records of test items operating at high speeds at long slant ranges. These mounts have

been used to obtain tracking records of artillery shells in flight, from near the muzzle to impact, and have revealed details of projectile flight that have never been recorded. This has been of great value in analyzing flight malfunctions.

(2) High-Speed and Ballistic Cameras. A variety of specialized cameras are used to obtain data and information on field operations. Camera systems using film from 16mm to 70mm are capable of providing detailed records of specific areas of interest. Each camera system has its own lens set and control unit and has the capability of accepting range timing signals for synchronization. Synchrono-ballistic cameras whose speed can be matched to the flight of a projectile provide observational photographs of projectiles in flight with sufficient detail to show failures of small metal parts. A family of ballistic cameras provide flexibility of operating as plate cameras or pulse-operated sequential cameras to provide specific data on range impact areas.

(3) Film Reading and Data Reduction. Semiautomatic film readers are used to convert data from camera film into computer acceptable format. Data points are transferred to punch cards, then transmitted to the computer center for computation and conversion to customer-requested format. Other readers are used to read coordinates from ballistic plates, analyze high-speed motion picture records and meet the data-reduction requirements of the optical instruments operation.

(4) Laboratory and Pictorial System. A still photograph, motion picture photographs, graphic arts and laboratory system supports the technical mission and installation support program.

(5) Still Photography. A capability exists to provide still photographs in a variety of film sizes, in black and white and color. The test program is routinely documented to provide input for final reports and for information and historical use.

(6) Motion Picture Photography. A capability exists for the production of documentary motion pictures. A contract is used for producer's services which cannot be accomplished in-house. In a normal situation, about 90% of the total production effort can be accomplished in-house, although regulatory restrictions may reduce this percentage. Documentary motion pictures are not made on all test programs, because of the high costs, but restricted to those specifically requested by the customer or possessing a unique reporting requirement.

(7) Still Laboratory. The still laboratory is largely automated, with machine processing used in both black and white and color processing. The laboratory can complete in-house black and white and color assignments in processing and printing. The automated print-processing machines provide high-volume output as required.

(8) Processing Motion-Picture Film. Facilities exist for processing 16mm and 35mm motion picture film in black and white and color. Processing of color emulsions is limited to those used on instrumentation films. The ability to process instrumentation film provides quick-look data on important field projects and permits film reading and data reduction with

Table I-2. Photo Instrumentation

Tracking Mounts (Photo-Sonics Cine Sextant) 2 units	Dependent on cameras used see separate listings below	Engineering Surveillance tracking of a wide variety of airborne items for time and functioning information.	N/A	N/A	N/A	See camera listings below	See camera listings below	24, 48 100 and 200 in.	Highly Mobile may be used throughout the test range as required
Non-Track 70mm Pin-Registered Cameras (Photo-Sonics 10A) 6 units	10, 15, 30, 45, 60 pps	Various trajectory segments of small missiles. Terminal portion of artillery projectiles and aircraft delivered ordnance.	.5 to 5	1 to 5	5	+ 50	5 days or less	4, 6, 10, 14 and 20 in	Require previously prepared operations site for Precision Single Axis Mount (PSAM) or concret-pedestal with camera orientation targets. May be utilized on tracking mounts.
Non-Track 35mm Pin-Registered Cameras (Photo-Sonics 4E) 3 units	27 to 360	Same as above (Nontrack 70mm)	.5 to 5	1 to 5	5	± 10	5 days or less	4, 6, 10 14, and 20 in.	Same as above. (Non-Track 70mm). These are the primary cameras for the tracking mounts

Table I-2. Photo Instrumentation (Continued)

SYSTEM	SAMPLE RATES	SYSTEM APPLICATIONS	SYSTEM POSITION (m)	DATA VELOCITY (m/sec)	ACCURACY ACCELERATION (m/sec^2)	EVENT TIMING (msec)	DATA DELIVERY	FOCAL LENGTH	REMARKS
Non-Track 35mm Rotating Prism Cameras (Photo-Sonics 4B) 6 units	100 to 2000 fps	Same as above. (Non-Track 70mm)	.5 to 5	1 to 5	5	Up to $\pm$1 dependent on sample rate used	5 days or or less	4, 6, 10, 14 & 20 in	Same as above. (Non Track 70mm). These cameras are used extensively in ballistic synchro or smear photography.
16mm Pin-Registered Cameras (Miliken DMB-5) 8 units (Mitchell 16) 4 units	24 to 200 fps 24 to 128 fps	Providing high resolution photographic records of munition performance for engineering study and timing information	N/A	N/A	N/A	$\pm$ 10	5 days or less	Up to 15 in.	These cameras are used extensively on the tracking mounts
16mm Rotating Prism (Photo-Sonics 1C) 2 units Hycam, 2 models) 10 units	1000 to 4000 fps 100 to 11,000 fps	Same as 16mm Pin-Registered cameras above	N/A	N/A	N/A	$\pm$ 1	5 days or less	Up to 15 in.	
Ballistic Cameras 6 (still) units	Up to 20 per sec (or dependent on onboard Beacon flash rate)	Trajectory and event point of items that are self luminous or carrying a flashing beacon	.5 to 2			N/A	20 days	12 in.	Restricted to night use other than special application Requiring PSAM or concret-pedestal mount with camera orientation targets

a minimum of delay.

(9) Graphic Arts. A complete graphic arts facility supports orientation, command briefings and training programs by providing completed slides and viewgraphs from conceptual drawings to final graphics. Typesetting and lettering equipment, special cameras and processing units support this operation. The field printing plant is also supported by the production of half-tone negatives, line negatives andlayout services.

e. Calibration. The calibration laboratory provides calibration services for most of the instrumentation inventory. A continuing program upgrades the capabilities to keep pace with procurement of new instrumentation to the extent that available funding allows. Facilities are available to calibrate the following: Voltage and Current (AC/DC); Resistance, Capacitance & Inductance; Frequency and Spectrum Analyzers; Distortion; Sound, Shock and Vibration; Pressure and Vacuum; Torque; Mass; Flow; Temperature; Dew Point and Air Velocity.

f. Other General Instrumentation.

(1) Telemetry. Telemetry systems, as described in Section 4.f(2), and Section 4.g(1), and 4.g(2) comprise the main automated data link at DPG. These and the 4-channel link, are related between stations through a relay station high on the Cedar Mountains. Also, there are mobile radar vans in case an area not reached by Cedar Mountain Station is needed for a test, such as the West Granite Range. Transmitter-relay-receiver systems are specific to the equipment for which they are used; spare channels are available and could be used for other purposes with little effort.

(2) Meteorological Systems. DPG has extensive portable and mobile meteorological systems. The automated data-acquisition system (ADAS) and the miniature data-acquisition system (MINIDAS), can be transported by air and used to gather micro- and mesoscale meteorological data at any location.

(a) Meteorological Test Grid. The meteorological test grid consists of eight mobile, remote stations, which gather data from over 200 meteorological sensors from up to eight wired grid arrays. These operate in conjunction with (and under the control of) a central data processing system. The remote stattions contain the electronics for assembling and translating the meteorological data for transmission, via RF link, to the central data-processing station. The central station queries each remote station in a programmed schedule and subsequently validates, processes and stores the signals received.

The purpose is to collect, process, and anlyze meteorological data during tests at DPG. Meteorological conditions considered include:

Wind Speeds
Wind Direction
Air Temperature
Temperature difference by height
Dew Points
Radiation factors

Other meteorological conditions can be calculated by combining time correlated measurements of the above named conditions, sensed at various locations in azimuth and altitude. Among these calculated conditions are:

Average wind speeds
Average wind directions
Vertical temperature gradients
Standard deviations of vertical and horizontal wind direction
Averages of net rediation

The primary and calculated values defining the various meteorological conditions are used to provide data regarding:

Range safety
Prediction for optimum placement of instruments
Pretest predictions for conformance to prescribed meteorological conditions
Real-time estimates of agent or simulant cloud position for correct sampler activation time
Real-time calculation of standard deviation
Post-test analysis for correlation of dosage and concentration during tests, and relating growth of plumes to turbulent energy spectra

After the data have been collected, they are stored in raw and condensed form for later analysis. A central computer makes it possible to program data collection in a sequence that lends itself to the test problem and assembles and evaluated those data for immediate use.

The meteorological testt grid comprises the following subsystems:

1. Remote Station. The remote station operates under command of the central computer through an RF link. It is a self-contained unit incorporating the necessary logic and other electronic equipment to format and transmit a meaningful data message in response to specific interrogation from the central station. Power is supplied by a field generator or commercial power, if available.

Each remote station has the following capability:
Analog-to-digital conversion of up to 128 high level (-3 to +3V) analog signals with central computer control over selection of signal sources
Analog-to-digital conversion of up to 32 low-level (-1 to +1MV) analog signals with central computer control over selection of signal sources
Digital-to-analog conversion with storage of a single analog
Control of up to 128 latching power relays
Digital response to the condition (closed or open) of up to 265 contact circuits
Central computer control of 11-decimal character remote console
Remote station engine starting by RF transmitted audio tone

Except for engine starting, the remote station performs these functions on command only, gathering either replies containing the requested analog-to-digital conversion or a repetition of the command received for verification by the computer. A manually triggered phase modulated audio frequency is used for starting the generator.

2. Central Control Station. The central control station consists of the following equipment:

A general-purpose digital computer with 16,384 words of 32-bit core memory
A VHF link controller and transceiver
Two digital magnetic tape transports (primarily for raw data storage and readback)
An on-line 300-lpm printer for hard-copy outputs of results of calculations
A go/no-go status display panel for 71 red and green status indicators
A 40-point trend chart recording system, computerr controlled, for selectable analog display of pertinent variables
A 12 vector display and wind direction (10 degree increments) and wind speed (numeric digital display)
A systems operation console with control panels, digital readouts, field station startup controls, communications controls, and high speed papertape and output equipment

3. Data Assessor. The FSG-1A Data Assessor is a medium size, stored program, general purpose, single address digital computer, modified for use as the programmable central controller in the DPG meteorological data acquisition and analysis system. The FSG-1A is designed to handle data transmission and to perform instructinal operrations simultaneously; it permits parallel programming to achieve maximum processing speed. The solid-state machine employs core memory and performs data acquisition in the solving of scientific problems. The main characteristics are as follows:

Word Length: 32 bits
Memory: 16,384 words
Operation: parallel mode
Cycle Time: 6.4 microseconds
Console: includes paper tape reader, paper tape punch, electronic matrix printer, electric typewriter, register contents display
Registers: four effectives
Flexible Instructions: fixed point arithemetic, logical, data transmission and control, 32-bit or 16-bit arithmetic
Binary Arithmetic: sign-magnitude representing multiple modes of operating the data
Address: single address logic capable of addressing 16,384 words
The software consists of three subsystems:
Operational control system
Data-reductions control system
Utility system

(b) Automated Data Acquisition System (ADAS). Two systems are at DPG, a data central collection terminal which can be housed in an air-transportable mobile van. The other ADAS is in building 4126. Each system can control up to 12 high-data rate remote stations. Data are telemeter ed from the remote stations via simplex RF links to the central terminal. Each remote station can handle up to 63 sensors.

These systems can accommodate 12 high-data rate remote stations having a maximum of 63 individual sensors per station, 24 of which can be sampled 10 times per second and the remaining 39 once per second. One of the data central terminals can be housed in an air transportable mobile van. Data are telemetered from the remote station via simplex RF links to the central terminal. Each remote station has a separate received in central for the receipt of digitized sensor data. The data are demodulated, assembled and placed into the control computer memory. With 8k work memory, limited data processing occurs to facilitate test control via 12 strip chart displays or a typewriter printout. A seven-track magnetic tape records data for permanent retention as well as limited programming input and output. (NOTE: One of the data central collection terminals had been removed from a mobile van and placed in the data-acquisition room to provide backup for the meteorological test grid. This transfer was made to increase total system reliability.)

The capability of the ADAS to support large-scale, large area testing allows it to do the similar function at any remote test location, that the meteorological test grid system does for DPG. However, the ADAS, in satisfying the requirement for complete mobility, dictates certain compromises in real-time compitational and display capabilities.

(c) Mesometeorological Network System (MESONET). MESONET comprises eight fixed stations at selected locations for mesoscale meteorological input of area coverage other than at the grid sites. The MESONET is a definitive data-recording system used for acquisition of mesoscale data for test conduct, test control, and climatology. It is a digital telemetry meteorological network, having the capability of measuring meteorological parameters for up to 5 data channels.

The data are transmitted to a central network by land lines. Data received and transmitted include temperature, precipitaion, wind direction, and windspeed. The fifth data channel is open. Data are recorded at the centaral network on both typewriter output and tape for computer processing. Data can be received on a slow (but continuous) daily rate or at fixed intervals up to one hour. The system is operated 24 hours per day, 7 days per week. This system differs from the ADAS and test grid systems in that it characterizes mesoscale circulations and is not capable of characterizing the atmosphere in the very fine or mesoscale.

(d) Miniature Data Acquisition Systems (MINIDAS). DPG has three MINIDAS which are small field systems that receive analog from sensors, perform sequential digital conversion and record these data on magnetic tape. They are capable of accepting 100 tow-wire input channels which have variable analog input voltages from 0 to +140 volts or 0 to 6 volts. The system will automatically scan 100 channels per second and convert to a digital form on a standard 7-channel incremental model NRZI IBM compatible tape recorder, which is capable of recording with a packing density of 200 bits per inch, and records 300 characters per second. The system is controlled by a digital clock, which maintains its time base through a crystal oscillator or line frequency. The system is capable of data playback, which allosw for reproduction of the recorded dat on an esterline-Angus recorder (0-1mA) and a digital voltmeter. Recorder output is also available for the selected input channel. Any input channel may be selected by tow rotary switches for monitoring by a digital coltmeter. Dual recorder operations can be accommodated for control if required.

The MINIDAS is engineered to provide trouble-free service in extreme field environments. Most electronic elements are solid state and mounted on plug-in printed circuit boards for easy replacement. The system is capable of normal operation from a primary power source of 115 VAC $\pm$ 10 percent, 16Hz $\pm$ 10 percent, single phase. The system is capable of normal operation at temperatures of 20°C to +40°C and is capable of withstanding temperatures -50° to +75° when not in operation without damage to the system.

(e) Weather Station. Weather forcasting services are provided by an Atmospheric Sciences Laboratory (ASL) team, which serves as an important element for the test program. Also, qualified ASL observers take hourly observations. Facilities associated with this service include the National Weather Service Facsimile Network, which provides extensive information and analysis related to forecasting problems related to testing. The information available includes upper-air charts, computerized prognostic charrts, vorticity analysis, and prognostic charts. Teletype citcuits (services A and C) also provide meteorological data.

(f) RAWINSONDE. DPG has a fixed and mobile rawinsonde system that provides upper-air measurements. Observations are taken by tracking a balloon borne radio-sonde which senses and transmits pressure, temperature, and humidity data. Wind information is obtained by calculating the space change of position projected on a flat plane. Raw data are processed by a computer to furnish foruteen observed or derived atmospheric parameter in 100 or 1,000 foot intervals from the surface to maximum balloon altitude. These data are used to satisfy external ballistic or aerodynamic requirements.

(g) Data Processing. ADP facilities provide for the preparation of climatological studies, statistical and mathematical evaluation, and analyses of test data and comparison of theoretical concepts and models with empirical equations developed from test data. Printed or punched results are produced for further evaluation, analysis and mechanized processing. The meteorological test-grid network provides real-time data acquisition, computation, display and recording of data during testing. Mathematical models for computing dosage during tests and real-time computation of cloud travel are provided during tests for range safety and test control. Recorded data are utilized for test analyses and meteorological research. The combined DPG meteorological data systems (in terms of the total number of meteorological sensors), area covered by sensor networks, and the total data-acquisition and processing capabilities form the largest system for the support of field tests in the United States.

(3) Survey. A US Coast and Geodetic First-Order Survey has located fixed lines and points about the DPG test grid area. When special test missions require additional field site location for instrumentation, these necessary sites are located by survey.

(4) RFI/Electromagnetic Compatibility. None.

(5) Visibility (Light Level Measurements). Dugway has a capability for instrumentation of visibility related to meteorology, photography, and smoke obscuration disciplines. Instrumentation includes: (1) Pyronometers covering all of the visible and into the neazr infrared spectrum, (2) Photo instrumentation includes wide angle (fish eye) sky cameras, video recording systems and light meters, (3) Smoke/obscuration related instrumentation comprises telephotometers, telespectral-radiometers and various radiometers.

(6) Sound Measurement and Analysis. A sourd meter is available for measuring noise levels in working areas.

(7) Safety and Security. The DPG Safety Office utilized the following instruments to ensure that safety criteria are being met.

Show Condivity Test
Ultra-violet Meter
Electromagnetic Leakage Monitor
Carbon Monoxide Detector
Microwave Survey Meter
Combustible Gas Indicator
Radiac Set (Radioactive Measurements)
Sound Meter
Light Meter

(8) Soil Conditions. None.

9. Special Purpose Instrumentation

(1) Mobile Data Acquisition System (MODAS). The MODAS is configured around amodified EMR 7071 PCM Data Formatting System. The system features a basic computer programmable PCM front end and is equipped with the hardware and software necessary to process a serial PCM input stream and decomputate the raw data from selected channels for display on analog devices. The system is capable of formatting any standard IRIG PCM code onto a digital tape that may subsequently be processed on a larger computer system. The main frame components of the system are controlled by a minicomputer and consist of the following equipment:

Computer PDP 11/35
Bit Synchronizer
Decom Unit
Word Selector Unit
Digital Tape Transport
Time Code Generator
High Speed Paper Tape Reader/Punch
CRT input/output Device
Line Printer

Disc Pack
Graphics with hard copy capability

The front end has a data handling rate that is program tunable from 1 bps to 5 mbps. The maximum data thruput rate from the computer to the digital tape unit is 100K word per second with an average thruput rate of 75K word per second. The thruput rate is limited by the digital tape units recording ability.

DPG has the capability of generating, recording, formatting and processing PCM data with the following existing equipment: (1) Analog Recorder, Mdl 4040, 14 channel, (2) Analog Recorder, Mdl 3700B, 14 channel. Encording Equipment Encoder, Model 704, 6 to 12 Bit Word, Prom Programmable

Input Levels	Low level: Max of 72 channels at the following levels 0-mv ($\pm$2.5mv), 0-10mv ($\pm$5mv). 0-20mv ($\pm$10mv), 0-40 ($\pm$20mv)
Data Rates	Prom programmable with a max rate of 256 kbps
Output Level	0-5V PCM serial data
Output Codes	Hard wire changeable to NRZ-L, NRZ-M NRZ-S, BiO-S, BiO-L, BiO-M, RZ
Environmental specification	Type 704 units will operate through the range of from -20^{o}C to $\pm$85^{o}C
	Encoder, Model 704, 6 to 12 Bit Word, Prom Programmable
Input Levels	Low Level: Max of 48 channels at the following levels, 0-5mv ($\pm$2.5mv), 0-20mv ($\pm$10mv), 0-40mv ($\pm$20mv) High Level Differential: Max of 48 channels at the following levels 0-250mv ($\pm$125mv), 0-500mv ($\pm$250mv), 0-2V ($\pm$1V) High Level: Max of 48 channels with input range of 0.5 ($\pm$2.5V) Discrete Data: Max of 10 words of bilevel discrete data
Data Rate	Programmable with a maximum rate of 256 kbps
Output Level	0-5V PCM serial data
Outputy Codes	Hard wire changeable to NRZ-L, NRZ-M, NRZ-S, BiO-L BiO-M, BiO-S, RZ
Environmental	Type DS 704 unit will operate through the range of from -20^{o}C to +85^{o}C

Synchronizing Equipment: DPG has presently on hand a PAM/PDM synchronizer that converts a PAM PDM signal to a serial PCM bit stream.

(2) Ballistic Data. Dugway has been involved in extensive artillery, rocket and mortar testing throughout its history. Instrumentation is available velocities, pressures, trajectories, impact, functioning, rate of descent a telemetry system (paragraph 4.f(1)) is available to receive and record selected parameters from instrumented rounds.

(a) Radar Tracking. Three radars are used for artillery tracking: the M33 auto track radar, the Nike-Hercules radar and the Hawk doppler velocimeter. The M33 currently provides most of the artillery tracking but will be phased out when the Nike Hercules is fully furbished. Both of these radars are fully described in paragraph 4a(1)(a). The Hawk radar is on extended loan to Dugway.

(b) Photographic Instrumentation. Four high speed tracking mounts are used to obtain engineering surveillance motion-picture footage of test itesm. Syncroballistic cameras whose speed ccan be matched to the flight of a projectile provide detailed photographs which cam show failure of small metal parts. A family of ballistic cameras provide smear capability or pulse operated sequential photographs of trajectories and range impact areas (paragraph 4d(3)).

(c) Velocity Instrumentation. Velocities of artillery and mortar rounds are measured by radar chronograph system. DPG currently has 3 units on hand, 1 scheduled for delivery in July 1981 and 2 additional units scheduled for delivery in late 1981.

(d) Function Position Instrumentation. Mirror position finders and transits are used to determine functioning positions of munitions such as hand signals and illuminating flares. These are described in paragraph 3a(1)(b).

(3) Chambers

(a) Environmental Chambers (Carr Facility). These chambers range from 3' x 6' to 20 x 25' x 21' in size and can be equipped to provide for operation of equipment in the environment with instruments for operating parameters. Vehicle access is limited by 7-foot wide doors. Combined environmental tests can be conducted, using programmable controllers, which are provided for many of the chambers. There is a total of 22 of these chambers, as seen in Table 1-3, excluding those listed below (Defensive Test Chamber, Building 3008, BIOTRON Chamber) and aerosol and environmental chambers in the laboratories.

(b) Defensive Test Chamber. As a result of national policy on open-air chemical-biological testing, procedures were required to evaluate CB defensive materiel under conditions that precluded release of afents into the environment.* In response, DPG constructed a defensive test chamber. The chamber provides the capability for challenging vehicles and other defensive items with chemicll and biological agents in various simulated environments. The interior of the chamber provides a working space 30 feet wide by 50 feet long by 20 feet high, which can be environmentally controlled. Equipment access is gained through a large exterior door, 25.5 feet wide and 17.5 feet high. (Figure 1-19)

The chamber is airtight and operates at a slightly negative pressure. A scrubber system allows removal of the majority of agent before internal air is finally exhausted through particulate and gas filters. Tests have been conducted to check out test and safety procedures, and the chamber has been certified safe. Toxic chemical and biological agent challenge tests have been conducted safely and successfully. During the last year, the exhaust filter system was reconfigured with redundant filters, sampling ports and a filter bypass capability. The mechanical systems were modified to assure agent containment. Interlocks on the air supply and exhaust valves were provided to assure proper sequencing and maintenance of differential pressures during various operational modes and test phases. Improved communication and sampling systems were installed for improved test control and conduct. The data-acquisition and chamber-control systems were updated to meet new test cirteria. These modifications of the chamber have provided DoD with an operational and unique facility for CB agent challenge testing without agent release. All support, control and ancillary equipment and instruments are contained within the common structure contiguous to the chamber. The interior of the test chamber, principally of stainless steel, is designed to eliminate materiel entrapment, thereby facilitating decontamination. There are numerous accesses for instruments, power vacuum, compressed air, water, docontamination solutions, andother support. Personnel view the chamber interior through an observation window. (Voice communications systems are present within the chamber, control room, agent room and equipment rooms).

Data recording and chamber control are accomplished by a digital computer-controller, allowing preprograming with operator override for specific test requirements and situations.

Technical Capabilities:

Temperature: -25^{o}F to $+125^{o}$F

Relative Humidity: 45% to 90% over a temperature range of $+40^{o}$F to $+125^{o}$F; 10% RH over a $+95^{o}$F to 125^{o}F temperature range

Rain: 1 inch to 12 inches per hour over a floor area of 20 feet by 25 feet

Solar Radiation: 364 BTU per square foot per hour, which is equivalent to 110 watts per square foot. This meets the military standard for sunshine tests

Air Circulation: Velocities of 150 to 450 feet per minute

(c) Building 3008. This building is constructed with tow identical operational work spaces 35 feet wide by 60 feet long for total containment of toxic agents. The building is designed to be operated at a negative

*It should be emphasized that release of chemical agents into the open air is not prohibited, although it is subject to certain constraints. However, the release of pathogenic biological aerosols, but not simulants is prohibited.

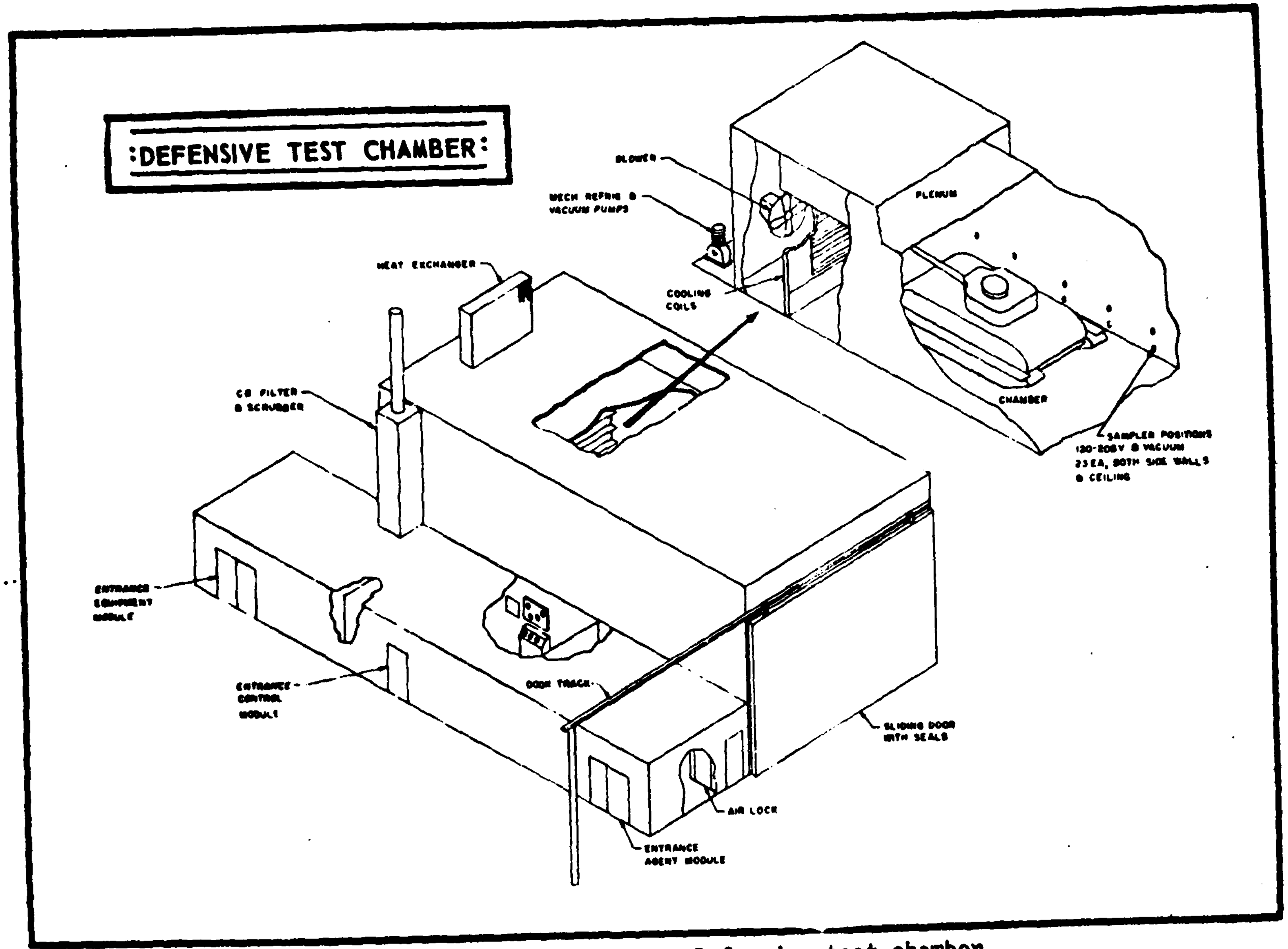


Figure I-19. Defensive test chamber

Table I-3. Description and Capabilities of Chambers

Physical Description	Technical Capability	Interior Cubage	Load Capacity
A. Desert Chamber (1)	Ambient to 185°F; size 21' X 21' X 13'	6' 6" W X 9' H X 19' Long X 2	Unlimited
B. Arctic Chamber (1)	Ambient to -85°F; size 18' X 12' X 13'	7'-8" W X 9' H X 16' Long	Unlimited
C. Tropic Chamber (1)	Ambient to +120°F RH from 10% to 100%	6'-6" W X 9' H X 19' Long X 2	Unlimited
D. Portable Cold Chamber (3)	Ambient to -85°F; size 4' X 4' X 8'	3' X 3' X 7'	1 Ton
E. Portable Hot Chamber (6)	Ambient to +240°F; size 4' X 4' X 8'	3' X 3' X 7'	1 Ton
F. Mobile Hot Chamber (1)	Ambient to +200°F; size 8' X 8' X 12'	7' X 7' X 11'	10 Ton
G. Mobile Chambers (2)	-65°F to +200°F; size 8' X 8' X 12'	7' X 7' X 11'	10 Ton
H. Sand & Dust Chamber (1)	Size 8' X 8' X 25'	6' X 6' X 20'	10 Ton
I. Salt Spray Chamber (1)	Size 8' X 8' X 25'	6' X 6' X 20'	10 Ton
J. Fungus Chamber (1)	Size 8' X 8' X 25'	6' X 6' X 20'	10 Ton
(1)	Size 6'8" X 4'10" X 7'	3' X 3' X 3'	100 pounds
K. Altitude Chamber (1)	-100°F to +350°F; 4,300' to 10,000' RH control over range of 10% to 95%, size 6' X 7' X 6'	5' X 6' X 5'	5 Ton
L. Rain Chamber (1)	Recirculating--any rate attainable by nozzle change; Rain temperature controlled but no blown rain; door size 3.5' X 8'	7' X 12' X 8.5'	1 Ton
M. Hot-Cold-RH Chamber (1)	Temperature -80°F to +200°F ±2° in 4 hours; 3' X 8' side door	3' X 3' X8'	1 Ton

pressure relative to the atmosphere. The agent room air supply and exhaust system provides continuous absolute particulate and has filtering. (Figure I-20)

The design of the building permits equipment access through a large exterior door, 12 feet by 15 feet. Personnel can enter the agent chamberrs via a personnel interlock and airlock room, which operates at a negative pressure relative to atmosphere. ; This enables personnel to wxit from the agent room through the airlock room to the shower and dressing area. There is an observation room so designed that both main agent rooms can be monitored simultaneously. Voice communications are present within the chambers, observation rooms, and the control area.

These chambers have been used extensively in toxic agent challenges of collective protectors; for stockpile reliability tests of smaller protective items invilving agents in quantities larger than could be safely processed in laboratories, or reliably removed from vented air by laboratory building exhaust system; for agent transfer, sampling, mixing and detoxification in quantities up to ton containers. The facility finds particular use in cases where environmental controls available in the Defensive Test Chamber ar unneccessary. For demilitarization procedukres in Building 3008, several modifications are planned, entailing an emergency electrical power source, monitoring and alarm system, air systems including filters, heat, cooling, pressure, air changes and distribution.

(d) Biotron Chamber. The Biotron Chamber was originally disigned to supply aerosols for challenge of biological aerosol detectors and high volume samplers. The chamber simulated field trials and provided aerosols comparable to those expected a mile or so downwind from a functioning field munition. The concentration and paticle size are controlled at ambient temperatures for the determination of the threshold detection levels of the biological alarm detectors and samplers.

The Biotron Chamber is presently being renovated and updated to accommodate four (4) pairs of alarm detectors and samplers. The original chamber will be enlarged, and the instrumentation for monitoring and control are being updated (Figure I-21).

The basic components of the system include: (1) main aerosol delivery tunnel with high efficiency filters at the inlet and outlet, (2) crossducting used to dilute the spray suspension from field strength to the required concentration, (3) flow straighteners and turbulence grids, (4) sample tube inlet bundle, (5) Class III hood for housing the detectors and samplers, (6) exhaust ducts and vacuum system, (7) incinerator, (8) instrumentation for determinign temperature, humidity, velocity pressure and the size, number and distrubution of particles, (9) and a computer interface for data recording storage and analysis.

The basic operational concepts for the system is the generation of a concentrated aerosol and its dilution in the crossducts and main tunnel to the required challenge concentration. The air for dilution is drawn from the room through high efficiency filters into crossducts and main tunnel. The aerosol suspensionis diluted in the crossduct and a small amount of is is discharged into the main tunnel where it is diluted further. The air

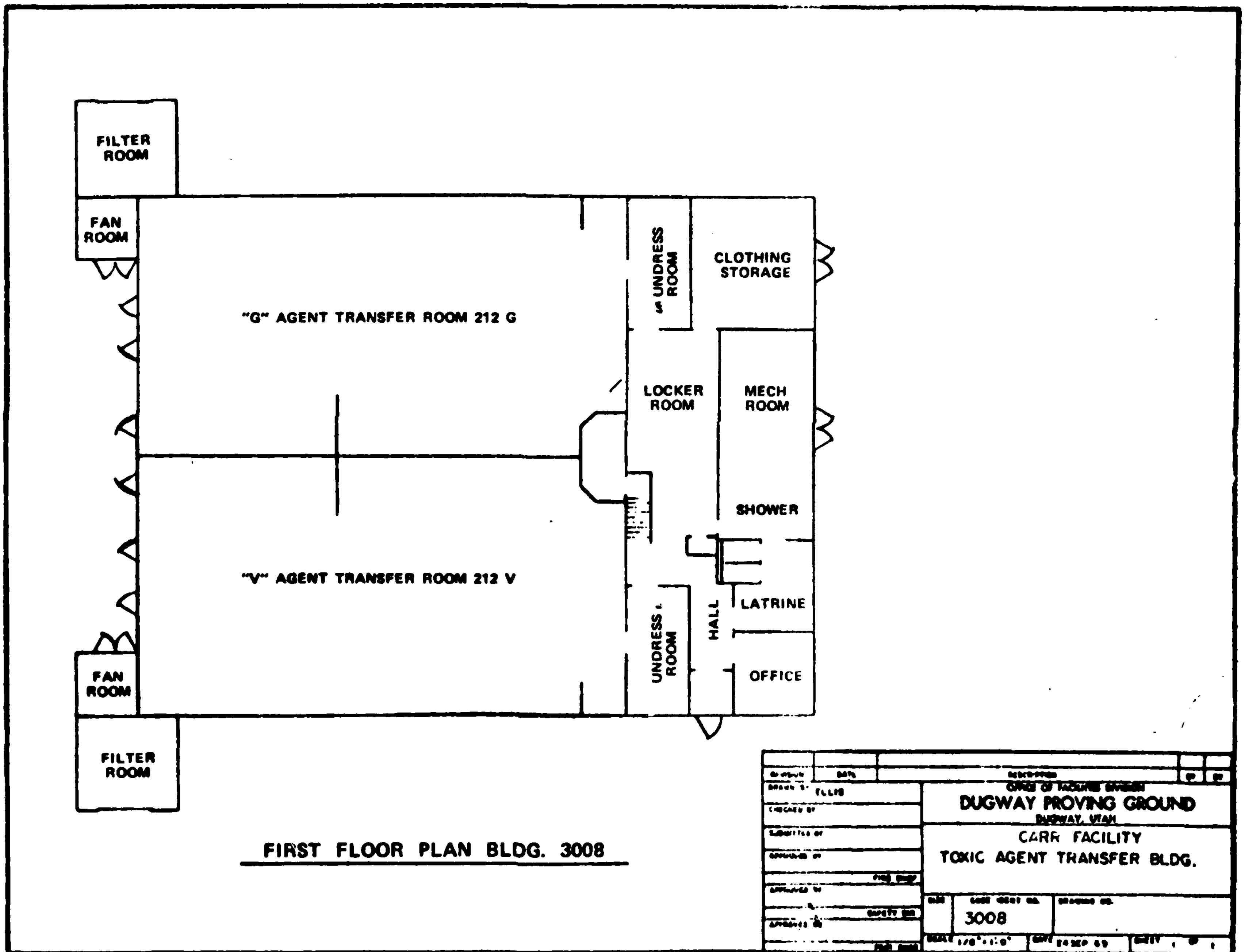


Figure I-20. Toxic Agent transfer bldg

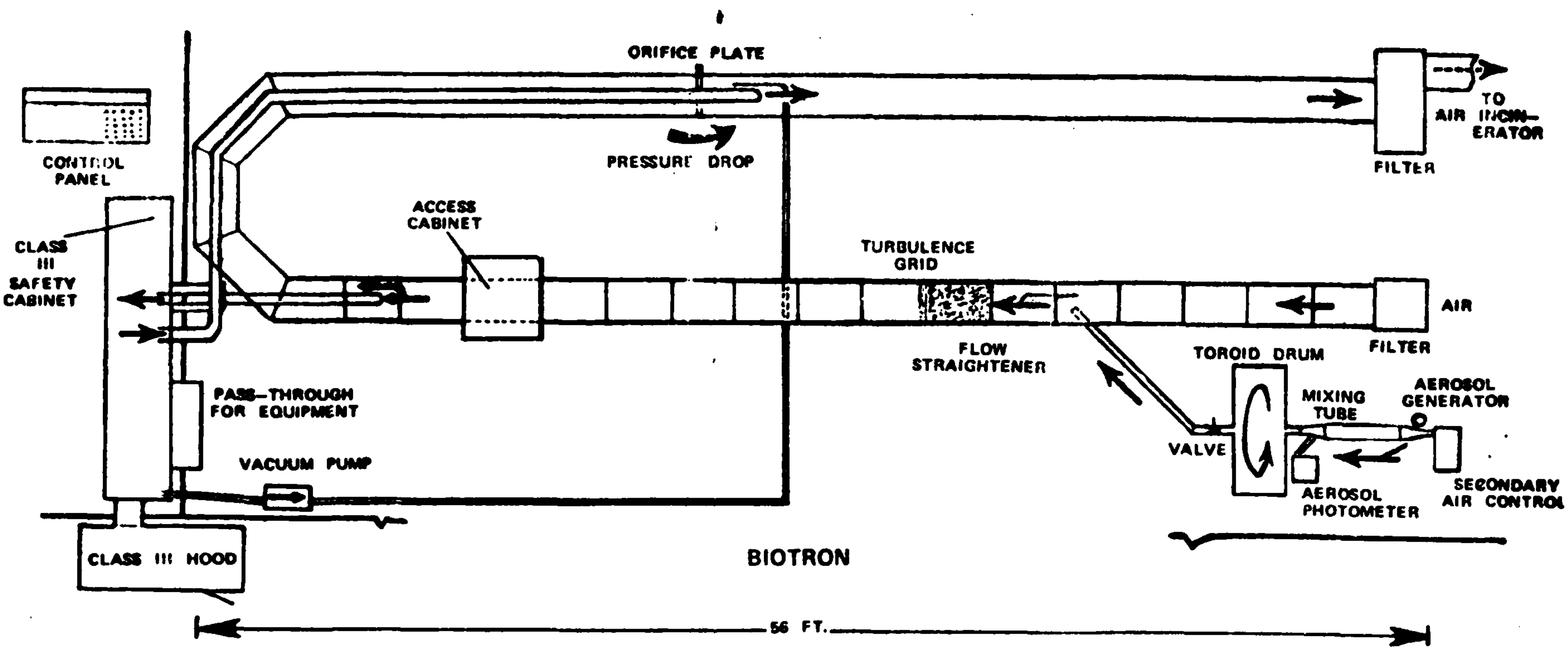


Figure I-21. Biotron

velocity, particle size, distribution and concentration are measured at a point in the main tunnel to monitor the actual generation of the aerosol and other parameters. The same parameters are measured at the entrance to each of the sample tubes. The air velocity is measured and determines the tunnel velocity to provide isokinetic conditions at the tube entry and inlet to the concentrating devices.

A portion of the aerosol travels down to the sample tukbe through the detectors and samplers and is exhausted with the major portion of the generated aerosol not used for challenge. The exhaust air passes through the detectors and samplets and is exhausted with the major portion of the generated aerosol not used for challenge. The exhaust air passes through a high efficiency filter before the air is incinerated at 900°F.

The entire system will be controlled from a remote console. The instrument console will control the air velocities, particle concentrations and the balance of the complete system. For safety from aerosol exposure, the instruments, solenoids, and motorized valves will maintain the constant pressures that lower in the aerosol chamber and hood area than in the surrounding room.

The aerosols for challenging the detectors are to be in a size range of 2.5mm to 10mm and possess concentrations of 5 to 250 particles per liter. An extension of the safety cabinet (transfer duct) into an adjacent room allows for the safe transfert of small items into and out of the cabinet during operations.

(4) Physical Measurement Systems

(a) Vibration. Vibration tests are conducted on electrodynamic and mechanical vibrators. The equipment includes two 6,000-pound electrodynamic shakers with complete instrumentation, one 1,000-pound electrodynamic shaker with complete instrumentation (capable of high-altitude operation to 50,000 feet), and several mechanical shakers, in chambers, for "Gaynes Bounce" tests. The electrodynamic vibrators are powered by individual amplifiers, and several controls are available for any type of sweep oscillator-controlled functions. Instruments include up to eight channels of acceleration data, with capacity to control from the average of any four accelerometers. The explosive limit on all shaker systems is 70 pounds of explosives, or less, whether in controlled or exposed environments. See Table I-4 for listing.

(b) Shock. There are three shock test systems in current use the first, and most common, is the drop tower. This tower, which can be remotely operated, can be used to test packages up to 1,000 pounds can make drops in any desired attitude.

The second shock system is the Conbur-type inclined-impact system. The test item is secured to a wheeled cart which accelerates down an inclined track, impacting on surface normal to the track. Accelerometers and oscilloscopes are available to monitor shocks.

The third shock system is a shock test machine of unusual capability. The table travels downward on a single standard and impacts on

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lead cones or cylinders to produce a shock waveform of any standard shape. Pneumatics may be used to generate any desired acceleration. Impact is limited to about 100 g's on a 1,000-pound package. The unique features of the machine include mobility and the capability to tilt the entire system and deliver full shocks to test items when it is not desirable to change the mounting attitude of the test item. Table I-5 describes the shock test systems.

(c) Other. The laboratory is equipped with a complete range of standard measuring instruments for determinstion of physical characteristcs of a test item; e.g., dimensions and weight. In addition, for rockets and projectiles, specialized instruments for routine measurement of center of gravity and moment of inertia are provided. These instruments make use of the latest techniques in timing and motion determination for accuracy of results.

Two penetrometers are maintained for the purpose of measuring the penetration and life of CB filters. The penetration is measured by passing 0.3 micron smoke through and measuring the degree of penetration. Gas life is determined by exposing the filter of exposure to a known phosgene concentration prior to penetration. These instruments are shown in Table I-6.

(5) CBR Instrumentation. Within the testing area are numerous instrumented grids used for testing chemical agents. Different agent release methods, requiring sampling arrays, and agent characteristics have led to the use of portable equipment. As a result of the ban on biological offensive weapon systems and constraints on open-air testing of chemical agents, some of the grids have been deactivated. Figure I-4 illustrates the DPG test area indicating the test ranges, impact areas, and test grids. The active grids are listed below and are described in detail in paragraph 3a(1)(a):

- Tower Grid (Howitzer and 8-inch projectile firing)
- West Vertical Grid (small point source detonated chemical munitions)
- Aerial Spray Grid (ASG)
- All Purpose Grid (APG)
- Downwind Grid
- Downwind Grid Defense Array (Target "S" Grid)
- "V" Grid (artillery fired)

(6) Sampling Equipment. Because of the number of target arrays required for the complete spectrum of engineering tests involving chemical weapons and biological defensive systems, DPG has concentrated on the use of portable sampling equipment. Over 8,000 samplers of various types, together with ancillary equipment, are available for testing smaller munitions over very densely sampled grids, and for testing area weapon systems over target

TABLE I-4. Vibration-testing equipment

MANUFACTURER & MODEL NO. OR OTHER	NO. IN USE	TYPE DRIVE, OR POWER SUPPLY	MAXIMUM SPECIMEN WEIGHT (lb)	TABLE SIZE (in)	MAXIMUM ACCELERATION AT MAXIMUM LOAD (g)	MAXIMUM DOUBLE AMPLITUDE AT MAXIMUM LOAD (in)	MAXIMUM FORCE OUTPUT	FREQUENCY RANGE (cps)	ENVIRONMENT	EXPLOSIVE TESTING (Max. lbs & Class	REMARKS
L. A. B. SNLVML-8	1	Package tester Rotary	2000	56 x 90	1.15	1	-	0-5	Hot, Cold Ambient	70 Class 4	Mil-510 B-0B
L. A. B. SVMC-6	2	Package tester Rotary	2000	72 x 72	1.15	1	-	0-5	Hot, Cold Ambient	7C Class 4	
MB C10B	1	Electro-Magnetic	200	10" Dia		1	1200	12-2000	Hot Cold Ambient Altitude Humidity		Mil-Std-810B
MB C66	2	Electro-Magnetic	1200	13 3/4 Dia	5 g	1 70" per sec [illegible]	6000	5-5000	Hot, Cold	70 Class 4	Vertical and Horizontal vibration Mil-Std-810B

TABLE I-5. Shock-testing equipment

MANUFACTURER & MODEL NO. OR OTHER DESIGNATION	NO. IN USE	TYPE	PULSE SHAPE	PULSE DURATION (ms)	MAXIMUM ACCELERATION AT MIN PULSE DURATION (g)	MAXIMUM ACCELERATION AT MAX PULSE DURATION (g)	BARREL LENGTH OR MAXIMUM DROP HEIGHT (in)	TABLE SIZE OR DIAMETER OF BORE (in)	MAXIMUM SPECIMEN SIZE (in)	MAXIMUM SPECIMEN WEIGHT (lb.)	REMARKS
Incline-Impact (CONBUR)	1	Gravity						36 x 42"	36 x 42"	2000	Mil-Std-810B. 10° incline ramp. 90° hardwood backstop.
Drop Tower	1	Free Fall					40 feet	72 x 72"	72 x 72"	2000	Electro-magnetic pickup. Steel on concrete impact surface. Maximum velocity 16 feet per second
L. A. B. Corp SPA-VH-48	1	Accelerated Drop	Half Sine Saw-tooth Square	.05 to 50 ms	500 g	30 g		48 x 48"	48 x 48"	1000	Mil-Std-810B. Mobile. Air & hydraulic actuation. Horizontal & verticle test capability. W/storage scope. Tek 5604 w/Shoek monitors, Endevco 2708M2, w/scope camera.

TABLE I-6. Other physical testing equipment

TYPE/MANUFACTURER	NO. IN USE	FIXED MOBILE, OR PORTABLE	REMARKS
Radiography	1	Portable	Output: 1 KVA Current: 4 AMP Max Weight: 46 lbs Operating Temperature: 0° to 55°F Radiation Output: X-Ray Operational Rating: 70 to 140 KVP Continuous Target Angle: 20°
Radiograph GE 250 Type 4	1	Mobile	Plate Size: 11 x 17 in. at 36 in. focal distance Max Focal Distance: 56 in. Tiltable and rotating head Current: 15ma DC Output: X-Ray Operational Rating: 250 KVP at 10 ma DC Voltage Rating: 300 VAC Target Angle: 30%
Wind Tunnel	1	Fixed	5 x 6 foot tunnel Wind Velocity: 25 mph max.
Penetrometer DOP (Dioctyl Phthalate)		Fixed	Air Velocity: 700-1250 cfm at 10 in of water Particle Size: 0.3 microns US Army Chemical Corps
CG Penetrometer	1	Fixed	Standard Phosgene Concentration Generator
Center of Gravity	1	Fixed	6 x 6 in. table 10 x 10 table 100 in lbs, 250 in -lbs, 1000-2500 in -lbs.
Feeder, Dust Fisher-Klosterman Mod. AFI	1	Fixed	w/calibrated orifices; 1 1/2, 2, 3, 6, and 8 in. w/1200 CFM Blower, w/Calibrated Dust Feeder
Moments of inertia	1	Fixed	Standard torision pendulum Capacities to 200 lbs

areas of several hundred square miles. The inventory of samplers includes large numbers of all the conventional samplers such as all-glass impingers, Anderson sieve (particle-size discriminating) samplers, Reynier slit samplers, rotorod fluorescent-series of building equipped for ecology/epidemiology studies and as a base for field operations, including laboratories for isolation and identification of pathogens from captured animals, and a building for breeding and rearing of wild indigenous species.

Consistent with the functions of the Life Science Ecology Laboratories, which are unique within DoD, much of the equipment and the buildings housing the equipment are not duplicated elsewhere. These, together with the Defensive Test Chamber (described under chambers), constitute the only remaining facilities for realistic challenges of military material with biological agents while operating in total confinement to preclude release completely of hazardous material to the open air.

In addition to these capabilities are laboratories where requisite agents can be produced on the small scale required for such tests and where samples can be processed an assayed by incubation on culture media, by seriological and other diagnostic methods in animals, under conditions designed to operate safely and maintain the integrity of the samples.

The same capabilities apply and are used for similar tasks with nonpathogenic baterial simulants, for ecological epidemiological investigations, and, in addition, for the support of field test and environmental studies with pathogens.

(a) Life Sciences Laboratory. The Life Sciences Laboratory is, in itself, sufficiently different from routine laboratory structures to warrant a brief description.

The floor space is 33,550 square feet. The building is maintained under negative pressure relative to its exterior, which precludes release of contaminants, e.g., pathogenic microoganisms. It has a system for suppling filtered air to personnel fully protected against infectious agents when clothed in plastic suits or hoods. Special shower inclosures and autoclaves located in strategically-located areas are provided to decontaminate garments. Additionally, when the laboratory goes "hot" (any time work is being done with pathogens), entry and exit are through special change and shower rooms requiring complete change into or out of laboratory clothing. Used laboratory clothing, once sterilized, is treated in the Technical Processing Plant described elsewhere. Airlocks with ultraviolet lamps further ensure greatest possible freedom from biological contamination in the building. A series of steam and ethylene oxide-carbon dioxide autoclaves are available in various sizes to sterilize contaminated materials ranging from small laboratory items to large animal racks and cages. Animal rooms are equipped with laminar-flow air systems to minimize tisk of cross-infection among animals. A number of chemical hoods and safety cabinets are designed to protect laboratory personnel and eliminate the risk of hazardous laboratory infections. Included in this category are freon-tight, Class III cabinets, which provide access through tanks filled with decontaminant, and permit work in the interior through rubber gloves sealed to the metal frame. Air exhausted from them is decontaminated with incinerators or by passage through absolute patriculate filters.

When the laboratory houses work with human pathogens, liquid wastes can be heat-sterilized in a waste-collecting, holding and heating system to eliminate infectious waste. This waste and disposal is not operated presently, because large amounts of heating can be conserved by sterilizing the smaller amount of infectious waste by autoclaving it within the laboratory proper.

Solid wastes with water content as great as 75 percent can be decontaminated by the laboratory incinerator system (rate: 1,000 pounds per hour). The system processes contaminated waste only, because other waste is buried in approved landfills.

The feature just described deal with the capability to work with viable microorganisms principally. The laboratory itselfd and its satellite buildings are also equipped for the other special work as well and built-in incubators and cold rooms, vacuum and carbon-ring compressed air and distilled water systems, glassware cleaning and sterilizing rooms, andiman holding units with automatic watering and animal cage washing facilities, and special rooms housing the chamber equipment.

(b) Biological Chamers

1. The Biotron Chamber. The Biotron chamber is described under test facilities (test chambers). It is an integral part of the Life Sciences Laboratories, because of its usefulness as a test facility with pathogens depends entirely on the support provided by the laboratories. The laboratories arre also necessary to provide the backup, from production and evaluation of agent materials to be used in challenges of defensive equipment through assay of specimens.

2. Reyniers Chambers. The Reyniers chamber facility permits generating dynamic aerosols under rigidly controlled conditions of temperature and humidity. Evaluation of sampling techniques, assay methods, animal susceptibility can thus be performed with aerosols that approximate those clouds generated outside in the field with the requisite safety aspects observed. Also possible is comparison of the effects of environmental factors on confined aerosols to approximate aerosols produced in the open air.

3. Toroid Chambers. These facilities with supporting atomizing equipment and temperature and humidity controls permit study of static aerosols. Because these "drums" rotate, the gravitational effect diminishes to permit determining the effect of prolonged periods of storage, thus permitting simulation of "aging" of free-floating aerosols.

4. Environmental and Other Chambers. Environmental chambers include those programmable to control humidity and temperature and to simulate solar radiation for studying fungal growth and survival of other microorganisms in selected environments. Various other equipment include incubators for culture plates, tissue culters and inoculated eggs.

(c) Microthread Facility. A relatively new capability, the microthread mobile laboratory was assembled to permit DPG to duplicate and expand a technique developed in the United Kingdom. The technique permits determining the effect of urban and industrial pollutants on the viability of "airborne" biological particles. It consists of aerosolizing microbial slurries under controlled conditions of humidity and temperature and depositing the micron-sized droplets of biological material and exposing them to extremely fine stainless-steel wires held on frames on a confined duct system. Thereafter, the suspended droplets may be exposed to a variety of industrial and urban air to determine the effects of air pollutants, relative humidity, temperature and solar irradiation ofn the survival of suspended microorganisms. This procedure allows study of ambient conditions without the release of possible objectionable aerosols. As presently constructed, this mobile facility is limited to investigations for effect on nonpathogens.

(d) Production of Test Materials. In recent years, DPG became self-sufficient in production of 200-liter quantities of nonpathogenic microbial slurries (sumulatants) for aerosolozation in the open air as test directives required for challenging Army material in decontamination studies, determing the functional characteristics of protective gear, garments, and collective protectors, and investigating biological alarm systems.

The production in the batch fermentor along with concentrators and a pelleting device requires selecting suitable strains of organisms, developing optimal growth media and conditions, and defining appropriate conditions for harvesting, concentraing and storing suspensions to ensure quality and uniformity. Pathogens are produced in quantities of laboratory scale only and in facilities designed for utmost safety, as described above.

Fungal spores for use in fungus-exposure tests are also produced in the Life Sciences Laboratories.

(e) Assay and Technology. The original purpose, and still a major one, of the main building housing the Life Sciences Laboratories, is the support testing requirements. Other activities, such as those concerned with environmental studies and ecological and epidemiological investigations, are housed in the building for consolidation and changed policies and goals. This capability remains, however, for conducting all phases of the laboratory work essential to field and chamber testing and is essential for current laboratory tasks and field testing with simulant microorganisms. Included are facilities for conducting technology and methodology investigations aimed at developing and evaluating newer aerosol samplers, collecting fluids and assay methods. Disciplines maintained comprise bacteriology, virology, rickettsiology, and mycology and several areas in chemistry and physiology. Equipment exists for processing field and laboratory samples on a large or modest scale. For all related tasks, such as preparing, quality-controlling and assaying biological materials before and after its dissemination, facilities exist as well. In other respects, the laboratories are well-equipped with a variety of instruments and equipment including laboratory areas for propagating tissue cell lines. Typical examples include the following:

Multichannel particle size analyzers (Royco analyzers and mulliport imaging system)
Bacterial colony counters
Spectrophotometers and colorimeters (ultraviolet and visible)
Centrifuges (both low to ultraspeed preparatory types)
Microscopes (visiblelight, fluoresescence, phase-contrast)
Mictophotography apparatus (paper, gel-electrophoresis, hanging curtain, column, gas)
Respirometers (Warburg type)
Aerosol generators (various types
Ozone generator
Pollutant-measuring equipment (ozone, sulfur dioxide, nitrogen oxides)
Automated gas chromatograph
High pressure liquid chromatographic equipment
Spectrospan

There is also a full complement of instruments normally associated with microbiological laboratories.

(f) Fluorescent Air Tracers. Aside from the skill and equipment to perform virtually any type of microbial assay, a complete capability of fluorescent-particle tracer work exists. This capability ranges from evaluation of powder fluidizers, testing and quality control of fluorescent pigments, to the assay of field samples by procedures maintained under quality assurance programs. Such tracers are useful in a number of ways e.g., (1) to delineate aerosol clouds both directly and indirectly when used as a tracer to screen and thus reduce the workload by eliminating furtherr assay of negative samples; (2) to aid in studies involving determination of biological versus physical decay of aerosol clouds, and as an agent simulant; and (3) in meteorological and environmental pollution studies. Fluorescent tracers are versatile, find use in defining the hazards created by secondary aerosols, in testing the efficacy of particulate filters, and for characterizing the performance of aerial spray equipment.

(g) Environmental Studies. Environmental studies at DPG are conducted by the Environmental and Life Sciences Division and are essential for the early identification of potential adverse environmental consequences from installation activities and testing programs, including tests with various chemical simulants, smoke agents and others. Documentation includes: records of environmental considerations (RECs), environmental assessments (EAs), environmental impact statements (EISs) and hazardous waste considerations (RCRAs).

Environmental sceintists within this division constitute a readily-available, highly-skilled local team that assist and resolve environmental problems. In the recent past, laboratory investigations by these and other scientists developed bench-scaled models for removing excess nitrates from waste affluents of Army munition plants, and assessd the hazards toman for biological aerosols inherent in industrial cooling towers that use water from treated sewage.

(h) Toxicology. DPG possesses toxicological expertise in the form of cooperative efforts betwwen Life Sciences and Chemical Laboratories and extends to both laboratory and field capabilities.

Routine tasks include chemical analysis of toxic materials, acetylcholinesterase analysis, determinations of dose response and toxicity for compounds of interest particularly ones supplied by the Department of Transportation. Ability to supply novel and unique solutions exists too and this asset hass been used effectively in demilitarization projects and in assisting other installations with solutions similar problems.

(i) Ecological Toxicology and Ecological Epidemiology. Since 1951, an intensive toxicilogical and eqidemiology program has been conducted on the perimeter and within the reservation of Dugway and areas distant from Dugway selected as control sites. Consequently, the general area of DPG has been well characterized ecologically and is an important factor in test operations invilving potential impact on the environment.

Earlier, interest was focused mainly on population dynamics of wild animals and on the rise and fall of disease activity in nature. More recently, a more comprehensive toxicological survey was added to establish baseline data on levels of erythrocytic acetylcholinesterase activity in wildlife and livestock. In addition, a separately funded independent laboratory initiated research (ILIR) program has been in progress for a number of years investigating the indigeneois arborviruses in the Bonneville Basin area of Utah. Included in the study ar the epidemiological significance of these viruses, the relative frequency of their incidence, their vectors, and the host preferences of these vectors, and particularly aimed at the appearance of new types of viruses.

In all instances, the field effort requires extensive laboratory work to permit interpreting the data collected. The results depend on microbiological, serodiagnostic, enzymatic, and tissue culture capabilities which exist in the laboratory to meet that requirement. Native animals for these purposes are bieng supplied from the faunal colony being maintained in theLife Sciences Laboratories, or, to some extent, by trapping.

(8) Chemical Laboratories. Chemical laboratory facilities are designed for physical, analytical, organic and biochemical operations; for the preparation of reagents and sampling equipment for field tests; for the automated receipt, handling, and analysis of thousands of samples resulting from field tests; and for applied research. Facilities and items that contribute to a well-equipped chemical research and analytical center include the massspectrometry laboratory, a gas-chromatography laboratory, liquid chromatography facilities, a rediosotype-tracer laboratory, various infrared, visible, and ultraviolet spectrometers, a nuclear magnetic resonance spectrometer, recording polarograph, organic synthisis facilities, argon plasma emission spectrometers, automated gas chromatographs, automated data acquisition system (laboratory computer), automated chemical analyzers, selected physical test equipment and common chemical laboratory instruments and equipment.

DPG is especially staffed and equipped to conduct applied research in virtually any area of analytical or physical chemistry but can also conduct studies in organic, biological, and toxicological chemistry, and in related fields unique to sampling of airborne materials. Personnel assigned are highly qualified to perform chemical and physical analyses of samples of agents, simulants, protective materials, and air and water pollutants of virtually any type. With few exceptions, the laboratory staff are professional chemists, and all are experienced in the precise, accurate analysis of large numbers of samples for trace materials.

In addition to mass-spectrometric, gas-chromatographic, rediologic and infrared photometric equipment, severral major pieces of equipment are, in themselves, quite important and worthy of individual mention. Among these are the nuclear magnetic resonance spectrometer, the Chromatronics high pressure liquid chromatograph, the Cary Model 15 UV-visible spectrometer, the automatic spot counter and sizer, the semi-automated gas-chromatographic system, and sulfur-phosphors detectors, and semiautomated visible spectrophotmeter.

There is also a large quantity of less sophisticated and common laboratory equipment of all types, such as spectrofluorometers, various heavy-duty and small centrifuges, many potentiometric pen and ink recorders of various types, numerous pH meters, dust and particle counters, dry boxes, automatic titrators, etc. In fact, a complete inventory of all types of ancillary equipment required for a modern competent chemical laboratory is available.

The Chemical Assay laboratory is staffed and equipped to perform chemical or enzymatic analysis on relatively large numbers of samples (up to 10,000 from a single source, presented at one time). This laboratory is also prepared to conduct small-scale tests using toxic chemicals. Safe techniques for handling toxic materials have been developed over the years, and all such handling is done in chemical fume hoods whose exhausts are filtered through activated carbon as well as particulate filters. Among the major instruments of laboratory facilities are:

(a) Gas Chromatography Laboratory

1 - Model 1520B Varian Aerograph (dual column)
1 - Model 220 MT Micro Tek (four column)
1 - Model 1848 Varian Aerograph (dual column preparative GC)
1 - Model 5840 Hewlett-Packard
1 - Model 5840A Hewlett-Packard
5 - Model 5713A Hewlett-Packard with automatic sample injectors
3 - Model 2100 Varian Aerograph plus ancillary equipment of all types (four column)
5 - Model 5713A Hewlett-Packard
1 - 3354B Hewlett-Packard Laboratory Automation System

The gas chromatograph is an effecient tool for the rapid separation and detection of components presented in mixtures of volatile compounds. The method is used to measure the amounts of component by using sensitive and in some cases specific deterctors and by optimizing other parameters, the gas-chromatogaph can be used for trace analysis where the components to be measured are present in the picogram range. The preparative gas-chromatograph can also be used for the preparation of pure materails in place of less effecient distillation or other purification techniques where sample charges in the gram range are employed.

This laboratory is versatile; it is capable of intensive research and analysis on single samples as well as assay of large numbers of samples for a single desired component.

For assay, semiautomated gas chromatographs are used. Each is equipped with an automatic sample injector and driven by a laboratory automation system. This instrument receives the raw data, performs calculations, and prints out the data on a printer and on magnetic tape. The magnetic tape can be edited and then fed into a computer for complete data reduction and calculations. Presently available gas-chromatographic detectors give approximately a tenfold enhancement of sensitivity, compared to colormetric methods. The rate of analysis, however, is much slower with this equipment than with automated spectrophotometers by a factor of about 10. The technique is particularly useful when applied to stable, relatively nonreactive chemical compounds which do not redily form colored products or which do not have an intrinsic absorption of electromagnetic energy in the range of 300 to 800 nanometers.

The range and lower detection limit for analysis by gas-chromatograph (GC) is dependent upon the silvent used. For those chemicals reguarly analyzed by GC, the ranges and lower detection limits are presented below:

Chemical 1/	Solvent	Range (pg/ml)
BIS 1/	Isopropanol	0.5 - 200
TOF 1/	Isopropanol	0.5 - 200
TCP	n-Heptane	0.05 - 500
CS	Isopropanol	0.2 - 10 3/
DMMP 2/	Isopropanol	0.2 - 200
TEP 3/	Isopropanol	0.2 - 200
GA 2/	Isopropanol	0.2 - 200
GB 2/	Isopropanol	0.1 - 200
GD 2/	Isopropanol	0.2 - 200
VX 2/	Isopropanol	0.5 - 200
HD 3/	Isopropanol	1.0 - 500

1/ For samples collected in hexylene glycol (1-methyl 2,4-pentanediol) the lower detection limits are approximately 10 times greater than those listed above.
2/ The linear range of the flame photometric detector, when operated in the phosphorus mode, is 0 to 40 nanograms of phosphorus per ml; the extended range is obtained by injecting from 1 to 5 ml of sample.
3/ The flame photometric detector, when operated in the sulfur mode does not have a linear range; the working range is 1 to 70 nanograms of sulfur per ml.

(b) Mass-Spectrometry Laboratory. The Hewlett-Packard 5992B Gas Chromatograph mass spectrometer, and electronic instrument, analyzes materials by (1) separating components in solution in the Gas Chromatograph section; (2) producing ions from the substance under investigation; (3) arranging the ions produced in order of ascending mass to charge ratio; (4) recording the ion arrangement as a mass spectrum. The mass spectrum permits a unique identification of given organic or inorganic materials or simple mixtures.

Some applications for this instrument include identification of unknown compounds in mixtures, residual gas analysis, purity determinations, reaction kinetics, desorption and outgassing studies, pyrolysis studies, and simple structural determinations. Materials can usually be detected in the nanogram range and in some cases in the sub-nanogram range. Because of the long time required to analyze each sample. This laboratory is essentially restricted to research and identification studies only.

(c) Radiological Laboratory. This facility consists of a modest capability to label compounds with radioactive atoms during synthesis and to perform experiments with these labeled compounds. A radioactive counting facility is available to detect and measure radioisotopes in samples. This consists of:

1. A Nuclear-Chicago liquid scintillation counter

2. A Varian Associates TLC plate counter

3. A Nuclear-Chicago survey meter

Using these techniques and instruments, it is possible to follow the course of the various metabolic processes in plants or animals, to study chemical processes in vitro, etc.

(d) Infrared Spectrometry Laboratory. This laboratory consists of a Perkins Elmer Model 21 spectrophotometer and a Beckman IR-10 spectrophotometer, with a complete inventory of gas and liquid cells, prism interchanges, long-path gas cells, total reflectance (ATR and MFTR) accessories, etc.

The Beckman IR-10 spectrophotometer is a double-beam recording instrument that scans the infrared region from 4.000 cm^{-1} to 300 cm^{-1}. The maximum resolution of this instrument is 4 cm^{-1} between 4,000 and 200 cm^{-1} 3 cm^{-1} between 2,000 to 300 cm^{-1}. It is accurate to 8 cm^{-1} in the high wave-number region and to 4 cm^{-1} in the low wave-number region. The percent transmission accuracy is 2%. The instrument has been adjusted to make fast scans, and most of the Perkin Elmer accessories can be used with it.

The IR laboratory is used to identify compounds and to determine purity of compounds systhesized locally. It can be applied to identification and study of many types of compounds, organic and inorganic; in all physical states, liquid, solid or gas. Use as an assay facility is not practical.

(e) Nuclear Magnetic Resonance Spectrometer. The A-60D NMR spectrometer system is a proton magnetic resonance system with a 14,092-gauss magnetic field strength and sensitive enough to detect 0.005 molar concentration of hydrogen nuclei occurring in a single line of less than 0.6 Hz natural line width. The sensitivity can be greatly enhanced by the use of the C-1024 time-averaging computer. The instrument has a resolution of 0.3 Hz, and the intergrating accuracy is 2 percent.

The spectrometer is used to identify hydrogen-containing compounds, for structure determination of such compounds, and for monitoring chemical reactions in situ. Also, it can be used as a quantitative analysis instrument. Its use as a routine assay instrument would not be appropriate.

(f) Argon Plasma Emission Spectrometers. The laboratories have two Spectrometrics Model 51040 Argon Plasma Emission spectrometers. These are analytical instruments used to determine the trace metal content of samples. This technique is the most reliabel and rapid means for detecting and analyzing metals. The units contain burner units, light dispersion compartments, photomultipliers, and recording devices. The analytical senstivity when analyzing for trace metals is much greater than was possible with earlier atomic absorption spectrometers. The spectrometerrs have been applied to the analysis of trace metals in agents, cation analysis of water, components of screening smokes, and specific metal contamination of grease and lubricating oils. Up to 50 different metallic elements can be determined.

(g) Automatic Spot-Sizer and Counter. This equipment is used in the analysis of droplet stains on paper cards. The instrument provides a count of the total number if images of spots on a microfilm of the original card and can distribute the total count int 15 size groups ranging from 10 to 1,000 microns.

(h) Colormetric - Spectrophotometric Analysis. The laboratories have several instruments capable colormetric analysis. The instruments can be used to analyze virtually any material which will absorb light energy within the range of 300 to 800 nanometerrs, or which can react chemically to form such a compound. Among the available instruments are:

1. Beckman Model B2 Spectrophotometers (2). These are double beam spectrophotometers with digital printout and automatic sample pickup. These can analyze samples at a rate of about one per minute per instrument.

2. Cary Model 15 Spectrophotometer. This is a double-beam, ratio-recording spectrophotometer capable of deterrmining light absorption as a function of wave-length from 185 to 800 nanometers. It can read absorptives up to 3.4A, and 0 to 0.1A and can be expanded to cover the full scale. It is a versatile, highly accurate instrument, which can be used for routine assays as well as for research in chemical agent analysis.

3. Automated Analyzer Systems (2). These instruments are used for colormetric and spectrophotometric analyses for which time or temperature control is critical. Their main use is in the analysis of trace quantities of chemicals. Because of the time and temperature controls, these instruments are ideally suited to the enzymatic assay of trace quantities of agents (cholinesterase inhibitors).

The analytical range and lower detection of limit of automated techniques depend upon the compound being analyzed and the solvent in which the compound is dissolved.

In addition to equipment procured from commercial sources, several less sophisticated systems have been built in-house.

Typical concentration ranges for a number of simulants or agents are:

Chemical*	Method	Range (ug/ml)
MAA	Colorimetric	0.5 - 10
MAA	Colorimetric Hi-Sens.	0.1 - 1
DMHP	Colorimetric	2.8 - 50
DEHP	Colorimetric	4.0 - 60
BIS	Colorimetric	1.6 - 50
L	Colorimetric	2.0 - 40
PS	Colorimetric	2.4 - 40
CG	Colorimetric	1.2 - 50
CN	Cororimetric	3.2 - 80
AC	Colorimetric	0.4 - 10
AC	Colorimetric Hi-Sens.	0.13 - 1
HD	Colorimetric	0.6 - 10
CS	Ultriviolet	0.4 - 25
DM	Colorimetric	3.3 - 100
VX	Colorimetric	3.2 - 45
VX	Enzymatic	0.2 - 5
VX	Enzymatic Hi-Sens.	0.012 -0.15
GB	Colorimetric	0.75 - 20
GB	Enzymatic	0.31 - 5
GB	Enzymatic Hi-Sens.	0.01 - 0.15

*BIS - BIS(2-ethylhexyl) hydrogen phosphonate
DEHP - Diethyl hydrogenphosphonate
DMHP - Dimethyl hydrogenphosphonate
DMMP - Dimethyl methylphosphonate
MAA - Methyl acetoacetate
TCP - 1, 2, 3 - trichloropropane
TEP - Triethylphosphate
TOF - Tris (2-ethylhexyl) phosphate

AC, CG, CN, DM, GA, GB, GD, HD, L, PS and VX are chemical agents. The other substances represent simulant agents.

(i) Flame-Photometric Detectors. These instruments continuously sample with hydrogen, and burn the sample. If any compounds containing phosphorus (or sulfur) are present, they are detected and measured. With suitable adjustments, the instruments can measure, in real time, the airborne concentrations of compounds containing phosphorus over the range from 0.0001 to 100 ug/liter of air, for compounds having molecular weights close to the of GB (140).

Some of these instruments and systems are restricted to research, while others have limited assay capability and still others (gas chromatographs, atomic absorption spectrometer) are quite versatile and can be used both ways. These various facilities are so complementary and interdependent as to give an extremely versatile overall capability for research and analysis in many fields of chemistry.

(j) Physical Test Equipment. Laboratory scale equipment for both standard and specialized physical testing of materials is available. The standard commercial sources is used generally for the physical testing of materials. The specialized equipment was designed by, and fabricated for, the Chemical Corps especially for testing items of defensive equipment. The specific instruments are listed in Table I. In addition, equipment is available to test material for penetration by chemical agents.

5. DATA COLLECTION AND PROCESSING. Several methods of data collection are in use in the test system. This section deals with those methods primarily using the Centralized Automatic Data Processing (ADP) for technical data processing. The computer systems available include an IBM 4331 for administrative support and an HP 300 with two HP 100s for technical support. Figure 1-22 represents the computer configuration available at DPG.

The IBM 4331 is in the process of installation (Jan 81). Administrative support being provided by the HP 3000 will gradually dissipate as the total administrative workload is shifted to the IBM 4331. One of the HP 1000s is dedicated to meteorological support. The remaining HP 1000 and the HP 3000 represent a significant computer resource available for direct support of technical data reduction. Reduction software available "off the shelf" is composed primarily of standard math/stat routines and programs designed to handle data produced by Dugway testing over the years. These programs center around chemical concentrations, particle size analysis, meterorlogy and spatial tracking.

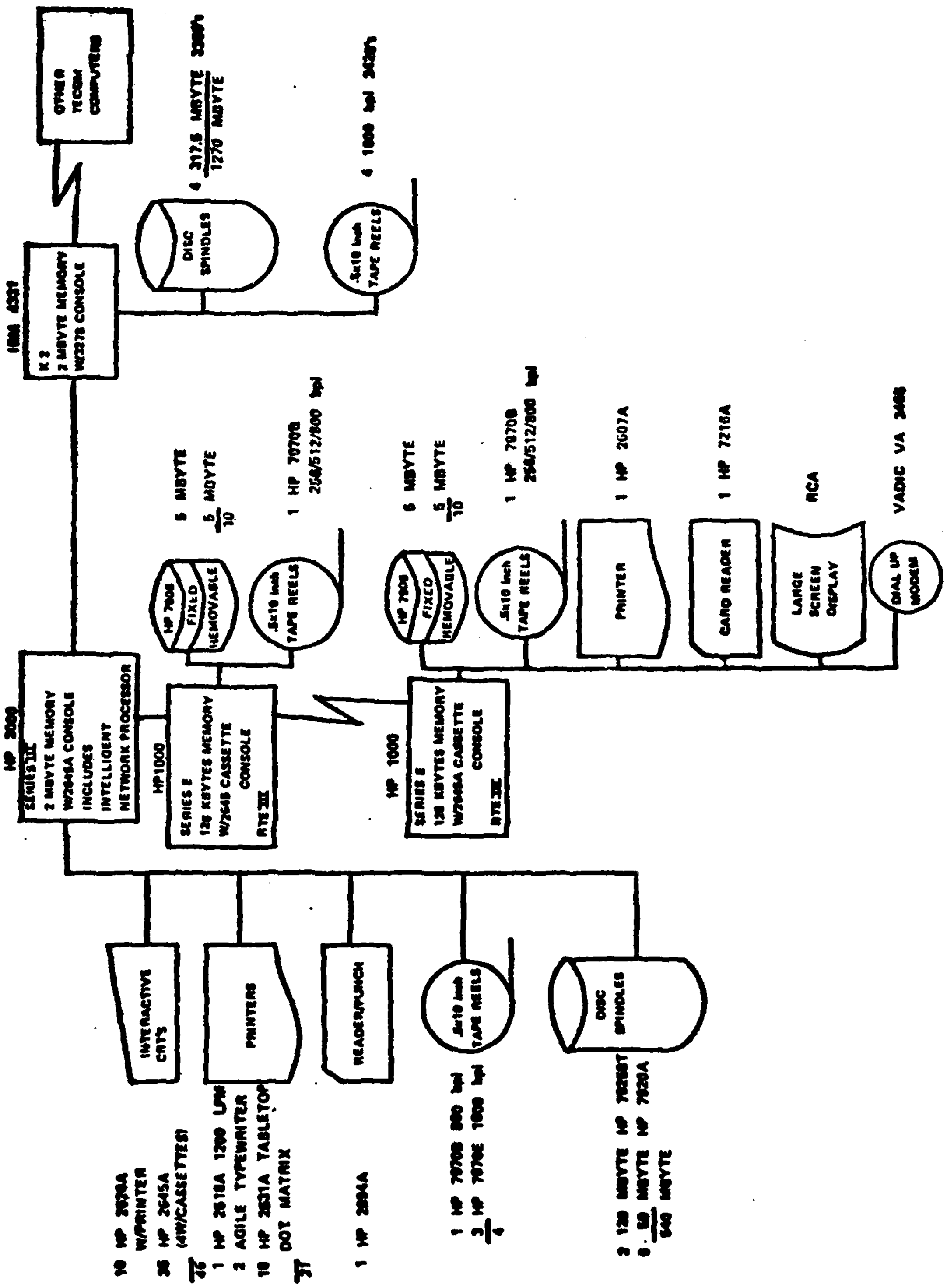


Figure I-22. Computer Figuration available at DPG.

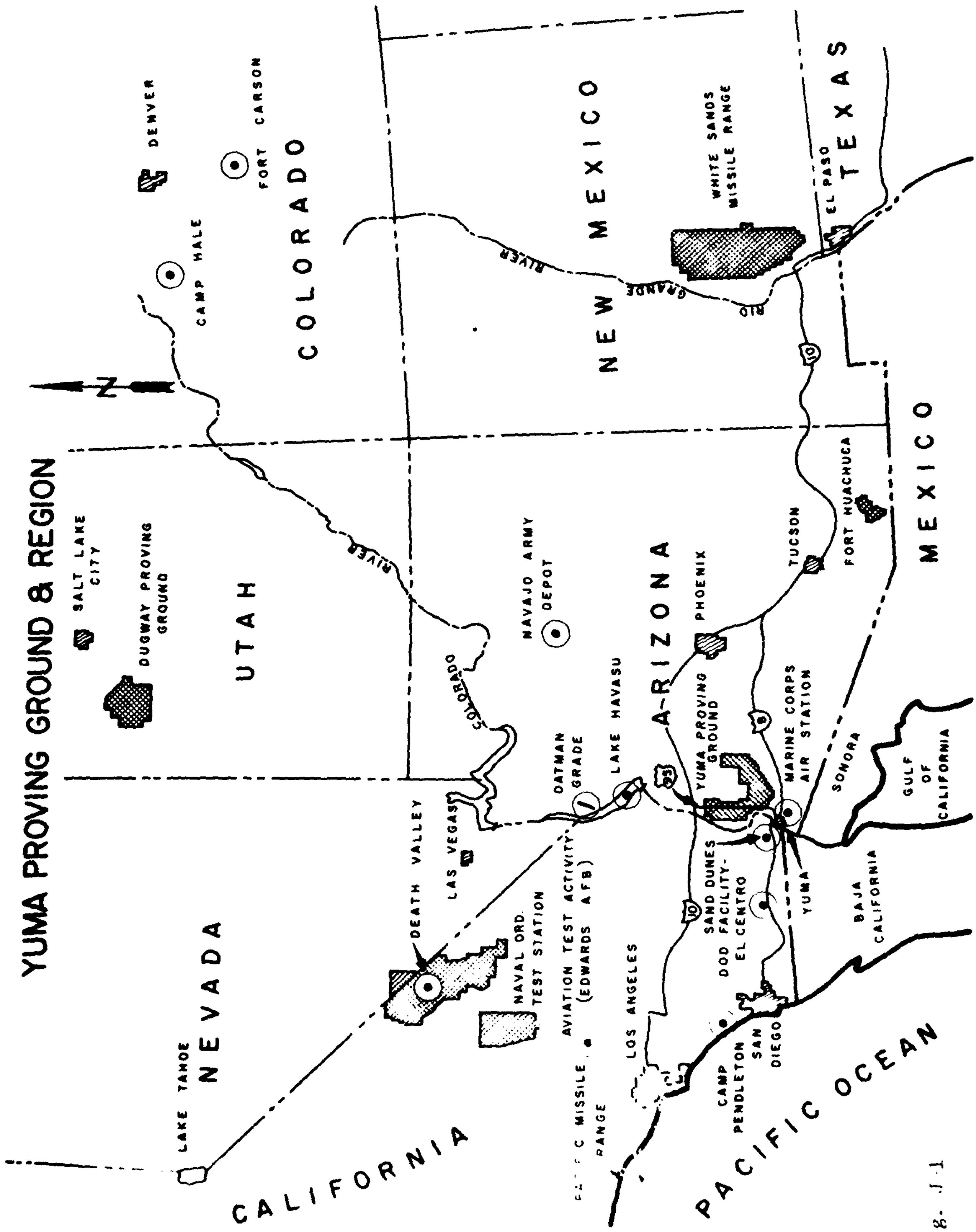
ANNEX J

OPERATIONAL TEST INSTRUMENTATION GUIDE

US ARMY YUMA PROVING GROUND

YUMA, ARIZONA

CONTENTS - ANNEX J



YUMA PROVING GROUND & REGION
N
SALT LAKE CITY
DUGWAY PROVING GROUND
UTAH
DENVER
FORT CARSON
CAMP HALE
COLORADO
NEW MEXICO
WHITE SANDS MISSILE RANGE
EL PASO
TEXAS
RIO GRANDE RIVER
COLORADO RIVER
NAVAJO ARMY DEPOT
ARIZONA
PHOENIX
TUCSON
FORT HUACHUCA
MEXICO
NEVADA
LAKE TAHOE
DEATH VALLEY
LAS VEGAS
OATMAN GRADE
LAKE HAVASU
YUMA PROVING GROUND
MARINE CORPS AIR STATION
SONORA
GULF OF CALIFORNIA
NAVAL ORD. TEST STATION
AVIATION TEST ACTIVITY (EDWARDS AFB)
SAND DUNES
DOD FACILITY-EL CENTRO
YUMA
BAJA CALIFORNIA
LOS ANGELES
CAMP PENDLETON
SAN DIEGO
MISSILE RANGE
CALIFORNIA
PACIFIC OCEAN
10
8
95

Fig. J-1

ANNEX J
US ARMY YUMA PROVING GROUND (USAYPG)
Yuma, Arizona

1. Introduction

a. Overview

Yuma Proving Ground (YPG) contains approximately 1400 square miles of land located in the southwestern section of Arizona. This area is part of the Sonoran Desert, a low altitude, hot-dry desert. In the United States, only this general area is considered to be environmentally comparable with the great deserts of the world. Comparisons of the world's deserts indicate that the Yuma area is not closely analogous to other desert areas in certain respects, but it does offer the most comparable overall environment to be found in the United States.

YPG Headquarters is located on the central west edge of the reservation, 26 road miles northeast of the City of Yuma, Arizona, an agriculture and tourist center of approximately 40,000 persons. The reservation is adjacent to the Colorado River and lies entirely within Yuma County which is situated in the southwestern part of the state of Arizona. The 870,166 acre area circumscribed by the installation boundary is of a general "U" configuration. The "U" extends about 54 miles north-south and 54 miles east-west. Within the arms of the "U" lies the KOFA National Wildlife Refuge. The western arm near the Colorado River is about 42 miles north-south and 18 miles east-west. (See Figure J-1.)

1The mission of the US Army Yuma Proving Ground (YPG), Yuma, Arizona, as stated in US Army Test and Evaluation Command (TECOM) Regulation Number 10-5, is:

(a) Test and Evaluation Mission:

(1) Plan, conduct, evaluate and report the results of development tests and other tests, and review plans for and monitor conduct of development testing planned or conducted by proponent materiel developers, producers, and contractors in accordance with integrated testing cycle policies for the following types of materiel as directed by the Commanding General, TECOM:

((a)) Tube Artillery Systems
((b)) Aircraft Armament Systems
((c)) Air Delivery Systems and Air Movable Equipment
((d)) Mobility Equipment

(2) Plan, conduct, and report the results of desert environmental tests of all classes of materiel as directed by the Commanding General, TECOM.

(3) Provide technical support to the mission of the US Army Cold Regions Test Center and to other federal government agencies as directed by the Commanding General, TECOM.

(4) Provide, coordinate, and control assigned air and land space for DOD agencies requiring these assets in the accomplishment of their missions.

(5) Provide advice and guidance on test and evaluation matters to materiel developers, materiel producers, and other services and private industry.

(b) Installation Management and Operations:

(1) Manage and operate the installation in accordance with DOD Directive 3200.11, other applicable publications, and as directed by the Commanding General, TECOM. (Examples are support of armed aircraft systems tests, Global Positioning System tests, and remotely piloted vehicle tests.)

(2) Provide administrative, technical and logistical support necessary to sustain the assigned test and evaluation mission and also to tenant organizatins as required.

(3) Perform other services as directed by the Commanding General, TECOM.

2. General

a. Military Units

(1) Tenant Organizations

Currently located at YPG are the following tenant organizations:

- US Air Force Space Division (AFSC)
- US Army Atmospheric Sciences Lab Yuma MET Team
- US Army Health Clinic
- US Army Communications Command - Yuma (Functions as YPG Communications-Electronics Directorate)
- TARADCOM/TARCOM Test Coordination Office
- ARRADCOM Test Coordination Office

(2) Nearby Government Installations

The installations which are readily accessible to YPG include:

(a) The Marine Corps Air Station at Yuma, with excellent facilities for handling all types of aircraft;

(b) El Centro NAF, California (93 road miles from YPG);

(c) Fort Huachuca, Arizona (329 road miles SE of YPG), with its extensive electronic test facilities;

(d) Camp Pendleton, California (243 road miles northwest of YPG), with facilities for amphibious testing in salt water; and

(e) Navajo Army Depot at Flagstaff, Arizona (278 road miles from YPG), with winter snowfields and terrain elevations to 10,000 feet.

b. Maintenance Capability

The maintenance capabilities of YPG are divided into the areas listed below:

- Level 3 and Level 4 maintenance of test vehicles (ground) by the Test Vehicle Repair and Maintenance Shop of the Material Test Directorate (MTD). This includes maintenance of tracked vehicles.

- Level 3 and Level 4 maintenance of munitions and weapons (including selected weapons systems) by the Weapons Repair and Maintenance Branch of MTD. This branch has the capability of maintaining tubed weapons as large as the 16-inch Navy gun and airborne systems such as the CW missile.

- Level 4 maintenance of Army aircraft by the Laguna Army Airfield.

- Level 4 maintenance of support vehicles by the Maintenance Branch of the Logistics Directorate.

- Maintenance of communication equipment by USACC Yuma.

c. Access

(1) Air

(a) Laguna Army Airfield - There are two runways. Runway 17-35 is 150 feet wide and 5,150 feet long, exclusive of overruns. It is constructed of asphaltic concrete in satisfactory condition; has variable intensity lights; is capable of single-wheel loading of 130,000 pounds, and twin-wheel loading of 140,000 pounds. Runway 64 is 6,000 feet long, 100 feet wide; is constructed of asphalt, in satisfactory condition; is unlighted and available for daytime use only; is capable of singe-wheel loading of 41,000 pounds and twin-wheel loading of 50,000 pounds.

(b) Castle Dome Heliport - There is one runway 3,000 feet long, 65 feet wide, of aluminum matting, in satisfactory condition with a temporary runway lighting system. The heliport is not available for fixed wing use except under unusal conditions. It is restricted to rotary wing aircraft, either under test or in support of test. The heliport has four aircraft parking spaces; one lighted taxiway; two aprons, one 400 x 200 feet, and one 380 x 150 feet; and a dual hangar 250 x 135 feet with two door openings, 80 feet each. There is no compass swing base, no electronic landing aids, no aircraft wash or repair facilities, no on-off loading facilities and limited tank truck fueling facilities. A limited traffic control capability is available during daylight hours.

(c) Other Facilities - The Marine Corps Air Station and Yuma International Airport (adjacent areas) are located at Yuma, Arizona. Commercial air passenger and freight service is provided at this point with several local carriers connecting to Phoenix, Arizona and San Diego and Los Angeles, California.

(2) Railroads

The main east-west line of the Southern Pacific Railroad passes 3 to 5 miles south of, and nearly parallel to, the southern reservation boundary. There is a siding for off-loading materiel destined for YPG. This is the Blaisdell Siding, the closest approach (1/16 mile) off the railroad to Highway 95, in the area. The Army has constructed a 4,000-foot spur leading from the siding into a small ravine. This spur track is used when off-loading Army materiel.

(3) Roads

(a) Interstate Highway 8 (US Route 80) is a major east-west transcontinental route, lying about 6 miles south of, and paralleling, the southern YPG boundary of the reservation. This road passes through Yuma, Arizona. US Highway 95, a two-lane, asphalt paved, north-south route links San Luis and Parker, Arizona. This road passes through Yuma and crosses the YPG reservation. It connects with Interstate 10 (US Routes 60-70) at Quartzsite.

(b) Interior roadways on the reservation are paved where they serve to connect the various areas. Intra-range roadways are usually gravel, although a major paving program has been initiated.

(c) Transcontinental bus service to Yuma is provided by Greyhound Bus Lines and Continental Trailways. Daily bus service is provided by the Army between Yuma and YPG at a nominal cost.

(d) Intrastate freight serving YPG is provided by ten franchised companies, interstate service by three companies.

(4) Sea

San Diego, California, 190 miles west of YPG, has the nearest ship docking facilities. The nearest railway connected port is Los Angeles, California.

d. Base Support

Located in the Main Post area are most of those facilities required to provide administrative and base support to the various activities, teams and boards. Among these are housing, messing, portions of maintenance, repair and storage, medical, educational, religious, security, recreational, and other administrative services. Administrative facilities are located in the vicinity of the Main Gate; family housing is located on the east and south edges; enlisted barracks and messing facilities are located in the central section. On the north and west perimeters, farthest away from the cantonment areas, are located maintenance, equipment pool and facility engineer shops.

The troop housing area consists of one permanent, noncombustible enlisted men's barracks of 436 man capacity and seven semipermanent barracks with a total capacity of 260 men.

Approximately 46,000 square feet of adequate ordnance storage space is available. This space is contained in 48 separate facilities located at eight different sites on the installation.

Munitions and weapons test areas are available and include artillery inspection, a modification and maintenance shop, weapon emplacement sites, munition inspection, assembly and disassembly buildings, temperature conditioning facilities, and range observation equipment.

e. Recurring Commitments

YPG's range areas are used by the 180th Field Artillery Unit of the Arizona National Guard and other reserve units to conduct training exercises. All training exercises are coordinated well in advance to avoid conflict with YPG's testing mission.

f. Special Operating Restrictions

None.

g. Facility Organization Chart

Figure J-2 shows the organization of YPG.

U.S. ARMY YUMA PROVING GROUND

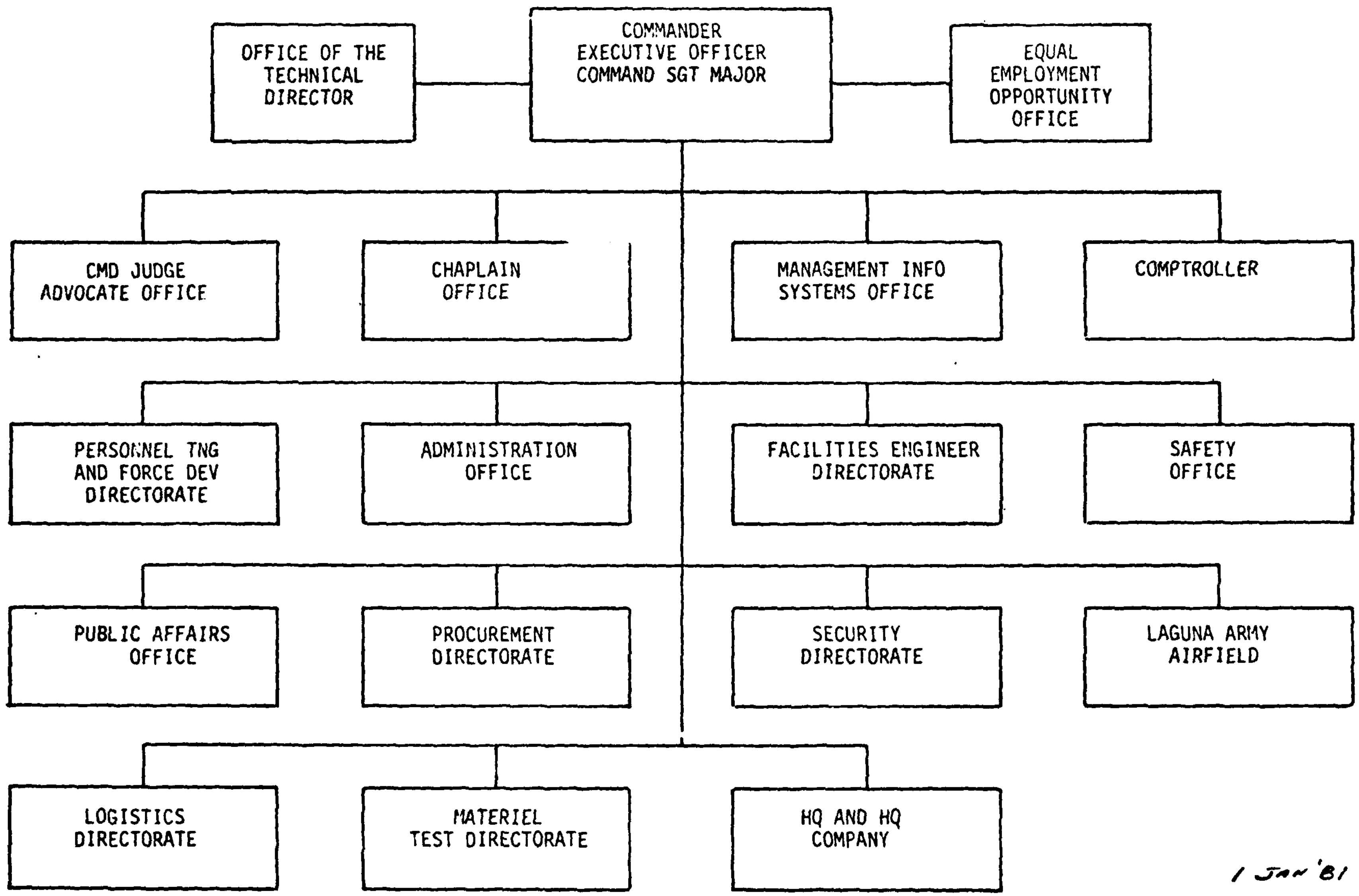


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Fig. J-2 Organization Chart

h. Environment (Climate)

The climate is characterized by clear skies, low relative humidity, large diurnal temperature variations, and slight rainfall. On almost one-half of the days of the year , temperatures exceed 90 degrees F. The average daily maximum temperature exceeds 100 degrees F during June, July August, and September. The temperature of objects exposed to direct solar radiation may range up to 80 degrees F higher than the ambient air temperatures.

The annual rainfall is about 2.5 inches. This rainfall is received in showers of short duration and moderate-to-heavy intensity. This type of rainfall in the desert areas is conductive to flash flooding with the attendent hazard to roads, utility lines, and buildings. The amount of rainfall in individual years may vary from 1/2 inch to about 6 1/2 inches. Any month, however, in a given year may be absolutely dry.

A significant feature of the Yuma area is the absence of cloud cover during the day and the associated high rate of solar radiation received at ground level. Annually, Yuma has 245 clear days, 88 days partially cloudy, and 32 days which are cloudy. Heavy fog in the morning hours occurs about 2 days per year, and wind storms occur about 10 days per year. Visibility is at least 10 miles throughout 95 percent of the daylight hours. Restrictions to visibility usually are caused by blowing dust and sand.

i. Topography

Approximately 870,000 acres are contained within the reservation (See Table 1). The reservation itself is within one of the largest uninhabited areas in the United Sates. It provides a variety of terrain for a wide range of testing programs. Mountains of schist, granite, and miscellaneous rock, ranging in height up to 2,770 feet, are scattered throughout the installation, and cover approximately 40 percent of the area. Remaining areas are well developed alluvial fans and intervening valleys in which clay, sand, and gravel support desert vegetation. Geomorphically, the installation falls within the Basin and Range Providence of North America. The Proving Ground covers the following types of generalized landscapes. (These landscapes were described by a Corps of Engineer slope study and were developed by combining plan-profile, slope occurance, slope amplitude, and relief data):

Landscape Type	Percent at YPG
Rugged Mountains	20
Moderately Rugged Mountains	20
Rugged Hills	10
Alluvial Fans	30
Alluvial Aprons and Plains	20

The alluvial fans are well-developed, coalesced, detrital slopes (bajadas). The fan and apron areas are intensely dissected by intricate wash complexes. Apron and plain surfaces generally appear as flat desert pavement or "malpais."

The soil types of half the installation are predominantely coarse grained. Samples from the range may contain up to 90 percent sand. Over a quarter of the installation is characterized by mosaics of bare rock and stony soils with a few scattered patches of coarse and fine grained soils. The remainder of the installation, particularly along the Colordo River, is made up of fine grained soils, predominantely silts with some clays. Figure J-3 - Airspace Map.

A major terrain asset is the California sand dune area, known as the Yuma Sand Hills. YPG has a conditional use permit for this when required. This dune area lies about 42 miles from YPG and is accessible from Interstate Highway 8. The area consists of approximately 25 percent flat "sheets" of loose sand. The remainder of the area is made up of complex dune structure, with the barcan type predominating.

YPG is bordered on the west by the Colorado River. In close proximity are the Imperial Dam (irrigation diversion) and the Senator Wash Dam (an equalizing reservoir). This proximity enables YPG to test amphibious qualities and water susceptibility which is an unusual capabilty in a desert environment.

j. Airspace Restrictions

The restricted airspace envelopes over YPG include:

- R-2306 A&B (0 to 80,000 feet) covers all of the Cibola Range Area except a small strip about one mile wide and 10 miles long (north-south) along the western bundary of YPG, which is covered by R-2306C (0 to 17,000 feet).

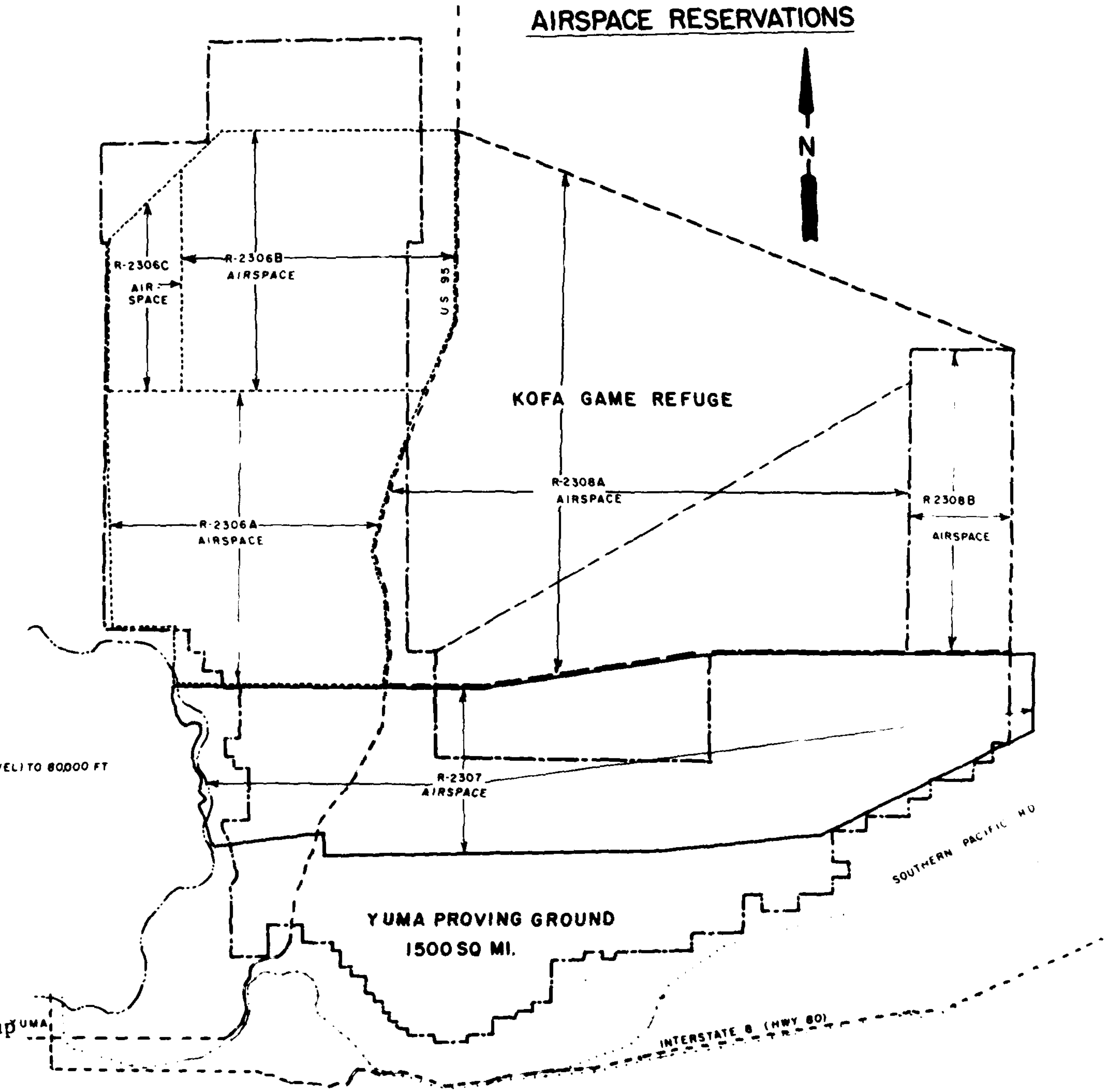
- R-2307 (unlimited ceiling) covers the KOFA Firing Range area and the air drop zones.

- R-2308A (1,500 feet above ground level to 80,000 feet) extends to the northeast leg.

- R-2308B (0 to 80,000feet) covers the northeast leg of the Proving Ground, and is adjacent to R-2307.

- R-2311 (1,500 feet to 5,500 feet) temporarily restrictd airspace for drone flights only.

The boundaries of these envelopes are shown in Figure J-3.



R-2306A - SURFACE TO 80,000 FT
R-2306B - SURFACE TO 80,000 FT
R-2306C - SURFACE TO 17,000 FT
R-2307 - SURFACE TO UNLIMITED
R-2308A - 1,500 FT AGL (AT GROUND LEVEL) TO 80,000 FT
R 2308B - SURFACE TO 80,000 FT

Fig. J-3 Airspace Map

k. Power Availability

Primary power is purchased from the Parker-Davis and Colorado River Storage Project of the US Water and Power Resources Service and the Arizona Public Service Company. The fee structure is complex and includes costly continuing penalities if predetermined levels are briefly exceeded. Because of these costs and Department regulations on energy conservation, any new use of electric power must be carefully planned, monitored, and controlled.

Power is transmitted from the USWPRS-owned Gila Substation (located near Yuma, Arizona) via 10 miles of 336 MCM ACSR Army-owned 34.5 KV subtransmission line with a capacity of 12.7 MVA (at 4% voltage drop and 85% PF) to a point referred to as "the Y." At this point, the line forks to the northwest and north. The NW branch serves the Main Post, Mobility Test, and Laguna Army Airfield areas. The north branch serves the Kofa and Cibola Ranges as well as the Castle Dome Heliport and Annex. Distribution voltages from the YPG substations range from 4.16 KV to 12.47 KV. Some remote areas are furnished power directly from a Government-owned 34.5 KV line tied to Wellton-Mohawk owned lines. (An alternate source is the Gila/Senator Wash Resevior Pumping Station line with a maximum availability of 13.5MVA.)

Emergency and standby power is provided for certain areas and functions related to safety, security and health as follows:

1)	Building S-14967,	Pump House,	Main Post
2)	Building S-2195,	Pump House,	Mobility Test Area
3)	Building S-3525,	Pump House,	KOFA Range Area
4)	Building S-990,	Health Clinic, 50 KW automatic start	Main Post
5)		60 KW automatic start	Laguna Army Airfield,
6)		MP Desk, 5 KW	Main Post,
7)	Building 703,	Sewage Lift Station, automatic start,	Main Post

Substations located on the installation from which the primary distribution circuits originate:

1)	Main Post	34.5 KV/4.16 KV	at	2,500 KVA capacity
	Main Post	34.5 KV/12 KV	at	2,500 KVA capacity
2)	Mobility Test Area	34.5 KV/12 KV	at	3,000 KVA capacity
3)	KOFA Range Area	34.5 KV/12 KV	at	1,500 KVA capacity
4)	Castle Dome Heliport	34.5 KV/12 KV	at	1,500 KVA capacity
5)	Cibola Firing Range	34.5 /12.47 KV	at	500 KVA capacity
6)	Main Alternate	69 /34.5 KV	at	10,000 KVA capacity

The existing electric distribution system has been recently expanded to include the alternate source of power and provision of firm power to down range test sites.

Basic Electrical Distribution Data:

1)	Exterior Lighting Lines (Security and Street Lights)	96,000 LF
2)	Power Lines	824,000 LF

1. Communications

(1) Telephones

External - Connections to long distance commercial telephone circuits of the Mountain Bell Telephone Company at Yuma are provided by a leased 180 channel microwave system. There is a 25-pair cable from the Chemical Test Area to the Martinez Lake Mountain Bell Facility, a distance of approximately 6 miles. This line serves as a backup feature to the present microwave system between YPG and Yuma.

Internal - Telephone circuits throughout the areas of the installation are served by both underground and aerial cable facilities. Service to the following areas is as follows:

1) Kofa Range - The Kofa Range, is served by a 100 pair trunk cable from the main post area 10 miles away. There is a 300 line Stromberg-Carlson telephone exchange at Kofa which serves the immediate areas as well as downrange users. The Kofa dial exchange has a technical control patch facility for interconnecting test project data/voice links. The Kofa range internal communications cable system is almost 100 percent underground and consists of the following major cable systems:

(a) South Boundary Facility, consists of 18 miles of 50-pair buried, pressurized and grounded cable, 7 miles of 50-pair aerial cable, approximately 8 miles of 25-pair and 67-pair buried cable, and 6 miles of open wire for a total reach of 39 miles downrange.

(b) Mid-Range Cable Facility consisting of approximately 16 miles of 50-pair buried, pressurized and grounded cable;

(c) North Boundary Cable Facility presently consists of approximately 18 miles of old lead-sheided aerial cable. This is scheduled for replacement with a 50-pair direct-buried cable system.

There is a 100-pair cable serving the Kofa fixed gun positions. In addition, a 25-pair special purpose instrumentation cable serves these facilities to enable low transmission loss of low-level analog data information from munitions and weapons testing.

2) Main Post - The Main Post Area is served by a Stromberg-Carlson 1200-line telephone exchange. Cable facilities in this area consist of approximately 70,000 feet of cable ranging in size from 6-pair up to and including 600-pair. This system has direct in-out dialing, both with commercial and AUTOVON circuits. Secure AUTODIN message service is available through the telecommunications center. Common user facsimile service is also available at this location. A 4 position Stromberg-Carlson cord-type switchboard provides information and operator assistance during normal weekday duty hours (special non-duty hour assistance can be arranged by the ACCOM Commander).

3) Mobility Area - The Mobility Test Area, some 5 miles from the main post, is served by a 200-pair cable from the main post and two 100-pair cables from a repeater cross-connect facility. There are approximately 50,000 feet of different size of communication cables within this area. Recently added to the area is the service of a 48-channel digital subscriber carrier system.

4) Chemical Test Area - The Chemical Test area, approximately 6 miles from the main post, is served by a 100-pair cable from a repeater facility.

5) Castle Dome Complex - The Castle Dome Heliport and Annex are located 21 miles from the Main Post area and are served by an on-site Stromberg-Carlson 300-line exchange. This Castle Dome exchange is served by a 50-pair direct-buried cable in conjunction with a 24-channel frequency-division multiplex carrier system from the main post telephone exchange. There are over 200,000 feet of different size communication cables within these areas.

6) Cibola Range - The Cibola Range Area, which extends from 35 to 50 miles from the Main Post Area is served by both a 50-pair aerial cable of 160,000 feet from the Kofa Main Front and a 100-pair cable of 21,000 feet from the Castle Dome Exchange. Two Simplex real-time microwave systems (one of which is a high speed data system) also serve this area.

7) Laguna Army Airfield - The Laguna Army Airfield, some 3 miles from the Main Post, is served by a 200-pair cable from a repeater racility.

In addition to the above cable and telephonic facilities and systems, YPG also has the following Government owned and operated telecommunication systems:

1) A Defense Communication Agency (DCA) Telecommunications Center with AUTODIN send/receive facilities for narrative and data card traffic. This is the only facility in the immediate Arizona-California area with the capabilities to provide TOP SECRET classification protection.

2) Capability for all levels of maintenance on UHF, VHF and avionic systems that support both the airfield and testing operations.

3) Intercom, technical control, radio/wire integration master control consoles, and subscriber carrier systems in support of all missions conducted at the installation.

4) Approximately 20 microwave links that process test data from the instrumented range areas to data reduction and command-control locations. This test data consists of high-resolution broad-band video, 512 kilo-bit digital data, 150 KHz analog data, and numerous 9600 and 2400 baud information channels. In addition, there is a duplex real-time color video microwave link between YPG and the National Parachute Test Range near Seeley, California, some 62 miles distant.

5) Solar-powered portable wideband microwave systems and VHF radio networks in support of mission testing.

6) Communications are being established with the Defense Advanced Project Research Agency to provide interagency usage of packet-switching computer data through the ARPANet (including interconnecting of selected word and data processing terminals through 300 baud acoustic couplers). (Currently there are five directories accessing the net through AUTOVON ties to open host TIPs.)

7) A secure voice AUTOSEVOCOM terminal for use by all personnel of YPG that have a need for secure telephonic communications through the AUTOVON voice system.

8) A common-user facsimile terminal located in the Telecommunications Center for a common-user basis. This terminal can be used to send/receive material appropriate for facsimile transmissions.

9) A terminal is being installed to access the Defense Technical Information Center RDT&E information system, located at Cameron Station, Virginia.

(2) Radio

There are many diverse radio voice networks available for use at YPG. In use at the present time are five range repeaters, one of which is 100 percent solar-battery powered:

- Repeater #3 - North/South Cibola

- Repeater #4 - East/West Kofa

- Repeater #5 - South Cibola / West Kofa

- Repeater #6 - East/West Kofa

- Repeaters #1 and #2 are currently not in use (frequency constraints)

- Repeaters #3, #4, and #5 have touch telephone interconnect capability. Compatible radios are available, if scheduled.

These repeaters are accessible by 61 portable radio sets (Handie Talkies). There are approximately 350 mobile radios, 10 solid-state base stations and 100 remote units currently in use. Radio communication networks at YPG consist of the following:

- Kofa Range No. 1
- Air Movements & Special Projects
- Cibola Range
- Military Police / Security Guards
- Transportation / Facility Engineer
- Automotive [aka Mobility Test]
- Fire / Crash
- Mission Control No. 1
- Mission Control No. 2
- Global Positioning System
- Cinetheodolite Master Control

There are approximately 200 radio frequencies assigned to and in use at YPG. Besides the above-listed voice networks, frequencies are dedicated for telemetry transmission, microwave data links, specific projects, command/control (and remote control of moving ground targets), range timing, and entertainment television.

3. DIMENSIONS

a. Landspace

Approximately 870,000 acres are contained within the reservation (See Table J-1).

Table J-1

US Army Yuma Proving Ground Real Property Status

Real Estate Within the Reservation Boundaries:	Acres
Public Domain Withdrawal	861,762.85
State of Arizona Grazing Lease	7,562.34
Privately Owned Land	650.61
Patented Mines	280.58
Subtotal	870,166.38 *
Real Estate Outside the Reservation Boundaries:	
Blaisdell Site	81,621.00
Electric Transmission Line from Gila Substation	57.30
Swamp Test Area	1,004.00
Access Road and Adjacent Land	379.00
Buffer Zone (KOFA Game Refuge)	171,000.00
Subtotal	254,061.30
Total Land Under Custody/Accountability of Army	1,124,227.68

* As a result of E.O. 11508, the Dept. of the Army is relinquishing 32,246 acres of unimproved real estate to the Bureau of Land Management. Most of this land is in the Muggins Mountains. Action is still pending as of 1 March 1980.

(1) Test Area Contiguity

Figures J-4 through J-7 show the location of the YPG test areas. A description of these areas can be found in Section 3.a(4) below.

(2) Easements

A description of the various easements in effect at YPG can be found on Drawing No. 18-02-2-0-0, Reservation Map, Real Estate and Land Use, Yuma Proving Ground, AZ, dated 1 August 1972 (available on request from STEYP-FED). These easements are mainly privately owned land areas, grazing rights, and mineral claims.

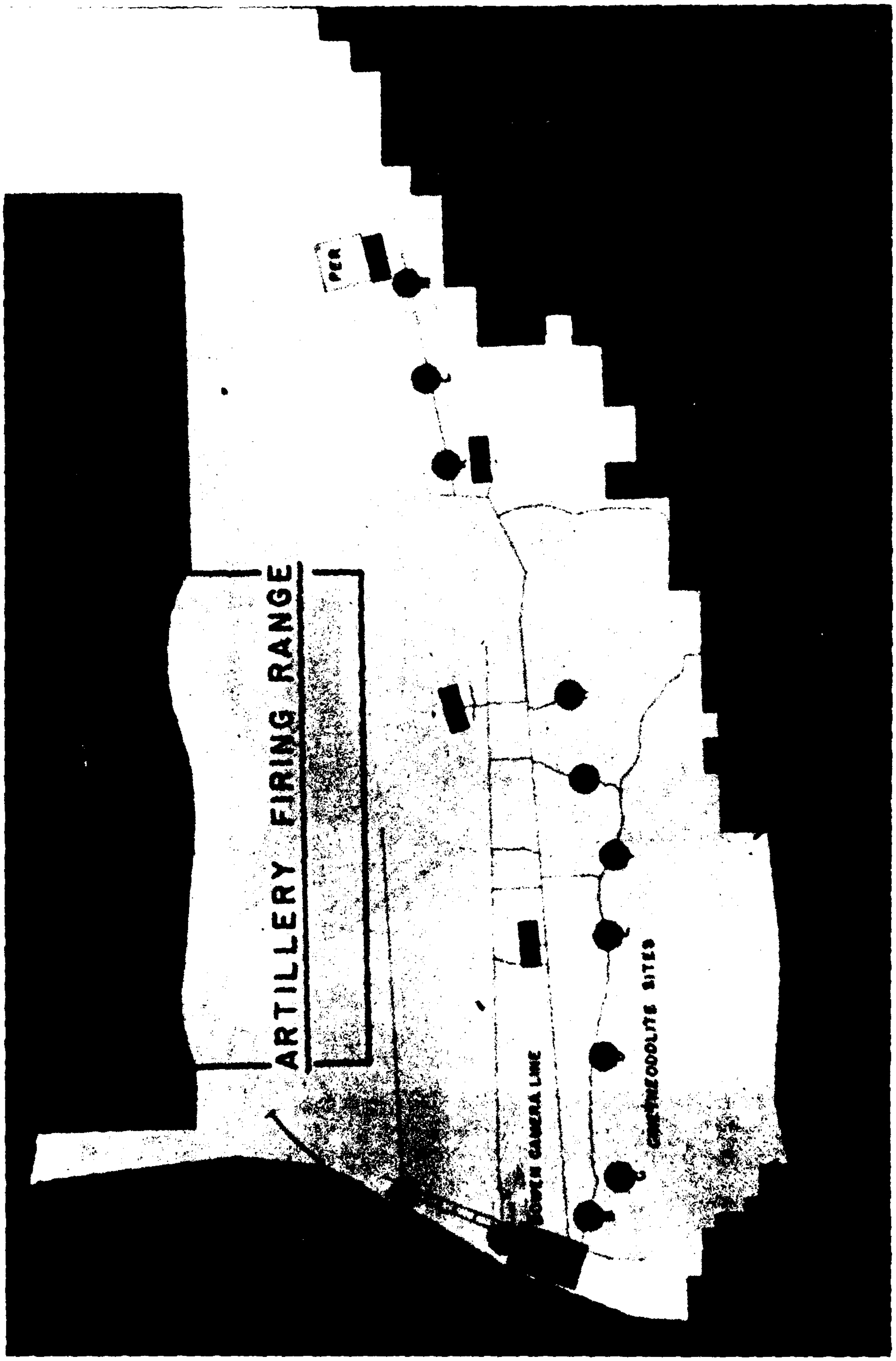


Fig. J-4

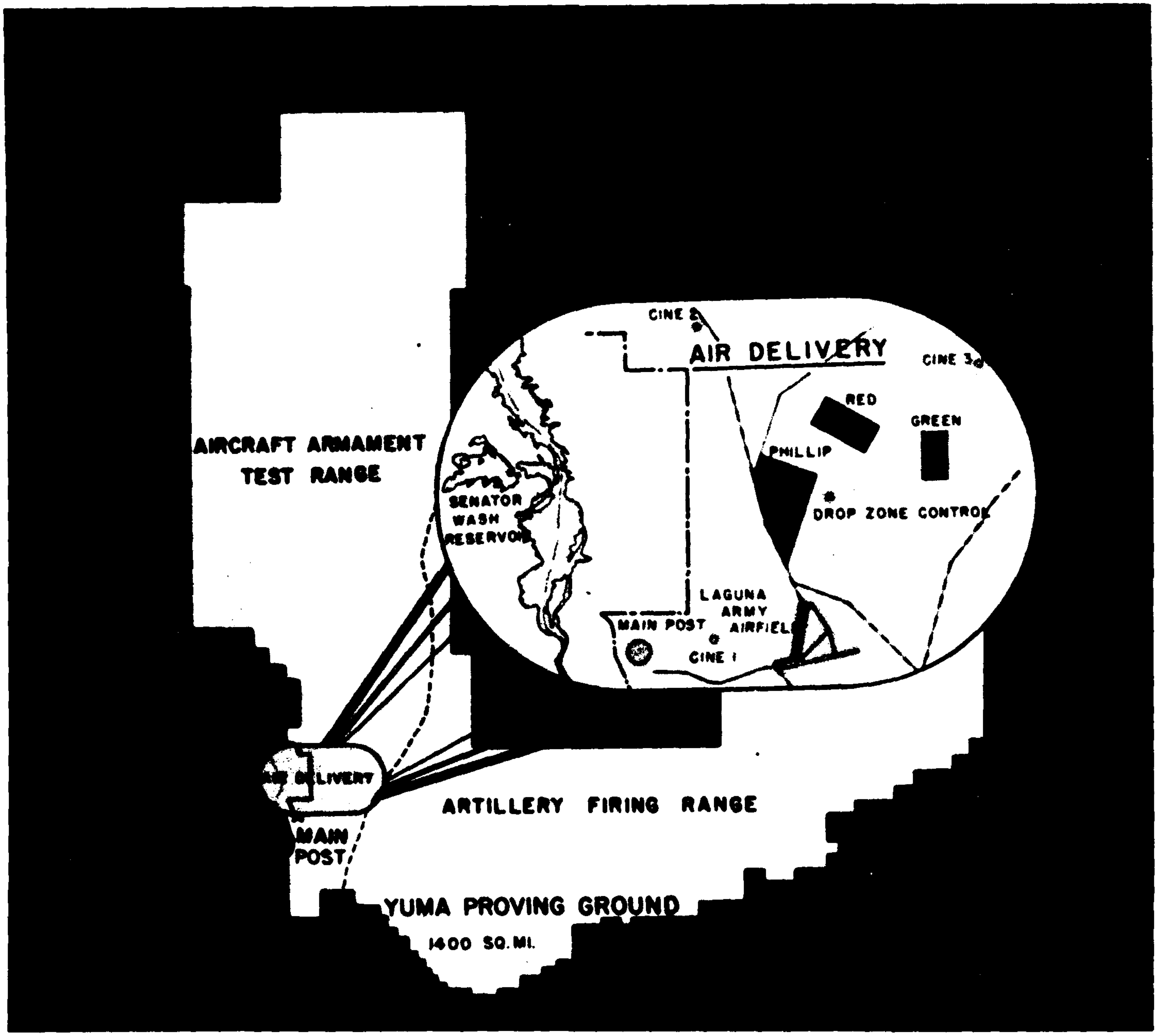

AIRCRAFT ARMAMENT
TEST RANGE
AIR DELIVERY
RED
GREEN
PHILLIP
DROP ZONE CONTROL
SENATOR
WASH
RESERVO
LAGUNA
ARMY
AIRFIEL
MAIN POST
CINE 1
ARTILLERY FIRING RANGE
MAIN
POST
YUMA PROVING GROUND
1400 SQ. MI.

Fig. J-5

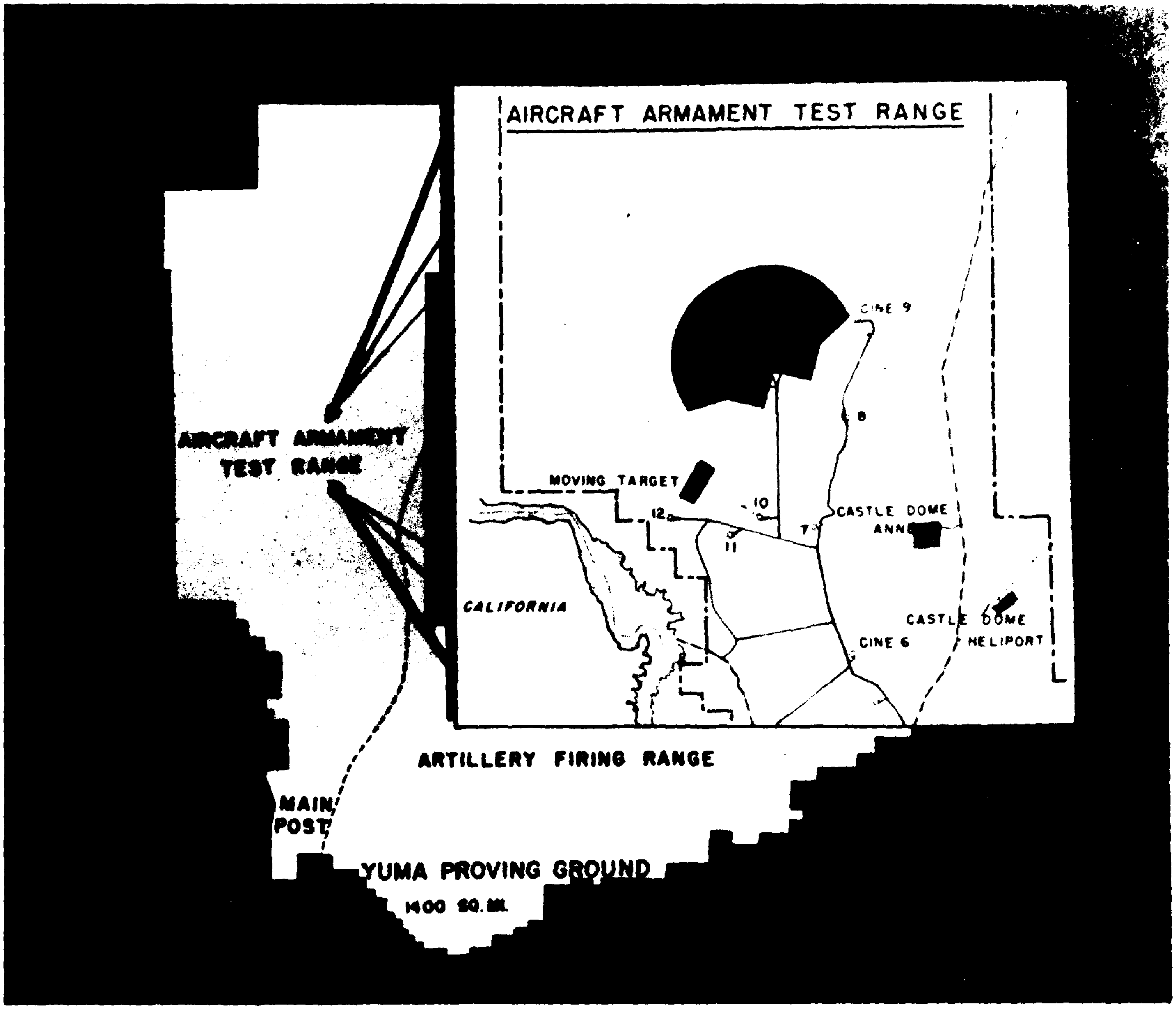

AIRCRAFT ARMAMENT TEST RANGE
CINE 9
8
MOVING TARGET
10
12
11
7
CASTLE DOME
ANNEX
CALIFORNIA
CASTLE DOME
HELIPORT
CINE 6
AIRCRAFT ARMAMENT
TEST RANGE
ARTILLERY FIRING RANGE
MAIN
POST
YUMA PROVING GROUND
1400 SQ. MI.

Fig. J-6

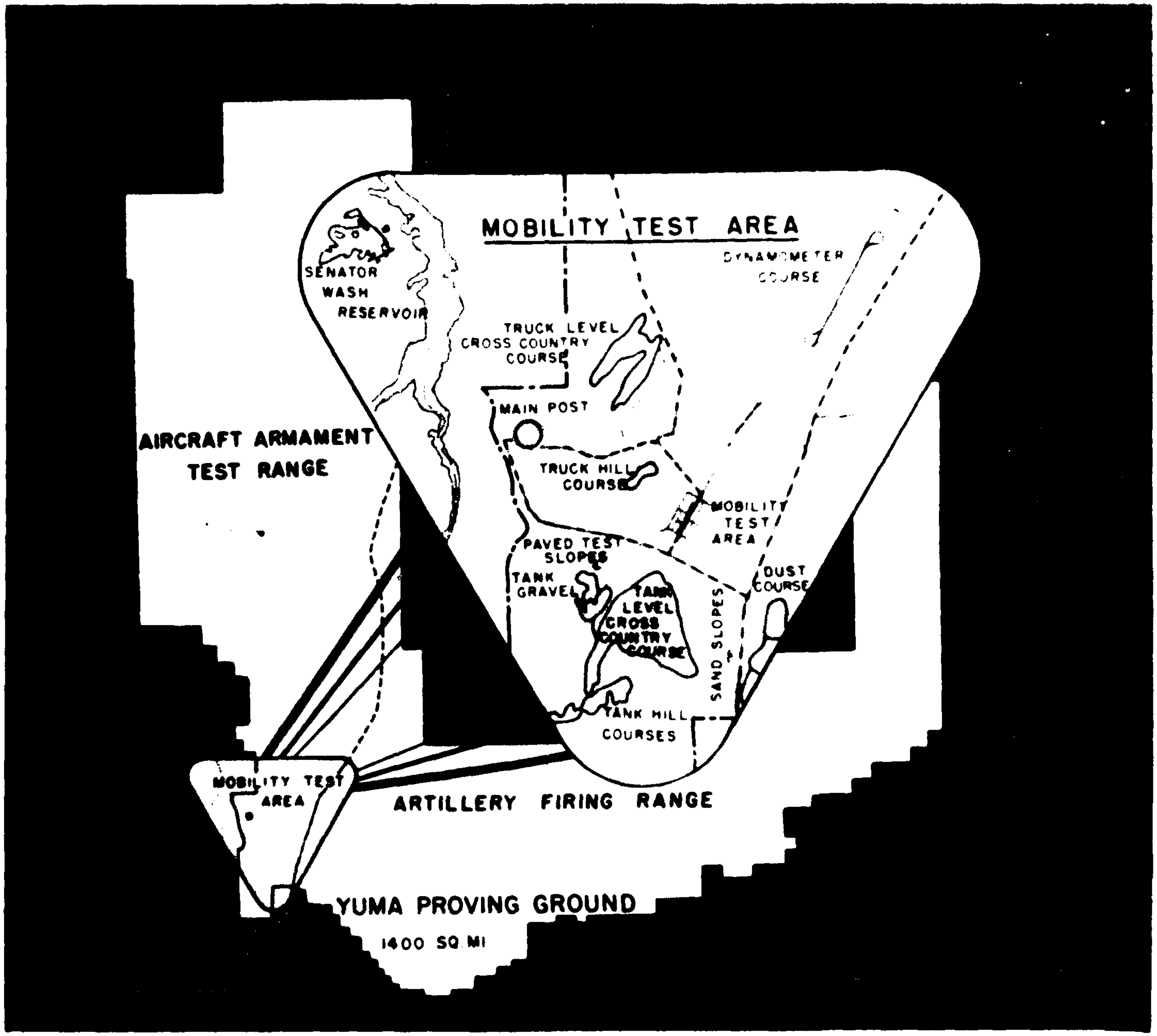

MOBILITY TEST AREA
DYNAMOMETER COURSE
SENATOR WASH RESERVOIR
TRUCK LEVEL CROSS COUNTRY COURSE
MAIN POST
TRUCK HILL COURSE
MOBILITY TEST AREA
PAVED TEST SLOPES
TANK GRAVEL
TANK LEVEL CROSS COUNTRY COURSE
SAND SLOPES
DUST COURSE
TANK HILL COURSES
AIRCRAFT ARMAMENT TEST RANGE
MOBILITY TEST AREA
ARTILLERY FIRING RANGE
YUMA PROVING GROUND
1400 SQ MI

Fig. J-7

(3) Impact/Live-Firings Areas

These areas are selected at the time of scheduling and are based on their availability as well as the type of munition.

(4) Test Areas

The following is a brief description of the major test facilities in existence at the present time:

(a) KOFA Firing Range

This area is in the southeastern part of the reservation and extends east of US Highway 95 to the eastern boundary. This range is approximately 6 miles wide and 40 miles long. It is oriented in and east-west direction over a relatively flat plain bounded by mountains and rolling hills to the north, east, and south. Small rugged mountains partially bisect the 65,000 meter artillery range.

(b) Cibola Firing Range

This area, composed of relatively large plains, surrounded by mountains, is approximately 18 miles wide and 40 miles long. It includes all of the western leg within the reservation boundaries lying north of the Chemical Test Area. The range was developed for aircraft armament testing. Its size, isolation, and the natural barriers afforded by the surrounding mountains, together with an advanced, real-time tracking and event instrumentation system have resulted in considerable expansion of the range's scope. As a result, current use ranges from attack helicopters to surveillance drones and navigation satellites.

(c) Mobility Test Area

This area is flat terrain bounded by low lying hills to the north and west. The flat terrain extending to the south is suitable for expansion of the area with minimum site preparation. It is close (2 to 5 miles) to the KOFA Firing Range, Laguna Army Airfield, Main Post, and numerous vehicle test courses even though all may be in use simultaneously.

(d) Laguna Army Airfield

This facility is located in the center of a large valley with flat terrain and low-lying hills to the north, west, and south. There are no land obstructions within 1.5 miles of the main runway, and the approach zones are unobstructed. The unrestricted characteristics of this area make it a suitable location for facilities related to aircraft operations.

(e) Main Post

This area, located on an alluvial fan, is bounded on the north and east by jagged hills, on the west by the Colorado River, and on the south by rolling terrain laced with gullies and washes. This area is best suited for family and troop housing activities.

(f) Castle Dome Heliport

This facility is located on a large plain with rugged mountains to the east and west. The plain is continuous to the north and south of the heliport facility.

(g) Chemical Test Area

This area is in the midst of gently rolling terrain in a large plain that marks the southernmost beginning of the Cibola Firing Range.

(h) Test Courses

Test courses are located in various parts of the reservation. They include test slopes, obstacles, a water-spray simulation device, a bore-sight range, fuel blending facilities, paved and gravel roads, a cross-country courses, and base-line areas representative of world desert types. These facilities are used to perform test and evaluation of wheeled and tracklaying vehicles, components, fuels, lubricants, and other items generally related to the automotive field. Most of the facilities are improvised; however, they are considered to be typical of conditions encountered in similar deserts of the world. The YPG Desert Terrain Data Base permits modeling to simulate mission profiles and "risk designs" for a majority of the deserts of the world. Most "Standardized" courses can be replicated if needed. The test courses and facilities are described as follows:

- Dust Course: A one mile oval course established in an area of finely divided silt and sand.

- Truck Level-Cross-Country Course: A 6.4 mile cross-country course over typical desert terrain.

- Truck Hill Course: A 2.7 mile course located in the hills adjacent to the Mobility Test Area with grades up to 20 percent.

- Truck Gravel Course: A 3.6 mile compacted and graded gravel course for testing tracked vehicles and heavy trucks under conditions similar to a secondary gravel road.

- Tank Cross-Country Course: A 6.7 mile desert cross-country course located on level, sandy terrain for testing tracked vehicle durability.

- Tank Hill Course: A 5.2 mile course located in rocky mountains to the south of the Mobility Complex.

- Vapor Lock Course: One, three, and seven mile loops located in a dry wash, providing an area for testing vehicles on cross-country terrain under severe temperature conditions.

- Paved courses are used for endurance tests of both wheeled and tracked vehicles, as well as high-temperature related performance tests (eg. braking, cooling, etc.):

  -- US Highway 95, which crosses the proving ground for a distance of 50 miles,

  -- a level 5 mile test course adjacent to Highway 95,

- Obstacle and Slope Courses: Vertical wall obstacles of 12, 18, 24, 30, 36, 42, and 48 inches in height are available.

- Vehicle Turning Circle: For measuring turning radii, fields of vision, and fields of fire of vehicles.

- Water Spray Facilities: A water spray deluge facility to determine the effectiveness of sealing against the entry of water.

- Bore Sight Range: A 1500-yard measured range for aligning and checking sighting systems.

- Dynamometer Course: A course two miles in length, 30 feet in width, with 500-foot radius turnarounds at each end.

- Dynamometer Course (Sand): A prepared, straight, level course of loose dry sand, 900-feet in lenght, used to determine vehicle speed and tractive effort in sand.

- Water Test Facilities: A fording basin and mud course are located on Department of Interior controlled land adjacent to the installation with use under an agreement basis.

b. Airspace

(1) Landspace/Airspace Relationship

The three major restricted airspaces over YPG include:

(a) The Cibola Range, approximately 460,000 Acres, is covered by R-2306 A&B (0 to 80,000 ft.) except a small strip about 1 mile wide and 10 miles long (north-south) along the western bundary of YPG, which is covered by R-2306C (0 to 17,000 feet).

(b) R-2307 (unlimited ceiling) covers the KOFA Firing Range area and the air drop zones, extending the full width of the Proving Ground, 56 miles from the Colorado River eastwards to the reservation boundary. It provides adequate space for testing such items as high altitude artillery, rocket firing, bomb drops, and aerial delivery.

(c) R-2308A (1,500 feet above ground level to 80,000 feet) extends to the northeast leg, including a major portion of the Kofa Game Refuge. It permits firing long-range artillery from the southwest to the northeast corner of YPG as long as there are no impacts within the refuge. A portion of this area, R-2308B, is restricted from surface to 80,000 feet to permit firing in the north-eastern leg (along the eastern edge of YPG).

The boundaries of these envelopes are shown in Figure J-3.

(2) Easements

Federal Airway V-66 is immediately south of R-2307 and overlays the extreme southern section of YPG. V-66 has a lower control altitude of 3,500 feet mean sea level (MSL) in this region. Thus, aircraft flying V-66 overfly the Mobility Test Area and the south string of the KOFA Range cinetheodolites. Just north of R-2306B is Airway V-16-94, whose lower control altitude is 5,500 feet MSL.

(3) Manned/Unmanned Airborne System

Airspace R-2306 (surface of 80,000 feet) covers the Cibola Range, which encloses the helicopter and aerial navigation system test areas. All Army aircraft weapons can be tested at YPG.

(The Marine Air Station at Yuma also uses the Cibola airspace regularly for air combat maneuver training.)

(4) Unmanned Airborne System

The entire KOFA Firing Range is within airspace R-2307, surface to unlimited, allowing firing of all weapons at any elevation angle. High altitude Research Project (HARP) firings using a modified 16-inch Naval rifle were made on this range.

(5) Area Surveillance

YPG has no air surveillance radars. Coverage of various portions of YPG-controlled airspace can be provided by radars at the USAF Oatman Mountain Facility and the USMC Air Station at Yuma. Such coverage requires special agreements. Airspace Operations are coordinated through YPG.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) PLS System

The Position Location System (PLS), uses a line-of sight, FM multiranging technique for 3-dimensional, real-time simultaneous tracking of up to 64 moving elements. The PLS system has been deployed with a currrent operation capability of tracking six moving elements. Up to 64 elements can be tracked with the addition of a transponder (Micro-Mount) for each additional element. The moving elements can be either high or low performance fixed-wing aircraft, rotary wing aircraft, ground tactical vehicles, infantry personnel or a combination of these. The system consists of three major components:

(a) One C-Station - The master station of the system. All data is collected, reduced and presented in real-time at the C-station.

(b) Five Micro-A Stations - These units are the ground interrogator stations which collect the data from the moving elements transponders and relay it to the C-station.

(c) Eight Micro-B Units - These units are the transponders being carried by the moving element and which transmit ranging and communication data.

The design accuracy of the system is ±3 meters in X and Y positions, and ±10 meters in altitude. The event data communication capability is 2000 bits/sec (excluding X, Y, Z data).

(2) Radar

(a) AN/MPS-25:

An AN/MPS-25 (transportable tracking system has been transferred from the White Sands Missile Range. It is a C-band pulse radar operating in skin or transponder tracking modes. The radar and its accompanying plotting vans provide real-time and post-flight trajectory, special measurement data, and acquisition/pointing commands for other range instrumentation.

Tracking is specified out to 500 miles with accuracy dependent on target size or beacon characteristics. The unit can record digital or analog data and can transmit in real-time digital data to a central computer system for display or post-flight analysis.

(b) AN/MPQ-33C/D:

In addition, a velocimeter system consisting of an AN/MPQ-33C and an AN/MPQ-33D illuminator, transmitters, and receivers is available. The radial velocity of a missile is measured for post-flight analysis as follows:

- Velocity precision: ± 5 ft/sec
- Maximum velocity: 10,000 ft/sec
- Minimum velocity: 100 ft/sec

Data outputs are:

- Quick-look strip charts
- Magnetic analog tape
- Computer display/printout

(c) AN/TPQ-39(V):

A prototype digital instrumentation radar (DIR) developed for acquisition of trajectory data on artillery projectiles and application to related artillery range problems. A single unit, it is designed to operate in the hot-dry desert environment. The radar operates in the C-band (5400-5900 MHz) permitting operation with existing transponders, minimizing interference with other range systems. The AN/TPQ-39 has been used in a variety of acquisition and tracking roles, including supplementation of MPS-25 coverage.

(d) Ballistic Acceptance Testing Radar (ARBAT):

YPG is testing a ballistic radar being developed by ARMCOM which is expected to remain at YPG and become a part of range instrumentation for artillery testing. Design performance features are as follows:

- Angular Accuracy: Total elevation error of 1.7 mils and an azimuth error of 1.54 mils at 15 kilometers.

- Range Accuracy: Within 7.5 meters at 15 kilometers.

- Doppler Velocity Accuracy: 1 meter/second is obtained.

Other features to be included in ARBAT are:

- Real-time data analysis
- Only two operators
- Inertial-less electronic beam steering.

(3) Laser

Four Precision Automated Tracking Systems (PATS) are in use at YPG at the present with the fifth to be installed during FY-81. A laser radar that can very accurately determine the position of an aircraft fitted with a retroreflector. A single van-mounted system automatically determines azimuth, elevation, and range to the aircraft at a rate of 100 sample sets per second, out to a range of approximately 20 miles.

The target retroreflector is an optical reflector with three internal mirrors arranged so that incident energy is returned to the tracker with high efficiency. Reflector arrays are small, lightweight, and very rugged. A variety of retroreflectors are used depending upon physical constraints and the required range of operation.

For manual acquisition, the operator slews the pedestal with a joystick while observing the monitor display. When the target is positioned in the central area of the field of view, the system will lock and automatically begin to track.

For automatic acquisition, the coordinates of the target are computed from remote site data and the pedestal is directed appropriately until lock-on and autotrack are achieved. The operator is not involved during this sequence.

After acquisition, the laser signal returned from the retroreflector is focused on the tracking and ranging receiver detector through a narrowband optical filter that limits background illumination. Range is determined by measuring the round-trip time for each laser pulse. The tracking receiver detects the displacement of the return beam from the boresight axis to provide an error signal for the servomotors to update the mount position.

During track, data is multiplexed and recorded on magnetic tape for subsequent processing. Also a coordinate converter (polar-to-cartesian) and plotter develop real-time analog data in a variety of formats. Six parameters can be plotted simultaneously.

The large variation in return power due to the range coverage of the tracker is compensated for by an optical power control system (designated optical AGC). Optical attenuators are inserted in 20 db steps in the transmitter beam. These are augmented by a continuous 0 to 20 db attenuator in the receiver to provide a continuous 0 to 80 db adjustment range. This is an automatic function during acquisition and tracking, but it is manually preset prior to acquisition.

The laser transmitter has moderately high power; therefore, some restrictions are required to assure complete personnel safety, The laser radiation is highly collimated (less than 1 degree in beam width) and readily controlled. Also, the reticle on the viewfinder provides positive indication of the beam location. The system has an eyesafe range of 350 feet to 3,500 feet, depending on the transmitter power setting. The eyesafe range is defined as the minimum range at which a person can look directly into the beam without any possibility of eye damage. An eyesafe range indicator is provided to assure positive indication of the laser power setting. At no time is the pilot or crew in the danger zone.

(4) Optical

The optical space positioning and velocity vector system is composed of cintheodolittes: 6 Contraves C Model and 3 CF (VIDEO) Model; 3 ballistic cameras (two 35mm Photosonic Model 4C, one 35mm TRAID Model 75); and 92 fixed cameras (30 16mm Milliken Model 4, 60 16mm Milliken Model 5M, and two 70mm photosonic Model 10A) which may be mounted on tracking mounts; with ancillary range time input, communications, and control equipment.

Cinetheodolites are tracking instruments which record the angle data, describing the line-of sight from instrument to target, and central timeing information on photographic film. All cinetheodolites can supply trajectory data support up to slant ranges of 60,000 meters, depending on target site, speed, and background.

Data Precision (Mean)*

Position	± 3 ft
Velocity	± 5 ft/sec
Acceleration	± 25 ft/sec

*Data precision varies with type of cinetheodolites. Data sampling rates from 5 per second to 20 per second.

Fixed and ballistic cameras are used primarily to determine event data of predetermined positions or in terms of central timing. The fixed cameras can supply trajectory data support up to slant ranges of 3000 feet for object drop tests, 1000 feet for missile tests, and 500 feet for projectile tests.

Data Precision (Mean)

Position	± 3 ft
Velocity	± 10 ft/sec
Acceleration	± 20 ft/sec

b. Timing

The range timing system instrumentation includes twenty-seven range timing receivers to receive IRIG timing where neded; a carrier to multiplex the IRIG, timing and pulsing signals; time code generators; distribution amplifiers; and a control console which is used for pulse initiation coincident with a countdown. In addition, new lighter range timing receivers are now available for placement in aircraft.

The range timing system develops IRIG time formats A through E for use as the standard common time throughout YPG. The system will provide time of year information in days, hours, minutes, and seconds with 100-microsecond resolution. Transmission of IRIG timing and synchronizing pulses for cinetheodolites throughout all of YPG is possible. Terminal units are available at the different cinetheodolite sites for demultiplexing range timing and control pulses, operating the cinetheodolites, and translating IRIG timing to the film.

Instrumentation enables a correlation to be made between the range time of the aircraft and the ground instrumentation.

c. Television

(1) Video Scoring System

This system is a combination of off-the-shelf components including an airborne gun-sight and heads-up-display television cammera, a microwave relay link, video recorder, a programmable calculator and a video annotator with a video monitor. The system may be used to evaluate gunner error and missile-tracking error to an accuracy of less than one milliradian angular position for helicopter-borne weapon systems, for overhead scoring of ground impacts from various weapon systems munitions, and for scoring hits on ground targets. The system is used as an operational test system and is being refined by replacement of components with technically improved equipment.

(2) Image Analyzer System

This system is a combination of off-the-shelf components centering around a Digital Image Memory/Processor and computer. The system is to perform certain arithmetic operations on sequential frames of television imagery at rates fast enough to keep pace with a continuous input signal. These operations consist of summing, averaging, and differentiating individual pixel values from frame to frame. The system allows the use of video to measure the beam-position pattern, and divergence-energy-distribution measurement of various laser tracker and designator test programs, such as YAH-64 (AAH) fire control system.

(3) Transient Waveform Readout System (TWRS)

The TWRS is a combination of off-the-shelf components including a television camera, a video tape recorder (VDR), a Spectrum Analyzer, a Digital Image Processor/Memory, and a video disc for computer. The system may be used to gather individual fast rise-time transient events are digitized and stored in memory in the spectrum analyzer. The event is captured and digitized to facilitate analysis of the waveform characteristics. Pulse width, use time, fall time, and instantaneous power levels can be interpreted from this data. From the analyzer, the data is dumped through the IEEE-STD-488, (GPIB) bus to the computer for further processing. This system is used at the YPG Proximity Fuse Test Facility.

(4) Self-Scanned Array Aiming Error System (SAES)

The SAES is currently being developed in-house for measuring the aiming errors of flexible aerial weapon system during aircraft armament test to an accuracy of less than one millirad. The system consists of a miniaturized TV camera utilizing a self-scanned array charge couple device and produces a standard video output. The TV camera will be largely repackaged, and boresighted to the pilot's helmet sight. The data will be reduced either by using the video scoring data reduction method or by interfacing it to a video reader. The system was utilized to support measurement of the aerial accuracy of the Improved Cobra Armament System DT program and the PVT-G Production AH-1S Attack Helicopter tests.

(5) Table J-1 describes other video systems in use at YPG.

Table J-2
YUMA PROVING GROUND VIDEO SYSTEMS

SYSTEM	NO.	PRINCIPLE USE	TAPE or MONITOR SIZE	COLOR or B&W	MANUFACTURER	MODEL	LIGHT RANGE
EDUCATIONAL							
Camera	2	Class-room tape	3/4"	color	JVC		visible
Recorder/Repro-		viewing and	cass'				
ducer	2	general suppt					
Monitor	2	backpack.	17"	color	Sony	1720/1750	
TTS GENERAL SUPPORT							
Camera, vidicon	7	Support of test		color	Cohu	2000/7200/4500	visible
Camera, mini	4	projects as		"	Edo Western	1800	
Recorder/Repro-		required					
ducer	12				Sony	VO3800/2000/2860	
Monitor	10		9/14/17"		Conrac	SNA/RQB/DZB	
Monitor	5		12/17"		Sony	1720/1750	
TTS SPT. PHY							
Camera	1	Monitoring of		B/W	Cohu	2800	
Monitor	1	Environmental	17"	B/W	Conrac	DZB	
		Fac. oper'ns					
TTS SPT AIRCRAFT							
Camera	3	Support of Air		color	Sony	1600/1000/1200	Visible
	6	Armt Test Proj		B&W	Cohu	2000/4500	
					Edo Western	1800	
Camera (ISIT)	3			B&W	Cohu	2800	visible to 10^{-5} ft-cand
Recorder	7		3/4" cass	color	Sony	3800/2800	
Monitor	8		9/14/17"	color	Conrac/Sony	CVM-1700/SNA/DZA	
Range Time Inserter	4				Hill	509	
Microwave							
- Transmitter	4				TarrCom	TCM-602	
- Receiver	4				TarrCom	TCM-602/UHF402B	

d. Photography

(1) Motion Picture Capability

Table J-2 describes the instrumentation motion picture capability of YPG. The majority of these cameras are used in ballistic event camera systems (see 4.g.(1) below). Documentary motion picture cameras are listed in Table J-3. The development of all motion picture film is done on contract, with a typical turnaround time of 24 to 48 hours.

(2) Still Photography

Table J-3 lists the documentary cameras available at YPG. Turnaround time on film may range up to 3 days for color prints.

e. Instrumentation Calibration Capabilities

The Calibration Section of MTD is capable of performing the following:

(1) Mechanical Measurements

Dimensional calibration using a gage block calibration system and a Pratt and Whitney measuring machine: Certification of gage blocks up to 24 inches with acuracy of +10 microinches. Length transfer standards up to 12 inches with an accuracy of +30 microinches.

Mass calibration using three precision analytical balances, one equal arm balance and class "S" reference weights: Mass capability to 160 grams with a precision of $\pm$ 0.02 milligrams, to 1 kilograms with a precision of $\pm$ 2.0 milligrams, and to 100 lbs. with a precision of $\pm$ 0.5 grains.

The force calibration system consists of five Morehouse Proving Rings, two force calibrators (loading machine), a Baldwin Universal Testing Machine, and a calibration machine especially designed for inplace calibration of drawbars of field dynamometers:

- Capacity of 50,000 lbs. to accuracy of 0.1 percent of reading.
- Capacity of 100,000 lbs. with an accuracy of $\pm$0.5 percent of full scale.

The temperature calibration systems consists of three temperature baths, one quartz thermometer, and one platinum resistance thermometer: Range of $\pm$80 to $\pm$0.03°C. Range of $\pm$183 to $\pm$650°F to accuracy of $\pm$0.01°C, respectively.

Four pressure calibration systems are in use:

- Range of 0 to 120 in. of hg to accuracy of $\pm$0.02 percent.
- Range of 0 to 600 psia to accuracy of $\pm$0.02 percent.
- Range of 40 to 40,000 psia to accuracy of $\pm$0.02 percent.
- Range of 10,000 to 100,000 psia to accuracy of $\pm$0.2 percent.

Angular calibration uses a 10-inch sign plate in conjunction with AA gage blocks.

Table J-3
INSTRUMENTATION CAMERAS
Yuma Proving Ground

Camera Used	Framing Rates (Sec)	Film Size Width (mm)	Film Size Length (ft)	Lens Focal Lengths (in.)
FASTAX:				
Smear	30-200 ft/sec	35	100	1 - 96
8-mm *	500-16,000	16	100	1 - 15
16-mm	250-8,000	16	100	1 - 15
35-mm	200-6,000	35	100	1 - 15
Mitchell	20-128	35	100	2 - 20
Bowen	30/60/90/180	5-1/2	100	12
Milliken	50/100/200/400	16	200	3
Milliken-HS	400	16	400	3
PHOTOSONIC:				
16-mm 1B	100-1,000	16	400	1 - 15
35-mm 4E	500-2,000	35	1,000	8
70-mm 10A	10-60	70	1,000	48 - 96
70-mm 10B	180/360	70	1,000	48 - 96

* Two 16-mm Fastax on hand with 400 ft. film capacity capability.

Table J-4

DOCUMENTARY CAMERAS
Yuma Proving Ground

Photographic Equipment	Make	Quantity
Motion Picture Processors	-	0
Still Cameras	35-mm Minolta	1
	70-mm Hulcher	1
	Polaroid Set Model 800	1
	CU-5 Polaroid	1
	Graflex Set KS-98B	2
	Graphic Set KS-4A(2)	6
	4x5 Graphic Set KS-4A(2)	6
	4x5 Ekoo-View	1
	4x5 Burke & James View	22
	8x10 Portrait Set KE-1A-(1)	1
	8x10 Studio Set, Deardroff	1
	8x10 View, Deardroff	5
	Graflex, XL, Roll Film	1
	8x10 Still Copy Set KS-7-(1)	1
Motion Picture Cameras	16mm Ariflex	3
	16mm Bell & Howell	4

A K&E Collimation Stand is used for optical calibration.

Static and dynamic (to 13 Hz) acceleration uses a centrifuge with a G-force range of 0 to 200 G and an accuracy of ±0.2 G.

Two RPM calibration systems are used. Fifth wheel speedometers are calibrated from 1.2 to 72 mph with an accuracy of better than 0.055 mph and an RPM calibrator whose range is 10 to 24000 RPM accurate to ±0.03 percent of reading.

Sound intensity range is 114 db re 20 micro N/M^2 accurate from ±0.3 db to ±0.7 db over a frequency range of 125 to 2000 Hz.

Vibration from 5 to 1000 Hz range for a 5 lb specimen and up to 0.5 inches of displacment is performed on a vibration console and results read from a "standard" piezoelectric accelerometer to comparison sensitivity accuracy of ±3%

(2) Electronic Measurements

Electronic standards and equipment are available for measurement of the following parameters within the ranges indicated.

- Frequency:	DC to 15 GHz
- AC voltage:	0 to 1,000 volts to 100 KHz 100 micro v to 0.25 volts from 0.05 to 900 MHz 0 to 13.5 volts from 5 Hz to 100 MHz
- DC voltage:	0 to 30K volts
- DC current:	0 to 300 amperes
- AC current:	0 to 100 amperes
- Resistance:	0 to 1000 megohms
- Capacitance:	0 to 1200 microfarads
- Inductance:	0 to 1200 henries
- Power:	10 microwatts to 10 milliwatts
- Rise time:	30 picoseconds
- Attenuation:	0 dB to 120 dB
- Distortion:	10 Hz to 3 MHz

ˉ. ˉ.her General Instrumentation

(1) Telemetry

The USAYPG Telemetry capability is used for transmission of data from test items to the receiving systems for recording and data processing purposes. At the present time, USAYPG has the capability to transmit and receive in L-band (1935-1540 MHZ) and receive in S-band (2200-2300 MHZ).

Strain gage and crystal accelerometers, force and pressure transducers and signal conditioning equipment are available to interface to subcarrier oscillators, or to PCM or FM analog type recorders.

Five and eleven channel TM packages with subcarrier oscillators ranging fron 3 KHz to 70 KHz are available for instrumentation purposes. Also available are five PCM systems with up to 100 analog channels and 200 discrete-bit capability.

Two airborne type recorders are available for airborne use. One is capable of both FM and/or direct recording and the other is capable of only direct recording. Frequency response in the direct mode is 1 MHz at 60 IPS and 40 KHz at 60 cps in the FM mode. Six speeds are available in these recorders.

YPG has eight separate TM frequencies authorized in the 1435-1540 MHz band. These frequencies are organic to USAYPG. Other frequencies in this band, or at S-band (2200-2300 MHz) are authorized on an "as needed" basis as test programs may dictate.

To accommodate the varied and flexible TM requirements of range users, USAYPG has several telemetry facilities, both fixed and portable.

(a) Telemetry Control Bldg.

The telemetry control building (3125) is located at YPG Site 4. The TM operations center, the building is used to receive, record, and process data from FM-FM telemetry, PCM and PAM telemetry in real-time, or from magnetic tape recordings. The center has microwave relay capability which can transmit test data to real-time mission control centers for viewing by project engineers; can process data from PCM, PAM or FM-FM for viewing on thermal and event printer/recorders.

The telemetry operations center is equipped with the following major items of equipment:

- Proportional bandwidth discriminator for IRIG bands 1-19 and A-F. A constant bandwidth discriminator for IRIG band 1A-11A and two tunable discriminators are also available.

- Two AM-FM telemetry receivers capable of receiving data from L-or S-band transmitters. The receivers are capable of IF bandwidths up to 3.3 MHz (maximum deviation of 1.5 MHz). Predetector record/playback with data bandwidth up to 1.2 MHz is available.

- Two 8-channel and two 6-channel analog printer/recorders and one 40-channel event recorder permit immediate viewing of selected data signals.

- PCM signal conditioners that accept serial NRZ-L, NRZ-M, NRZ-S, BIO-L, BIO-M, BIO-S, DM-M, and DM-S PCM data, and supply an output signal of NRZ-L, BIO-L and DM-M. A clock output of 0, 90, 180, and 270 is available. Bit rates of 10 b/s to 10 Mb/s can be processed.

- PCM frame synchronizer capable of accepting serial NRZ-L data with bit rates up to 2 Mb/s. The serial data bit clock input of 0 and 90 is one-half bit in duration. The frame synchronizer will accept data word lengths up to 112 bits total and a frame length of up to 512 words, with a maximum frame synchronization pattern length of 33 bits. Parity indication is available and can be included or separated from the data. Selectable search, check, and lock indicators are available with up to seven allowable errors.

- Analog-to-digital converter that will accept up to 32 analog inputs of -5 to +5 volts full-scale. Sampling rates of up to 60,000 samples per second with 12 binary bit resolution is available. Output data is 12 bit parallel.

- Digital-to-analog converter that will accept up to 32 8-bit data words with a data transfer rate of 500 KHz. Thirty-two analog outputs are available with a resolution of one part in 256.

- Telemetry data channel and interface module to transfer the input/output data between the PCM interface equipment and the computer. This interface equipment will process up to 16 bit words. Up to 8 subchannels are available for data transfer to and from the computer.

- A PDP-11 computer with 64 K words of memory.

- Two PAM demultiplexer units capable of processing 32 input signals each.

- Two digital tape drives at 75 ips and two tape drives at 125 ips.

- Two disc drives each with 1.2 million word capability.

- One printer/plotter and 1 DEC writer-printer.

- A monopulse comparitor single-axis (azimuth) tracking antenna, including associated servo controls. This tracking system will track either L- or S-band transmitters.

The above equipment for the telemetry control facility represents basic RF and associated equipment for processing one TM data stream from a single test item. Planned for implementation by the end of CY 1981 is the capability to process two simultaneous TM data streams. This capability will require additional hardware, similar in most cases to the above equipment.

Also available at the center is a capability for processing analog FM tape on 12-channel oscillograph paper for a permanent record. Duplicate analog magnetic tape can also be made. The equipment to accomplish this includes a 36-channel oscillograph and processor; two magnetic tape recorders (1/2 inch or 1 inch), I Band FM or direct; two magnetic tape recorders (1 inch) wideband FM or direct; one magnetic tape recorder (1/2 inch or 1 inch) wideband FM or direct; and discriminators ranging in response from 400 Hz to 90 KHz.

(b) Site 7 Telemetry Facility

The Site 7 Telemetry facility is used to receive, record and reproduce for quick look viewing FM-FM telemetry data and PCM telemetry data signals. The facility was sited to provide complete line-of-sight coverage of Cibola Range. The Site 7 TM facility is equipped with the following major items of TM equipment:

- Proportional bandwidth subcarrier discriminator for IRIG bands 1-19 and, A-F and constant bandwidth subcarrier discriminator for IRIG bands 1A-11A

- Magnetic tape recorder (7 speeds, 1-3/4 to 120) capable of 7 data channels of direct record/reproduce. The frequency response of this recorder is 1.5 MHz at 120 ips.

- Thirty-six channel oscillograph for quick look viewing of FM-FM telemetry signals.

- Two AM-FM telemetry receivers capable of receiving FM-FM or PCM data from L-band (1435-1540 MHz) or S-band (2200-2300 MHz) transmitters. The receivers are capable of IF bandwidths of up to 3.3 MHz and maximum deviation of 1.5 MHz. Predetection record/playback with data bandwidths of up to 1.2 MHz is available.

(c) Mobil Telemetry Facility No 1.

This mobile telemetry Facility is used to set up, receive, record and reproduce for quick look analysis, FM-FM telemetry data transmitted from test items. It is capable of operating at remote sites and has a self-contained 10KW 200 VAC single-phase 60-Hz generator. Input for external AC power is also available.

This mobile TM facility is equipped with the following major items of equipment:

- Proportional bandwidth subcarrier discriminator for IRIG Bands 1-19 and A-F.

- One magnetic tape recorder capable of seven direct record-reproduce data channels and seven FM record/reproduce data channels on 1-inch magnetic tape. Frequency response is 2 MHz at 120 ips in the direct mode and 80 KHz at 120 ips in the FM mode.

- Eighteen-channel oscillograph for viewing quick look data records.

- Two AM-FM telemetry receivers capable of receiving telemetered data from P-band (215-260 MHz), L-Band (1435-1540 MHz), or S-Band (2200-2300 MHz) telemetry transmitters. These receivers are capable of IF bandwidths up to 3.3 MHz and maximum deviations of 1.5 MHz. The system is capable of accommodating a maximum of three telemetry receivers.

- RF preamplification and multiplexing for P-, L-, and S-Bands. The output of the multiplexers is capable of accommodating up to six receivers.

- A baseband spectrum analyzer is available for viewing the various subcarrier amplitudes to insure presence and quality of signals. This analyzer has a response of 400 Hz - 70 KHz.

- A variety of appropriate test equipments for configuring and checking associated TM data packages and equipment.

(d) Mobil Telemetry Facility No 2.

This mobile TM facility, commonly termed the CONDOR van, is used at YPG to set up, receive, record, and reproduce for quick look viewing, FM-FM telemetry data as well as recording of PCM data streams. The facility is capable of operating at remote sites and has a self-contained 12.5 KW 220 VAC single-phase 60 Hz generator. Input for external power sources is also available.

This facility is equipped with the following equipment:

- Proportional bandwidth subcarrier discriminators for IRIG bands 1-19 and A-F, and constant bandwidth subcarrier discriminators for IRIG bands 1A-11A.

- Magnet c tape recorder (7 speeds, 1-3/4 to 120 ips) capable of seven data channels of direct record/reproduce. The frequency response of this recorder is 1.5 MHz at 120 ips.

- Thirty-six channel oscillograph for quick look viewing of FM-FM telemetry signals.

- Two AM-FM telemetry receivers capable of receiving FM-FM or PCM data from L-Band (1435-1540 MHz), and S-Band (2200-2300 MHz) transmitters. The receivers are capable of IF bandwidths of up to 3.3 MHz (max. deviation of 1.5 MHz). Predetection record-playback with data bandwidths of up to 1.2 MHz is available.

- RF preamplification and multiplexing for L- and S-Bands is available. The output of the multiplexer is capable of accommodating up to six receivers.

(e) Trailer-Mounted Telemetry Facility.

This portable facility can receive up to three TM signals (within L- and S-Bands) and record information on magnetic tape. It can be moved to any location where telemetry reception is required, provided access roads are available. This trailer-mounted facility is equipped with the following major items of equipment:

- Proportional bandwidth subcarrier discriminators for IRIG bands 1-19 and A-F.

- One magnetic tape recorder (four speeds - 7-1/2 thru 60 ips) capable of seven direct record, or seven FM record/reproduce data channels. Direct response is 300 KHz at 60 ips and FM response is 20 KHz at 60 ips.

- Two AM-FM telemetry receivers capable of receiving telemetered data in L- or S-Bands. The receivers are capable of IF bandwidths up to 3.3 MHz and a maximum deviation of 1.5 MHz. The system is capable of accommodating up to three telemetry receivers.

- RF preamplification and multiplexing for L- and S-Bands is available. The output of the multiplexer is capable of accommodating up to six telemetry receivers.

- A baseband spectrum analyzer is available for viewing the various sub-carrier amplitudes to insure presence and quality of signals. This analyzer has a response of 400 Hz - 70 KHz.

(2) Meteorological

AB present, the ASL Yuma Meteorological Team provides YPG with Weather Forecasting, Climatological Studies and, surface and upper air movements. For upper air measurements, YPG has one permanent GMD-1 Site at KOFA Firing Range, an Automated GMD-1 system at Cibola Range, and a mobile GMD-1 for upper air soundings at downrange sites, For surface measurements, there are hand-held and remote recording instrumentation.

An advanced meteorological system consisting of T-9 pibal radars, 300-foot Met instrument towers and the automated GMD-1 system has been developed at Cibola Range. The characteristics of this system are:

(a) T-9 Pibal Radars (2)
- Mobile
- Plotting board readout-wind speed/direction

(b) Meteorological Instrumentation Towers (3 each)
- Real-Time Transmission to YPG Computer (2400 BPS modern transmission
- Temperature (all levels)
- Wind speed (all levels)
- Vertical wind (all levels)
- Relative Humidity (lowest level)
- Pressure (lowest level)

(c) Automated GMD-1 System
- Real-time transmission to YPG Computer (2400 BPS modern transmission)

(3) Survey

The Geodetics Section of the Materiel Test Directorate is capable of performing First Order surveying at YPG. The major instrumentation available for survey applications is listed below:

Wild Heerbrugg theodolites, models T-2, T-3, and T-4, are presently used on high order traverse and triangulation. The T-2 micrometer drum measures to 1-second of arc, and T-3 to 1/10-second of arc, and are used mainly for angle measurements. The model T-4 is used in obtaining astronomical coordinates, Laplace corrections, and gravity deflections.

The Ranger IV is a member of the family of electronic distance measuring equipment (EDME) that uses a directly-modulated, 3-milliwatt, helium-neon (red) laser as a light source. It can measure a slope distance of ± (5mm + 2ppm) using retro-reflectors at the remote station. The visible light beam makes target acquisition quick and easy.

The Hewlett-Packard HP3810A Total Station is also EDME using an infrared beam having capabilities of measuring slope, horizontal, and vertical distances or vertical angle with a flip of the selector switch. It also has a built-in theodolite for turning horizontal angles to the nearest 20 seconds of arc. Maximum distance measured is 1600 meters. The HP3810A has an accuracy of ± (5mm + 10mm per Km).

The HDM-70 Minitape, when attached to the T-22 theodolite has the same capabilities as the HP3910A with the angular accuracy of the T-2.

The Zeiss NI-1 model level is used on all precise level surveys. This instrument is self-leveling and when used with LO-VAR rods can produce first order results.

In addition to the above, T-16 theodolites, Zeiss NI-2 levels, chains, level rods and other general surveying equipment are available for third and fourth order survey work.

- Max Height 40,000 feet
- Temperature - degrees C to the nearest tenth
- Percent Relative Humidity to the nearest tenth
- Pressure in millibars to the nearest tenth
- Pressure heights in decameters to the nearest tenth

The following meteorological parameters are recorded 24-hours/day at the Central Meteorological Observatory in the mobility complex: Precipitation, Station Pressure, Dry Bulb Temp, Wet Bulb Temp, Dew Point, Relative Humidity, Wind direction and speed, Sky condition and Cloud cover, WBGT, Soil Surface Temp, Ozone, Temp gradient (1/2 mtr/4 mtrs), Visibility and Solar radiation parameters.

Accuracy for standard parameters are:

- Temperature to 140 degrees = 1 degree
- Humidity to 100 percent = 5 percent
- Wind speed to 100 KTS = 2 KTS
- Wind direction to 350 degrees = 2 degrees
- Precipitation to 20 inches = 0.01
- Pressure to 1200 mb = 0.1

(4) Radio Frequency Interference/Electromagnetic Compatibility

YPG presently has no instrumentation capabilities in this area. Tests are, however, conducted on wheeled and tracked vehicles both at YPG (in Building 2503) and at the Gila Bend Electromagnetic Range, by US Army Electronic Proving Ground personnel (or their contractor) from Fort Huachuca. Building 2503 is continually being modified to reduce ambient electromagnetic radiation so that all future tests of this type can be conducted at YPG.

(5) Sound Measurement and Analysis

Current instrumentation, including a new sound level reader, provides the capability to measure and record sound pressure levels from 30 Hz to 20 KHz, 30 to 1440 dB range.

The system consists of seven microphones and amplifiers, a 14-channel tape recorder, a 1/3-octave band analyzer, a graphic level recorder, a sound pressure level meter, and an impact noise analyzer.

(6) Safety and Security

YPG has no special safety or security instrumentation. The airspace can be monitored by radar from the Marine Corps Air Station.

(7) Soil Conditions

YPG has instrumentation for measuring inplace soil strength (load-bearing, penetration, and shear) consisting of a California Bearing Ratio Apparatus, an impact and cone penetrometer, a Penetro shear apparatus. In addition to the preceding, a soil density unit for input density measurements is available.

g. Special Purpose Instrumentation

(1) Ballistic Data

(a) Internal/Launch Ballistics (Optical System)

This system is composed of six Bowen velocity/acceleration cameras with precise mounts and environmental shelters, seven Factax 8mm high-speed ballistic cameras, three 7-channel camera event synchronizers and ancillary coders, time-base frequency standards, and associated mounts. Launch and initial trajectory data can be obtained to 1300 meters for launch velocities up to 400 FPS with projectiles larger than 75mm, and to 4,000 meters for missiles and rockets larger than 60mm with velocities below 1,800 FPS.

The data precision of these optical systems is as follows:

Parameter	Mean	
Velocity	.5 to 2.0	ft/sec
Acceleration	1.0 to 4.0 ft/sec^2	
Attitude (roll)	$\pm$ 10 degrees	
Pitch and Yaw	$\pm$ .5 to $\pm$ 2.0 degrees	

(b) Internal/Launch Ballistics (Electronic System)

Internal and External Pressure Measuring System:

The DBDAS (Digital Ballistic Data Acquisition System) is utilized to process up to 32 channels of near real-time data as a function of the required frequency response of the data. All data can be developed in near-real time on CRT terminals for quick look analyses and evaluation.

This facility also has a capability to digitize analog pressure data that was previously recorded. This makes it very useful in post-flight computer analyses should it be required.

There are two portable and one permanent analog pressure systems available for use at USAYPG. Each system can record 11 channels of FM or direct data. In the FM mode, frequency response is to 80 KHz. Internal chamber to 100,000 psi can be measured and recorded. Additionally, low pressures such as .1 psi and air pressure to 10,000 psi, strain gage data, recoil time vs. travel and overpressure parameters can be measured and recorded for further analyses.

Muzzle Velocity

USAYPG uses several approaches to ascertain, record and process muzzle velocity parameters.

There are four hawk radar units now in use. The majority of velocity data is now recorded on magnetic tape on-site at the radar location.

Additionally, compute and print chronographs are used as a basis for muzzle velocity measurement and are employed with coils in permanent or portable towers, ballistic screens and skyscreen systems. This approach of utilizing compute and print chronographs are not generally used unless all radar systems are down. However, this approach does offer an excellent backup system.

The overall velocity system capability and precision caliber is dependent upon rate of fire. Minimum performance in this regard is 6,000 rounds per minute at 20mm and larger diameters.

Special configurations of equipment using redundant systems and low rates of fire can improve measurement precision to $\pm$ 0.1 fps.

Projectile Fuze Times

A system of IR Fuze chronograph systems are utilized to measure projectile fuze times from T = 0 to fuze activation. The system consists of nine IR detectors and eight elapsed time counters. Fuze times ranging from 0.5 seconds to as long as 120 seconds can be measured.

c. Terminal Ballistics/Target Effects Measurement (Optical) Cameras

The system is composed of various size cameras/target arrays utilizing 12 cameras (nine 16mm Fastax, two 35mm Fastax, one 16mm Photosonic 1b) supplemented by 90 - 16mm cameras used for flight event data, positioned on fixed mounts with range time and control impact. Coverage is somewhat dependent on image size. An area of 800 feet by 1,600 feet can be covered if the cross section of the target exceeds 0.1 square foot. Coverage can be provided for 8 seconds at 0.01 second intervals or 1 second at 0.005 second intervals under optimum light conditions.

Direct Observation

This system is based on observers using modified transits and the positions are calculated using triangulation. The system is based on a device that uses shaft encoders and a printed output. Precise measurements are obtained by post-test survey. Precision of results is dependent upon safe range from impact and rate of fire.

Load bearing evaluation can be made for compression (1-800 psi) and shear (1-75 psi). An in-house device is available for measuring soil slickness.

The soil lab is instrumented with conventional lab equipment, with emphasis on analysis of airvorne dust, soil classificaion, and chemical agent particles. Particle size and distribution is determined with the Coulter counter, scopic examination, and photomicrographs. An emission spectrograph is used for metallic ion detection. Lower detection limits for many metals are possible with the atomic absorption spectrophotometer. Partical size can be determined by sieving - down to 10 micron Coulter, 400 to 0.8 microns ... concentration by:

Weight:	0.001 grams
Spectrograph:	1 to 10 ppm

(2) Environmental Facilities

(a) Dynamic Environment

Two electrodynmaic vibration systems are available for testing both inerrt items and live explosive test items (up to 3,000 pounds equivalent TNT). Each has the capabilities stated for sinusoidal excitation. Vibrations system capabilities include:

	System 1	System 2
Capacity	30,000 lbf	15,000 lbf.
Maximum acceleration	100 g	100 g
Maximum displacement	1 inch	1 inch
Maximum velocity	70 in/sec	70 in/sec
Frequency range	5 to 2000Hz	5 to 3000 Hz
Temperature limits	-100°F to $+200^{\circ}$F	-100°F to $+200^{\circ}$F
Maximum weight HE	3,000 lbs.	3,000 lbs.

The capability for random excitation of test packages is available on the 30,000 lbf. system. A digital controller provides both the sinusoidal and random drive signals for the 30,000 lbf. system.

The axis of each exciter can be rotated to duplicate vertical or horizontal loading conditions. Additionally, System 2 can be rotated 180° for suspended loading conditions.

A 6,000-pound capacity mechanical shaker for loose cargo tests is also available.

All vibration test systems are controlled from remote data acquisition and processing centers capable of immediate data analysis for test control.

A jumble test system and a jolt test system are available for fuzes and small HE loaded test items.

Remote facilities have been constructed for drop tests of both inert and hazardous items. An instrumented facility exists for inert loadsand tests of air drop systems. Drop test site capabilities include:

	Site 1	Site 2	Site 3
Height	12 feet	55 feet	70 feet
Capacity	500 lbs.	2,000 lbs.	10,000 lbs.
Data channels	6	6	32
Maximum weight HE	500 lbs	1,200 lbs.	0
Impact slopes	0°	0°	$0^{\circ}/15^{\circ}/45^{\circ}$

An 8-foot diameter by 8-foot high immersion tank is available for leakage tests. The tank can be utilized for items with a maximum dimension of up to 5 feet. However, there is no control of water temperatures.

A 1-foot by 1-foot by 6-feet long tank is available for both pressurized and evacuated leakage tests.

(b) Climatic Environment

An altitude chamber is available for testing both inert and hazardous items. The chamber has the following specifications:

Size:	6-feet long by 5-feet wide by 5-feet 6-inches high
Temperature range	-100°F to 350°F
Altitude range:	Ambient to 100,000 feet

A salt-fog chamber is available for conducting tests on both inert and hazardous items. The chamber has the following specificaions:

Size:	10-feet long by 6-feet wide by 6-feet high
Temperature range:	80°F to 100°F
Salt Fog:	0.5 to 3.0cc solution/hour/80sq. cm.

A large multi-purpose environmental chamber (20-feet by 20-feet by 12-feet high) is available for exposing complete stand-mounted aircraft weapon systems and ground vehicles to high and low temperature and humidity. This chamber provides controlled climatic conditions for testing weapon systems up to 30mm. The temperature range is -70°F to 100°F. Humidity is 15 to 95 percent. Chamber size can be increased to 20 feet by 34 feet by 10 feet with a reduced temperature range of -50° to 180°F for testing large vehicles.

Table J-4 lists the available climatic chamgers in addition to the three specialized units indicated above.

TABLE J- 5

YPG ENVIRONMENTAL CHAMBERS

High/Low Temperature

Chamber Size (inches) and ID	L	x	W	x	H	Maximum Parameters
MS40	83 1/2		47 3/4		47 3/4	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
MS41	83 1/2		47 3/4		47 3/4	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T10	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T11	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T12	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T13	72		60		60	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T14	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T15	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T16	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T20	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T21	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T22	144		90		78	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T429	60		46		36	$-100^{\circ}F$ to $+200^{\circ}F$ CO_2 for cooling
T70	316		79		72	$+30^{\circ}F$ to $+200^{\circ}F$ Mech Ref and CO_2
T357	161		85		73	$+30^{\circ}F$ to $+200^{\circ}F$ Mech Ref and CO_2
T188	84		60		60	$+65^{\circ}F$ to $+120^{\circ}F$ Mech Ref
T351	60		46		36	Ambient to $+200^{\circ}F$
T352	60		46		36	Ambient to $+200^{\circ}F$
T355	45		44 1/2		45 1/2	Ambient to $+200^{\circ}F$
T356	45		44 1/2		45	Ambient to $+200^{\circ}F$

Shrouds

ID	L	x	W	x	H	Maximum Parameters
	261		96		84	$+70^{\circ}F$ to $+200^{\circ}F$
	261		96		84	$+70^{\circ}F$ Mech Ref

Temperature/Humidity

ID and Location	L	x	W	x	H	
Ransco, JATO	LL4		84		80	5% TO 95%RH $-100^{\circ}F$ TO $+200^{\circ}F$
RANSCO, GP-1	47		48		50	5% TO 95%RH $-100^{\circ}F$ TO $+200^{\circ}F$
Webber, JATO	144		96		96	20% to 95%RH $-100^{\circ}F$ to $+200^{\circ}F$
Webber, GP-1	89		66		87	20% to 95%RH $-100^{\circ}F$ to $+200^{\circ}F$

(3) Vehicle Performance

YPG has many vehicle test courses for both wheeled and tracked vehicles. See Figure J-6. Instrumentation used to measure vehicle performance includes two 10,000-gallon storage tanks with pumps and blending metering devices, permitting nine blends of two base fuels with close repeatability, supported by a standard petroleum laboratory including an electron microscope with X-Ray analyzer; IR, UV, and atomic absorption spectophotometers; and an emission spectrograph. Two comparison engines are installed, one for octane and one for cetane.

Laboratory facilities can be used for most applicable ASTM tests required by the specifications for fuels, lubricating oils, greases, brake and hydraulic fluids, and antifreeze, except those requiring precise measure of low fuel flow rates during engine operaion.

YPG also has a dynamometer system consisting of series dynamometers and absorption trailers; strain, force, vibration, and fluid flow transducers; together with a 14-channel FM tape recorder and an 18-channel oscillograph. Normal tests are conducted on a 2-mile asphalt 0.8 percent grade, 30-foot roadway with 500-foot radius turnarounds, or on a 900-foot prepared sand course. Special tests can be conducted at other sites, under operational environment conditions. Tests can be conducted from speeds of 2 mph to 35 mph. Equipment ratings are:

M-10 dyno:	75,000 lbs.
M-12 dyno:	5,000 lbs
M-15 dyno:	100,000 lbs
Trailers (3):	20,000 lbs

YPG has recently put into operation an inertial reference system. This is a precision, three-axis, system providing continuous measurement of the dynamic performance of almost any vehicle, including position and rate outtputs for pitch, roll, yaw and three-axis linear acceleration. Position output is selectable - analog or digital. Rates and accelerations are analog only. These outputs are transmitted via PCM telemetry to ground recording equipment for near real-time processing or recording for later processing.

Performance Parameters

Attitude:

Pitch	$\pm 85^{\circ}$	
Roll	360°	(Accuracy = 0.1 degree referenced to true vertical)
Yaw	360°	(Accuracy = 0.1 degree - drift < 0.1 degree/min)

Rate Range:

Pitch and Yaw	+ 200°/sec (Accuracy 0.5% @ null)
Roll	+ 300°/sec (Accuracy 0.5% @ null)

Acceleration :

Pitch, Roll, Yaw	+ 5g (Accuracy 0.1% full scale)

(b) Physical Measurements

Measurements

The equipment consists of meters, gages, scales, etc., primarily in thee areas of dimensional, weight, moment of inertia, center of gravity, strength, and hardness measurements.

The following describes the available capabilities:

Physical Characteristics	Capability	Accuracy
Weight	0-200 lbs	±0.1 percent
	0-10,000 lbs	±0.5 oz to 2 lbs
Dimension	ID of tubes 0.3 to 16 in	±0.001 in
F	Fragment to 6 in	±0.001 in
	Degree of flatness	±0.002 in
	Depth, height, etc.	±0.001 in
Center of Conventional Gravity	Radial (less than 200 lbs proj)	±0.01 in
Moment of Projectile		
Inertia	60mm to 16 in	$\pm 1.0\ lb_m\text{-}in^2$
Imbalance	Parts up to 30-in dia, 96-in length, 500 lbs in weight	
Load Distribution and Ground Pressure	0-150,000 lbs	

Physical Characteristics	Capability	Accuracy
Hardness	Rockwell C-70	±1 Rockwell C No.
Strength (Proof)	160,000 lbs	

Inspection

Most of the equipment presently available to perform materiel and parts inspection utilizes non-destructive test methods. Metallurgical examination equipment is also available, including a cutoff wheel, polishing device, and a metallograph for microscopic examination of metals to determine grain size and crystal structure. Equipment includes:

140 KVP X-ray Unit
300 KVP X-ray Unit
420 KV Constant Potential X-ray
Linear Accelerator, 5 to 10 MEV X-ray
600 KV Flash X-ray 2-Pulser
100 Curie Iridium - 192
100 Curie Cobalt - 60 Gamma Ray Projectors
Magnaflux (Magnetic Particle Inspection) Unit
Eddy Current Inspection
Ultrasonic Tester
Fluorescent Penetrant Inspection System
Daylight Film Handling System
Electronic Image Enhancement System
Holographic Tire Inspection System

A Picker Polaroid X-ray film processor is available for quick-look radiographic exmination.

An optical tooling system with 10- and 20-feet horizontal bars and a 10-feet vertical bar. Measurement accuracy is to 0.0001 inch.

(c) The Range Command Status System (RCSS)

The RCSS is an in-house development prototype system which has just been completed and is currently being evaluated for further expansion. The basic prototype system utilizes one programmable desktop computer and several programmable grapphi translators and displays, all of which are deployed in the offices of management and test operations personnel. A graphic display format provides near real-time range information to management personnel to aid in the decision-making process. The RCSS is currently being used to inform management about the daioy scheduled activities and status on the Cibola, KOFA and Mobility Test Ranges. The system will increase in numbers of locations and expanded in categories of information in FY 81 and FY 82 depending upon available funds.

5. Threats/Targets

(a) Threats

YPG does not have any permanent tactical threats or challenges.

(b) Targets

(1) Mobile Targets

(a) Rail-Mounted

YPG maintains two rail-mounted moving targets to be utilized in live-firing tests of modern ground-based and airborne weapon systems.

(b) Radio-Controlled

Two radio-controlled target carriers were acquired to provide additional test and evaluation capability of modern weapon systems. The targets provide a live-fire maneuvering target carrier with target sail and berm-protection for the carrier. They also provide a free-play open-field maneuvering target for testing the tracking and fire control system functions - with or without the target sail attached. In the free-play mode, the targets frequently are used in conjunction with TSPI instrumentation for detailed target trajectory information.

The system capabilities are:

- Radio-controlled (406-550 MHz) or manual mode of operation

- Line-of-sight operation required in the radio-controlled mode

- Range--no practical limits as long as transmitter-to-receiver line-of-sight is maintained. (At long distances, without visual aids, operators are unable to maintain stable control due to lack of visual acuity and faulty depth perception. This may be remedied by the installation of video cameras to aid steering.)

- Minimum turning radius of 30 feet

- Maximum speed--
  - Manual operation - 50 MPH
  - R/C operation - 30MPH (limited only by the operator ability to maintain control)

- Minimum speed is 5 MPH (determined by engine idle)

- Fuel capacity/consumption
  - Tank - 10 gallons (MOGAS only)
  - Consumption - 30 MPG (average)

- Maintainability
  - Mechanical components are standard VW parts
  - Electrical components are designed for modularity and "blackbox" repair concept

(c) Simulated Moving Target

YPG maintains a simulated moving target for live-firing practice. The target consists of a series of strobe illuminated panels to simulate a moving vehicle.

(2) Thermal Targets

(a) Detection

YPG maintains a 2-bar detection target with a controllable thermal signature to $\pm 0.3^{\circ}C$ about a selectable setpoint for the field test and evaluation of modern weapons systems containing thermal vision fire-control / designation subsystems. The setpoint is some constant differential temperature to be maintained with respect to ambient. The setpoints are differentials of $1.25^{\circ}C$, $3^{\circ}C$, $5^{\circ}C$, $7.5^{\circ}C$, and $10^{\circ}C$. The image size is 2.3 meters by 2.3 meters.

(b) Recognition

YPG maintains a 6-bar recognition target with a controllable thermal signature with the characteristics described above. The image size is 2.3 meters by 2.3 meters.

(c) Scoring Board (Aimpoint Cross)

YPG maintains a scoring board which provides a cross-hair aimpoint cross in the thermal (infrared) regime. The cross-hairs are 2.3 meters by 2.3 meters. The thermal components provide the temperature characteristics as described above.

(3) Rotating Optical Targets

YPG maintains a series of rotating optical detection and recognition targets for the field test and evaluation of modern fire contro/designation systems containing direct-view optics and/or augmented vision devices. The targets may be rotated to present either vertical or horizontal bars. The third position presents a neutral optical pattern. By placing the detection and recognition targets in the various aspects, mixed with the neutral targets, an integrity of test is maintained which requires the pilot/operator of the system under test to correctly identify which target is in what position. Image size is 2.3 x 2.3 meters.

6. Data Handling and Processing

At the present the automatic data handling facilities at Yuma Proving Ground are located in three separate areas. Business functions are in Building S-712 of the Main Post Area. Scientific and Engineering functions are now split between the Range Operations Center (Building 2105) in the Mobility Area and building 3523 in the KOFA Firing Range Area. However, equipment is being installed to consolidaate the S&E system in Building 2105. The anticipated completion is third quarter of FY 81. The system described below is that being installed.

a. Business Computer Center

The Business Computer Center is located in Building S-712, Main Post Area and consists of an IBM 4331 Central Processor with 2 megabyte of memory, 300 megabyte disk storage, two magnetic tape drives, 1,200 LPM printer, card reader, card punch and related PCM equipment. The Central Processor is linked to an IBM 360/65 at White Sands Missile Range via a dedicated 9,600 BPS circuit, for processing of USATECOM TEAMUP Standard Systems on the WSMR computer as central host. Current plans call for migrating TEAMUP workload from WSMR to YPG during May 1981 - December 1981 time frame, to enable processing all YPG business systems at YPG. There are some stand alone systems operational on the 4331 including Security System (Vehicle Registration, Badge, Visitor Control); Facility Engineer Work Order System; Procurement System; Fleet Fueling System; Ammunition Management System; and Telephone Billing System.

b. Scientific and Engineering Computer Center

The S&E data handling and reduction capability at Yuma Proving Ground is a state of the art near real time system capable of distributive data processing. The system is located in the Range Operations Center (Building 2105). It is made up of six major subsystems: 1) PDP 11/55 and PDP 11/35 telemetry processors, 2) Multiple Discrete Event Input Units (DEIU), 3) Multiple Graphic Display Networks (GDN), 4) a SEL 32/77 control and processing unit, 5) a high-speed data communications channel (Hyperchannel), and 6) two UNIVAC 1106 post event processors. The overall plan is shown in Figure J-8, with the interfacing shown in Figure J-9.

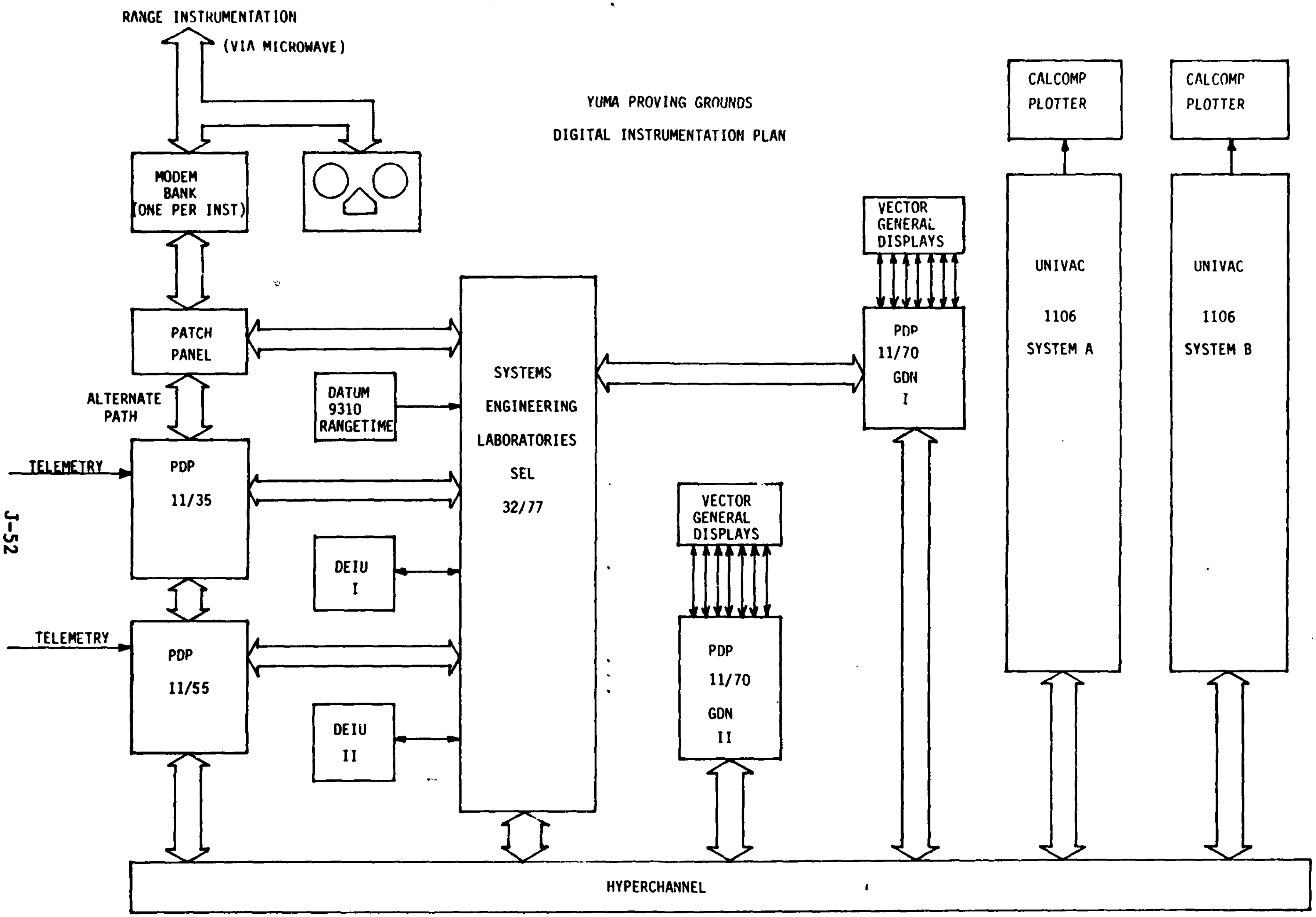

RANGE INSTRUMENTATION
(VIA MICROWAVE)
YUMA PROVING GROUNDS
DIGITAL INSTRUMENTATION PLAN
CALCOMP PLOTTER
CALCOMP PLOTTER
MODEM BANK (ONE PER INST)
VECTOR GENERAL DISPLAYS
UNIVAC 1106 SYSTEM A
UNIVAC 1106 SYSTEM B
PATCH PANEL
SYSTEMS ENGINEERING LABORATORIES SEL 32/77
PDP 11/70 GDN I
ALTERNATE PATH
DATUM 9310 RANGETIME
TELEMETRY
PDP 11/35
DEIU I
VECTOR GENERAL DISPLAYS
TELEMETRY
PDP 11/55
PDP 11/70 GDN II
DEIU II
HYPERCHANNEL

Figure J-8

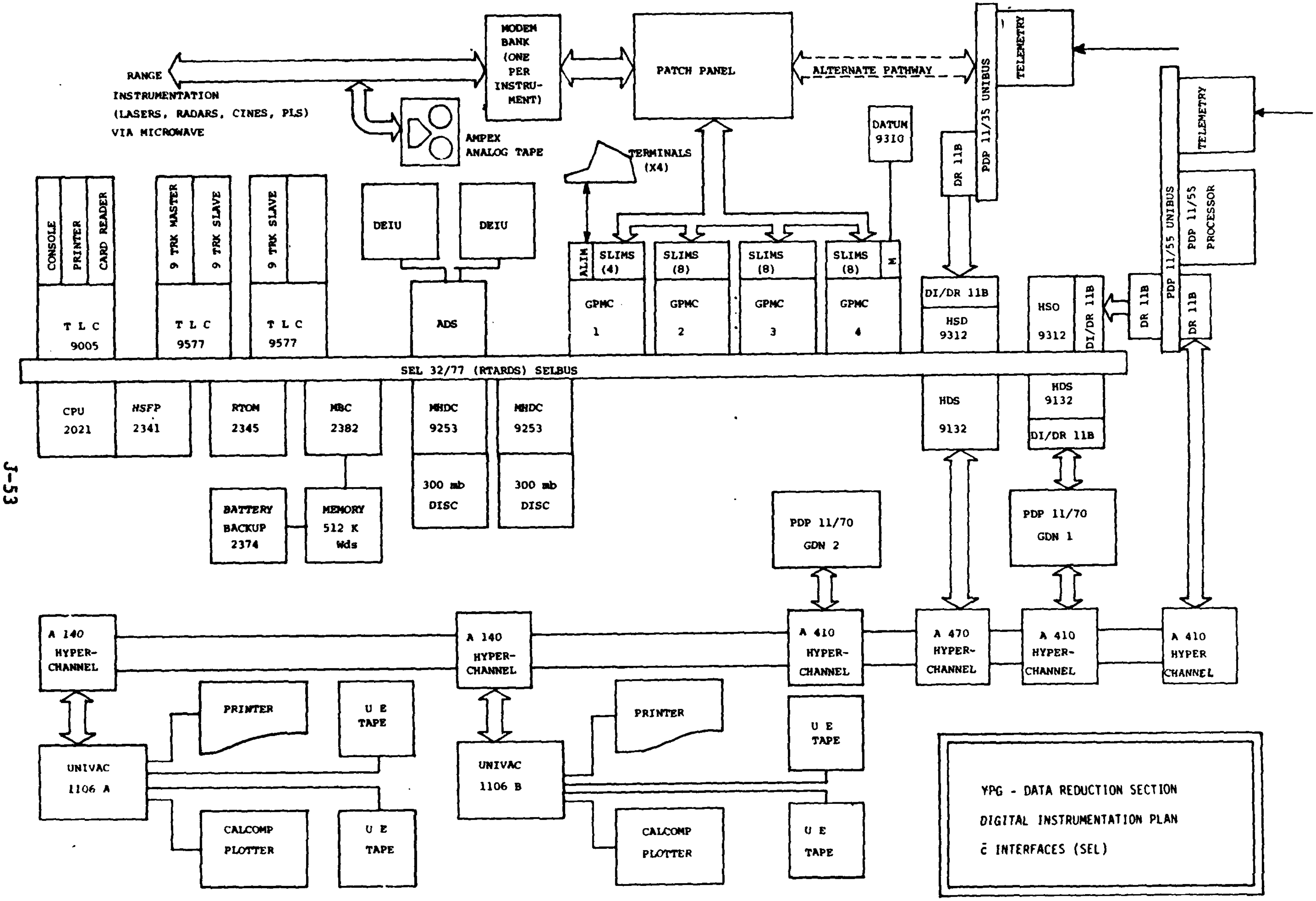

RANGE
INSTRUMENTATION
(LASERS, RADARS, CINES, PLS)
VIA MICROWAVE
MODEM BANK (ONE PER INSTRU- MENT)
PATCH PANEL
ALTERNATE PATHWAY
PDP 11/35 UNIBUS
TELEMETRY
TELEMETRY
PDP 11/55 UNIBUS
PDP 11/55 PROCESSOR
AMPEX ANALOG TAPE
TERMINALS (X4)
DATUM 9310
DR 11B
DR 11B
DR 11B
CONSOLE
PRINTER
CARD READER
T L C 9005
9 TRK MASTER
9 TRK SLAVE
T L C 9577
9 TRK SLAVE
T L C 9577
DEIU
DEIU
ADS
ALIM
SLIMS (4)
GPMC 1
SLIMS (8)
GPMC 2
SLIMS (8)
GPMC 3
SLIMS (8)
M
GPMC 4
DI/DR 11B
HSD 9312
HSO 9312
DI/DR 11B
SEL 32/77 (RTARDS) SELBUS
CPU 2021
HSFP 2341
RTOM 2345
MBC 2382
MHDC 9253
MHDC 9253
300 mb DISC
300 mb DISC
BATTERY BACKUP 2374
MEMORY 512 K Wds
HDS 9132
HDS 9132
DI/DR 11B
PDP 11/70 GDN 2
PDP 11/70 GDN 1
A 140 HYPER-CHANNEL
A 140 HYPER-CHANNEL
A 410 HYPER-CHANNEL
A 470 HYPER-CHANNEL
A 410 HYPER-CHANNEL
A 410 HYPER CHANNEL
UNIVAC 1106 A
UNIVAC 1106 B
PRINTER
PRINTER
CALCOMP PLOTTER
CALCOMP PLOTTER
U E TAPE
U E TAPE
U E TAPE
U E TAPE
YPG - DATA REDUCTION SECTION
DIGITAL INSTRUMENTATION PLAN
c̄ INTERFACES (SEL)

Figure J-9

In brief the functions of the six major subsystems are as follow:

PDP 11/55(35)

- Receives control informattion from the SEL 32/77
- Uses control information to set configure routines for decommutating and decoding selected TM parameters.
- Receives data from telemetry front end
- Decommutates TM data.
- Checks TM data for validity
- Decodes valid and selected TM parameters.
- Buffers up TM data for transmission to the SEL

SEL 32/77

- Receives 50 millisecond interrupts from range translator to drive real-time software.
- Receives all range instrumentation data, TM data, sends control data.
- Time tags data from all sources when it arrives.
- Decodes range instrumentation data at 20 PPS rate.
- Applies calibration coefficients and refraction corrections to prefiltered range instrumentation data.
- Converts space position data to desired cartesian coordinate system.
- Filters cartesian coordinate data to estimate smoothed position, velocity and acceleration components.
- Does an automatic source selection to determine which instrumentation provides the best solution for position of aircraft.
- Evaluates manual override information from DEIU.
- Performs computations with TM data as dictated by project requirements.
- Builds a composite solution
- Sends pointing data to appropriate instrumentation to aid in acquisition or change tracking configuration.
- Fills buffers with display data and sends it too GDN.
- Sends data to Univac 1106 through Hyperchannel.
- Records all input data and all significant computed parameters on a CDT (consolidated data tape)

DEIU (Instrumentation Control Unit)

- Provides 128 switches to set options in the real time application software on the SEL 32/77
- Controls real time instrumentation
- Provides display of 180 binary bits of data (primarily status bits from instrumentation data).

GDN (Graphics Display Network)

- Receives control information from the SEL 32/77.
- Receives display parameters from the SEL 32/77.
- Fills a variety of display buffers based on control information shared.
- Makes computations required to display relationships between various parameters.
    1. Inter-instrument differences
    2. Extrapolation to current or future time
    3. Range events
    4. Time events
    5. Miss distance at event time

- Displays on a graphics CRT a range map with reference trajectory and current aircraft positions.
- Displays on a graphics CRT plots of data or differences between various sources for data.
- Displays parameters in tabular form (generally in previously defined groupings of 10-40 parameters).
- Records display data on 9-track tape.

Hyperchannel

- Data communications path between SEL 32/77 and Univac 1106's for:
    1. Data used in post flight processing
    2. Data used for real-time analysis processing
    3. Data used for quick-look plots
- Alternate path for TM data from the PDP 11/55-35 to SEL 32/77.
- Provide pathway for information from SEL 32/77 to GDN.

Univac 1106

- Receive data from SEL 32/77 through Hyperchannel.
- Execute programs for production of data package requested by project, e.g.
    1. Plots of trajectory in near real-time.
    2. Plots of trajectory differences
    3. Tapes containing trajectory data, selected telemetry data, and meteorological data
    4. Line printer reports as requested by project and, as required, for quality

List of Equipment

SEL 32/77

Basic Unit and Peripherals

- 2021 CPU with 256K words of 600 ns memory and high speed floating point unit (HSFP)
- Two 300 Mbyte moving head disk drives
- Three 9-track, 800/1600 Bpi tape drives
- Hardcopy operator's console
- 900 cpm line printer
- 100 Cpm card reader
- Battery backup for memory
- Four terminals (CRT)

Interfacing

- Four General purpose multiplexer controllers (GPMC) with synchronous line interface modules (SLIM)
- One asynchrous data set with serial ports (ADS)
- High speed data set with parallel ports (HSD)
- Teletype, line printer, cardreader, controller (TLC)
- Two tape controllers (TC)
- One real-time option module (RTDM)
- One memory bus controller (MBC)

PDP 11/35

Basis Unit and Peripherals

- 11/35 processor with 32K 900 ns memory
- Two RK05J cartridge disk drives
- To 9-track 800 Bpi tape drives
- One terminal
- One Decwriter hard copy terminal
- One Versatic matrix printer

Interfacing

- Telemetry input
    One EMR 720 PCM bit synchronizer
    One EMR 710-2 PCM frame synchronizer/decommutator
- One DR11B parallel port

PDP 11/55

Basic unit and peripherals

- One CPU 11/55 with 128K words core memory and floating point processor
- Two RK05 Cartridge disks with controller
- One RP06 400 Mbyte disk with mass bus controller
- One papertape reader/punch with controller
- Four 9-track 800 Bpi tapedrives
- Two 7-track 800 Bpi tapedrives
- 600 cpm lineprinter
- 100 Cpm card reader
- One Decwriter
- Four terminals (CRT)

Interfaces

- See PDP 11/35

Graphics Display Network (GDN) 1 & 2

Basic processor and peripherals

- PDP 11/70 processor, 512K words of memory, 2K cache, floating point processor
- Three 67 Mbyte disc drive and controller (Massbuss)
- One 9-track 800/1600 Bpi tapedrive
- Two RX02 floppy disks
- Versatic printer/plotter
- One operators console
- One Decwriter III
- One card reader

Interfaces

- One PDP 11/Vax 11 interface to Vector General display controller (5 display sections)
- Two DR11-B parallel port to hyperchannel and/or SEL 32/77

UNIVAC 1106 (A & B)

Basic processor and peripherals

- 1106 CPU with 512K core words memory
- Three 8740 disk storage units with controller
- Three 9-track 800/1600 Bpi tapedrives with controllers
- One 1200 cpm lineprinter
- One 1000 Cpm card reader
- One card punch (A) or four CRT's (B)
- One system console

Interfaces

- Hyperchannel parallel I/O
- Calcomp serial/parallel I/O

Discrete Events Input Unit

- 3-phase switch panel (128 switches)
- Binary display (counter top with 180 lights)
- Binary display (stand alone with 180 lights)
- LSI-11 processor/controller
- One CRT
- Two RX02 floppy disks

Datum 9310 - Range Time Generator/Translator

ANNEX K

OPERATIONAL TEST INSTRUMENTATION GUIDE

U.S. ARMY ARMOR AND ENGINEER BOARD
U.S. ARMY ARMOR AND CENTER AND SCHOOL
Fort Knox, Kentucky

CONTENTS - ANNEX K

LIST OF FIGURES

LIST OF TABLES

ANNEX K

U.S. ARMY ARMOR AND ENGINEER BOARD (USAARENBD)
U.S. ARMY ARMOR CENTER AND FORT KNOX
Fort Knox, Kentucky

1. Introduction.

a. Overview. Fort Knox is located about 30 miles southwest of Louisville, Kentucky. It is the home of the Armor Center. Major commands include the FORSCOM 194th Armored Brigade and the TRADOC Armor and Engineer Board.

The mission of the Fort Knox facility is to control, train, and provide administrative and logistical support for all units assigned, or attached, to operate the U.S. Army Armor Center and to furnish administrative and logistical support to all units and activities tenanted at Fort Knox.

The facilities and range areas of Fort Knox are oriented primarily toward the training mission. The post consists of more than 100,000 acres. Firing ranges of from 100 to 19,000 meters are made available by the host installation on a space-available basis.

The terrain varies from low, rolling, wooded hills to sharp escarpments and densely wooded areas. Water areas include several lakes and accessibility to the Ohio River.

b. Generic Systems Tested. The U.S. Army Armor and Engineer Board (USAARENBD) is the only organization located at Fort Knox that possesses a true operational test and evaluation capability. The Armor Center, being the host organization, has control of the majority of test ranges and facilities. Although the Center is training oriented, it does perform some testing and evaluation of new and existing items.

The USAARENBD major testing capabilities include:

(1) Weapons. Direct fire cannon class armament integral to tanks and associated combat vehicles and engineer armored vehicles; combat vehicle mounted automatic cannon and machine guns, and related combat vehicle auxiliary class armament to include grenade launcher systems.

(2) Munitions/Demolitions. Conventional armor-defeating anti-personnel/anti-material, screening type munitions, demolition kits, and cratering charges.

(3) Tank-Automotive. Tanks and associated tracked combat vehicles including the engineer armored vehicle, wheeled-type armored combat vehicles, and all basic wheeled and tracked vehicles employed in command and logistic support roles by the Army in the field; also, various fault isolation sets for this equipment.

(4) Communications. Communications equipment or components associated with armored vehicles.

(5) Missiles. Ground-to-ground type missiles designed for line-of-sight engagement of armored vehicles for defeat of armor.

(6) Engineer Equipment. All classes of engineer equipment for the Field Army including construction equipment, generators, airfield surfacing, water purification units, bridging/ferrying equipment, material used in mine warfare, and firefighting equipment.

(7) General Equipment. POL dispensing, handling, transporting equipment, marine and transportation equipment, industrial equipment and field service equipment less mess-related items.

(8) Night Vision Equipment. All classes of materiel employed for illumination, observation, and detection to include weapon sighting applications for direct fire.

(9) Nuclear/Biological/Chemical Equipment. Radiation detection equipment and CB protective shelters.

2. General.

a. Military Units.

(1) Army Units. The following list of Army units presently located at Fort Knox will serve to provide partial insight into the basic ability and types of support that can be obtained by an outside user. However, many uncontrollable factors coupled with schedules and routine requirements limit use of these units. Further investigation of the user requirements as a function of quality, lengths of need and time frames required, correlated with existing or planned other user needs already scheduled for these units would be necessary.

(a) STRAF (Strategic Army Force).

HHC, 194th Armored Brigade

194th Signal Platoon

22d Replacement Detachment

4th Battalion, 54th Infantry (Mech)

401st Personnel Svc Co

5th Battalion, 33d Armor

431st Medical Detachment (Hel Amb)

61st Med Detachment

Troop D, 10th Cavalry

42d Field Hospital

75th Support Battalion

3d Battalion, 3d Field Artillery Battalion (155SP)

76th Maint Co

HHC, 544th Supply and Service Battalion

71st Ordnance Detachment (EOD)

30th Ordnance Detachment

43d Ordnance Detachment (EOD)

12th Finance Sec

4th Battalion, 37th Armor

13th Engineer Company

522d Engineer Company

514th Maintenance Company

19th Engineer Battalion (less Company D)

530th Maintenance Company

Troop G, 1st Cavalry

(b) Armor School Support Units.

School Brigade

2d Squadron, 6th Cavalry (TDA Augment)

Selected STRAF units

(2) Nearby Government Installations. The following Army installations are within a 300-mile radius of Fort Knox:

Fort Campbell, Kentucky

Blue Grass Depot Activity, Richmond, Kentucky

Jefferson Proving Ground, Madison, Indiana

Lexington-Blue Grass Army Depot, Lexington, Kentucky

Fort Benjamin Harrison, Indiana

Redstone Arsenal, Huntsville, Alabama

Mobility Equipment Command, St. Louis, Missouri

b. Maintenance (Vehicle-Tank-Helicopter). The maintenance of vehicles and aircraft is one of the important items for consideration by the testing group. Naturally, the operational requirements and additional loads placed on the Fort Knox maintenance units must be defined before accurate assessments can be made. Maintenance of vehicles such as tanks, trucks, and jeeps is available by the Logistic and Test Support Division of the USAARENBD. The levels of maintenance that can be carried out by the Board range from organizational to direct support to general support with a mix of soldiers and civillians--100% soldiers at organizational, 65% soldiers at direct support, and 65% soldiers at general support. The Board has facilities to perform maintenance on test items under realistic troop unit conditions while still maintaining controls that are necessary to provide valid test data, using trained, experienced military maintenance evaluators.

The Board presently has no maintenance capability for helicopters.

The Army Center and School maintenance of vehicles is carried out by the individual support units identified in the previous section. Helicopter maintenance is available at Godman Army Airfield. Also supporting the Army Center is the general support unit located at the Boatwright Ordnance area. This group is considered a very capable, high echelon vehicle maintenance repair facility, primarily civilian staffed.

c. Access.

(1) Air. Louisville Airport (7,800-foot runway) is 35 miles north by road, in addition to Godman Army Airfield on Post (5,200-foot runway), which is restricted to military aircraft.

(2) Water. The Ohio River borders Fort Knox, with the nearest certified port facility at Louisville, Kentucky, 35 miles north by road.

(3) Roads. Access to Interstate 65, 20 miles to the south, which links Fort Knox to the interstate road system (see Reference 9 for facility map).

(4) Rail. Fort Knox is serviced by the Illinois Central Railroad.

d. Logistical Support Capability. The logistical support capability of the host and tenant organization at Fort Knox is adequate for supporting present operations. Small increases of maintenance/logistic support required by outside users are most probably tolerable without major problems. However, as stated earlier in the maintenance section, defined requirements are necessary for a comprehensive view of the maintenance/logistics capability that could be provided.

e. Recurring Commitments. Annually, in the summer months, Fort Knox hosts ROTC and Reserve units with a strength of approximately 1,000 and [illegible],000, respectively. These perennial tenants are usually self sufficient in most aspects but can place some burdens on the Armor Center, particularly in maintenance and supply.

75th Support Battalion

3d Battalion, 3d Field Artillery Battalion (155SP)

76th Maint Co

HHC, 544th Supply and Service Battalion

71st Ordnance Detachment (EOD)

30th Ordnance Detachment

43d Ordnance Detachment (EOD)

12th Finance Sec

4th Battalion, 37th Armor

13th Engineer Company

522d Engineer Company

514th Maintenance Company

19th Engineer Battalion (less Company D)

530th Maintenance Company

Troop G, 1st Cavalry

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Lexington-Blue Grass Army Depot, Lexington, Kentucky

Fort Benjamin Harrison, Indiana

Redstone Arsenal, Huntsville, Alabama

Mobility Equipment Command, St. Louis, Missouri

These reserve units utilize a large number of range and training area during their stay. This usage, plus normal school training, makes availability of these ranges and areas relatively restricted during the summer months.

f. Special Operational Restrictions. Presently there are no special operational restrictions governing users of ranges and test areas. Normal restrictions and control for aircraft, range, and test areas are identified elsewhere in this document.

g. Facility Organization. Figure D-1 shows the primary organization of the U.S. Army Armor and Engineering Board .

h. Environment. Normally, in the Fort Knox area, precipitation is distributed throughout the year, with fall the driest season. However, wide variations in the total annual and the distribution of precipitation can be expected. In general, about 1 in 10 days has rainfall of sufficient intensity to affect trafficability. Rainy periods are usually short, but may occasionally last for more than a week, especially in the fall and spring months.

In winter, the average temperature is slightly above freezing, but more than half the nights are below. Evaporation and plant transpiration rates are very low and soils may remain wet for extended periods. During the winter, there may be periods ranging from several days to more than a week when the temperature remains almost continuously below freezing, and the ground is frozen to a depth sufficient to support a tank. Most commonly, the freezing period is at night; thawing occurs during the day. At such times soils are quickly churned into a deep mud by tank tracks. Such alternate freezing and thawing may persist from November to March.

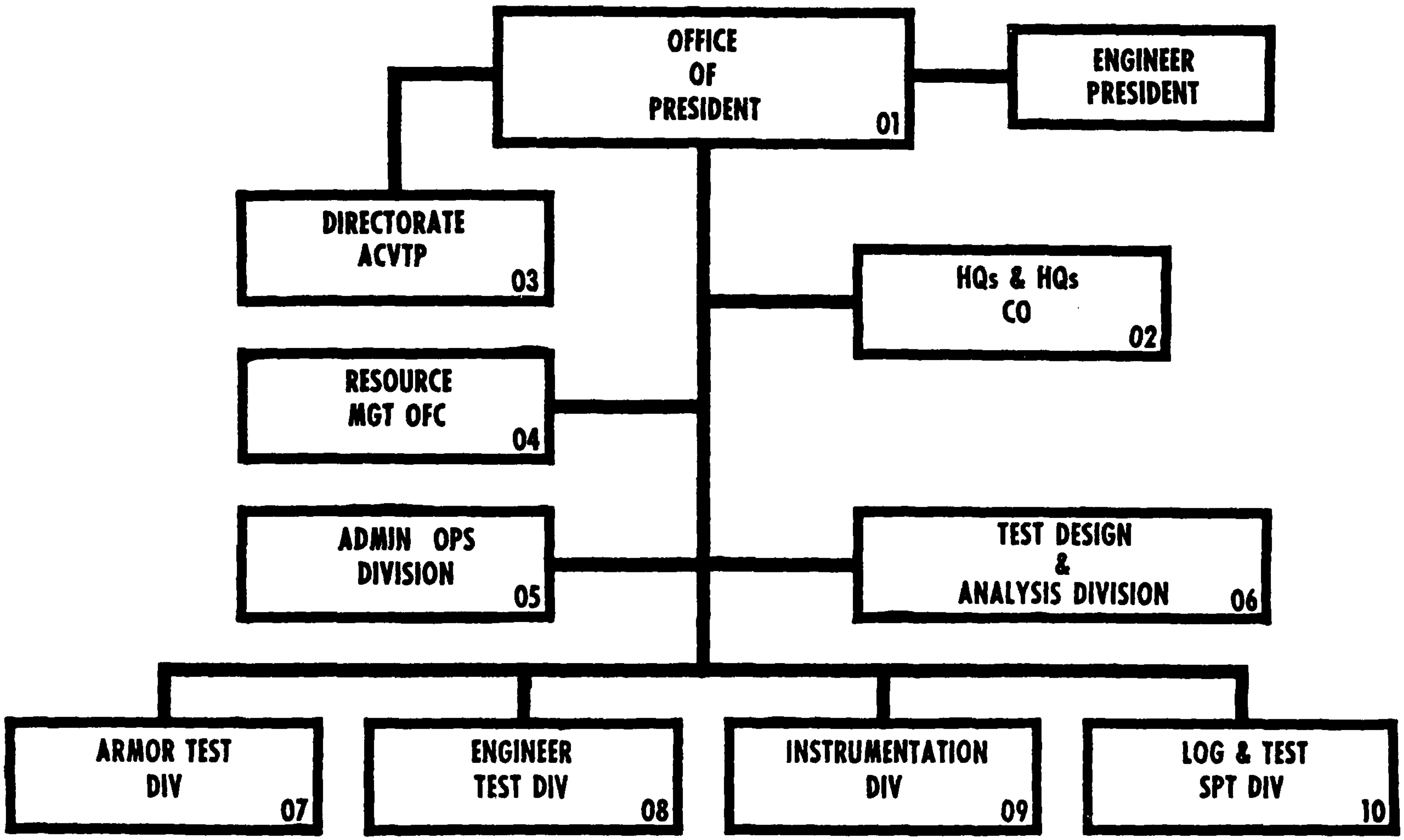
Summer temperatures are high, rising on almost a third of the days to more than 90°F. This, together with vigorous plant transpiration, causes rapid drying of the ground after rains. For this reason, the summer months provide a very high proportion of the days with easily trafficable dry ground.

Other climatic factors such as relative humidity, sunshine, cloudiness, and wind, are important in determining the rate of drying of the soils, but they cannot readily be evaluated. The lower the humidity, the more sunshine, the greater the wind velocity, and the higher the temperature, the greater will be the evaporation and rate of drying of the soil.

Further detail of the climatological conditions and effects can be found in the Special Study - Mobility Description of Terrain (see Reference 2 in the Bibliography).

i. Topography. Five distinct terrain units are recognized in the Fort Knox area. Two, the Ohio Valley and the Salt River Plain, are broad alluvialvilled valleys, enclosed by steep-sided valley walls. Only in detail are these units influenced by the local bedrock. Three terrain units, the Knobs, the Pennyroyal Plateau, and the Mammoth Cave Plateau, correspond to outcrop belts of the three major rock types. Two irregular

US ARMY ARMOR AND ENGINEER BOARD
ORGANIZATIONAL CHART



escarpments separate the lower Pennyroyal Plateau from the Knobs; the Dripping Springs escarpment separates the higher Mammoth Cave from the Pennyroyal Plateau.

A more indepth survey of the topographic conditions of the various test ranges and sites may be obtained from the topographic maps, (References 7 and 8) and the Special Study - Mobility Description of Terrain (Reference 2).

j. Airspace Restrictions. Military aircraft using Godman Field as on origin are restricted from flying over all test ranges and impact areas unless cleared to do so by the range control office. These restricted areas are R370 A and B. Area R370A restriction is from surface to and including 10,000 feet above Mean Sea Level (MSL) from 0600 to 2400 hours GMT, other times by Notice to Airmen (NOTAM) 24 hours in advance.

Area R370B restricts from 10,000 feet above MSL to 20,000 feet above MSL, activated by NOTAM 24 hours in advance.

During severe weather conditions or emergencies, Fort Knox may release R3704 to the FAA controlling agency until such weather conditions terminate. If the range controll office clears an aircraft of flight within the range complex, all procedures as specified in the Range and Impact Areas Handbook, USAARMC Reg Nol 385-22 (Reference 1) will be in effect.

All aircraft, private, commercial, or military are restricted from enroute fly-overs of the Fort Knox area as per the FAA Entoute Low Altitude Flight Information Publication Map Number L21 (see Bibliography).

Fort Knox, located only 35 miles south of the Louisville Airport, Standiford Field, is subject to FAA restrictions when any flights originating or enroute enter into the Standiford Control Areas. These restrictions are also specified on L21 FAA Map (see Reference 6).

k. Power Availability. Commercial electrical power, 115 volts, AC-60 cycle, is available at most ranges.

Paragraph 3.a.(3) of this document includes a listing of ranges with a yes or no indication of commercial electrical power presence. Condition and power load capacities are not supplied; therefore, further information would be necessary. Mobile generators for electrical power are available both at the USAARENBD and Armor Center. The Board presently has up to 5-kw mobile generator capability. The Armor Center generators would be available from the Center's Army support units. Post engineers are also possible sources of information of commercial and portable power capabilities for testing and equipment users.

l. Communications. All communications used by the USAARENBD, Armor Center, and range installations are standard military equipment. The Board uses both man portable and/or vehicle mounted radios of various types on a loan basis as needed for the majority of their requirements. The Armor Center relies on the Army supporting units for communications, which includes communications vans or vehicles, M577, that can carry a wide variety of radio teletype and artillery control equipment.

Landlines for telephones are installed on most ranges. The listing of ranges in paragraph 3.a.(3) indicates those ranges with landlines and the number of lines installed.

3. Dimensions.

a. Landspace. Fort Knox comprises 110,300 acres of landspace. This total landspace is divided into two groups: the Post installation of buildings, housing, etc., and test areas, ranges and impact area (wee Figure K-2). The majority of the Fort Knox landspace is llotted to this latter group.

(1) Test Area Contiguity. See special map of Fort Knox (Figure K-2).

(2) Easements. There are presently no easements in effect for any of the test ranges or areas. Forestry work and hunting are very low priority items and would never interfere with range usage. Airspace and normal operational restrictions are described in the Range and Impact Areas Handbook (Reference 1).

(3) Impact/Live Firing Areas. Many different type of firing ranges are located at Fort Knox. By using the Fort Knox special map (Reference 5) precise locations are possible.

Other test ranges are available for maneuvers or nonfiring exercises. Three such areas are:

Carpenter Test Area

Two-Way Stop Loop

Dorrets's Run Loop

These areas are used almost exclusively by the USAARENBD but are available if scheduling permits.

b. Airspace.

(1) Landspace/Airspace Relationship. This relationship is described in paragraph 2.j, Airspace Restrictions.

(2) Easements (FAA Air Routes). There are no easements except those already mentioned in paragraph 2.j.

(3) Manned Airborne Systems (Missile, etc). Ground-to-ground, ground-to-air, and air-to-ground weapon systems are capable of being utilized if proper safety zones are available, or necessary range airspace/landspace is sufficient for existing operational procedures governing that particular system or systems.

(4) Unmanned Airborne Systems. Drones are usable with normal operational restrictions as outlined in the Range and Impact Areas Handbook (Reference 1).

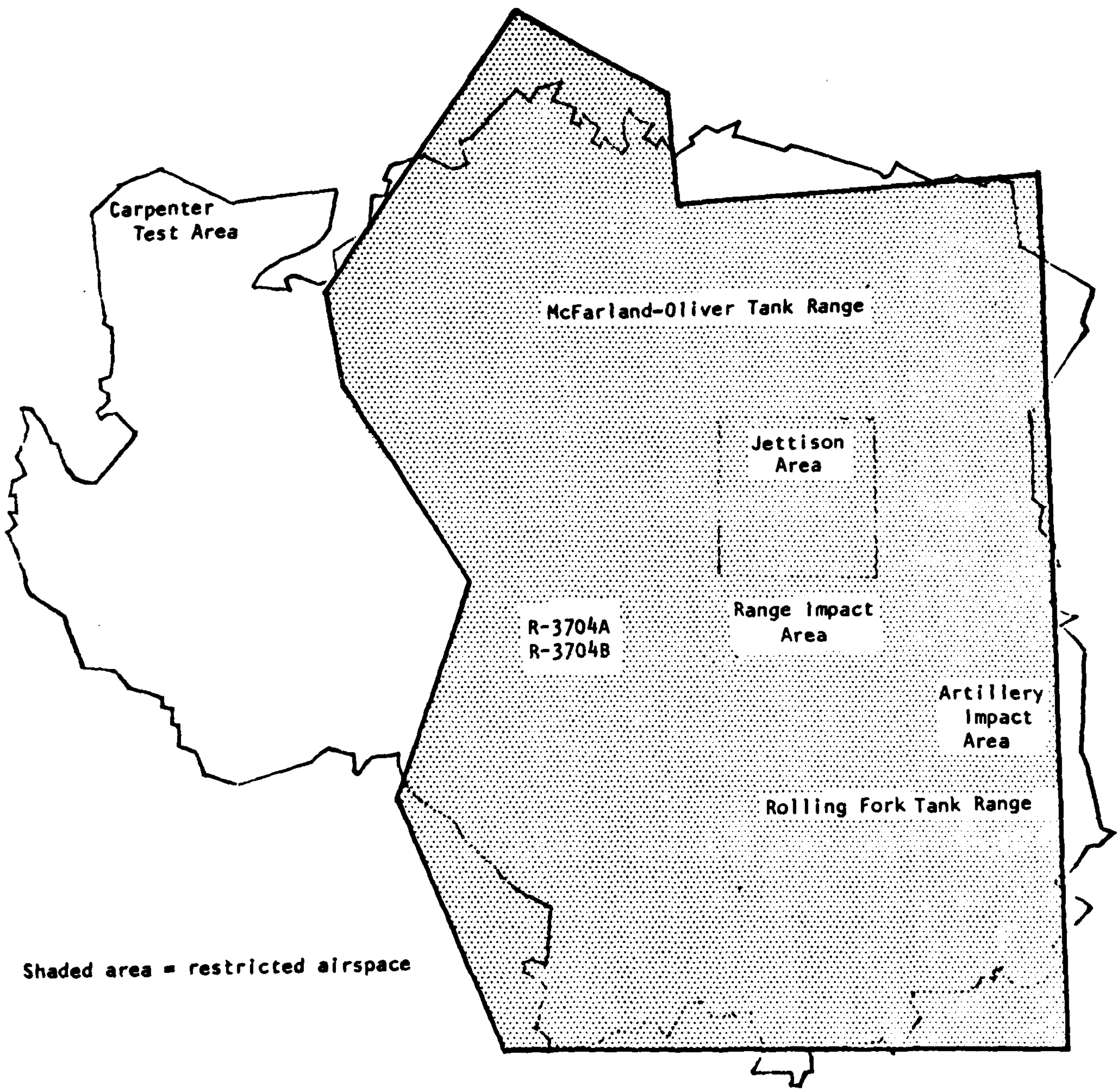


Figure K-2: Fort Knox Landspace, showing Restricted Airspace

(5) Area Surveillance. No surveillance equipment is available except standard communications networks necessary for range control operations.

4. Instrumentation. (See Reference 3 of Bibliography)

a. Position Location Systems. The USAARENBD has two Motorola Mini-Ranger III (MRS III) systems. Both systems operate on the principle of pulse radar and are used to monitor the location of up to 16 vehicles equipped with a transponder in real-time simultanelusly. However, only one vehicle can be plotted in real-time. The plots of the other vehicles, in cases of multiple vehicles, must be performed in the post-process mode. Outputs for system #1 are computer magnetic tape and paper printer. Outputs for system #2 are computer magnetic tape, paper printer, and graphic plots. A computer printout with a time reference is provided.

The Board also has a Video Automatic Target Tracking System (VATTS). This system is utiliaed to collect azimuth and elevation angles from a fixed reference point to a target being tracked. Range data is also collected by utilizing the laser rangefinder. Output consists of computer magnetic tape and video tape operating from a surveyed pedestal.

b. Timing. Each instrumentation sytem owned by teh USAARENBD has as a part of its equipment, a precision, pre-setable clock to input time into the system. In addition, the Board owns a time standard synchronized to WWV.

c. TV. The Board has two Sony Video Rover II Cameras; completely portable, battery-operated systems. The TV camera is held like a movie camera, has an electronic viewfinder which displays the TV picture as it is taken, and can be used as a playback device. Sound or voice also can be recorded via a built-in microphone. The recorded video can be played back on the Boards's TV monitor.

The Board also has three GBC Model CTC-2100 television cameras. These cameras are tripod-mounted and must be connected to a TV monitor.

A prime application of these systems is to provide a quicklook capability of the data being obtained by photographic recordings of test data. The TV units, therefore, are operated in conjunction with data recording movie cameras.

TV equipment is owned by the Armor Center, primarily for the production of video recordings for training purposes. Besides TV studios, they have two fully equipped mobile vans, one with a color system, the other with a black and white system. For field test, these mobile systems have been used to provide TV coverage.

Table K-1

LISTING OF PHOTOGRAPHIC INSTRUMENTATION
IN ARMOR AND ENGINEER BOARD INVENTORY

System	Description	Application	Capability Limitation Remarks
Cameras, Gun-Type (millikan) Motion Picture	16mm motion picture frame rates to 500fps	Mount on gun tube or turret to record date of firing results	Capable of absorbing high G stresses, 400-ft roll film limitations
Camera, Rapid Sequence Still Picture, 70mm Mulcher	70mm stills at rates up to 50 per second, hand held and tripod mount	Rapid sequence stills either remote controlled or electronic flash coordinated, to obtain data of ammunition tests, missile firing, observation or tank interior systems operations	Capability includes 100-ft roll film; provides more observation per event
Cameras, 16mm Motion Picture, Silent, Arriflex	Lightweight, through lens focusing and viewing, 400-ft magazine, electric motor drive	Film test operations for data acquisition and docmentary coverage	Capable of easy portability in field
Camera, Underwater Type Still	Waterproof still camera, 35mm wide angle lens	Photograph under water action of test items such as track action or mine emplacement	Capable of underwater photography
Camera, Motion Picture, High Speed, Hycam	16mm High-Speed motion picture camera, 400-ft model	Photograph extra rapid event action for data acquisition too fast for eye sensing	Capable of filming 5-8 seconds of action events at at 11,000 frames per second

The Board has six GBC Model CTC-2100 television cameras which have been modified to mount on the M32 and M35 tank periscopes. These cameras mount where the IR periscope is usually positioned. This enables the television camera to see what the gunner sees. These TV cameras are mainly used in tests of tracking and firing capabilities.

In addition, the USAARENBD has one (1) L&W Model 112-C Film Analyzer System equipped as a TV analyzer. The analyzer is microprocessor controlled to output x-y cartesian coordinates and compute angles, offsets, irregular lengths, and areas. They can be programmed to provide an output on paper or magnetic tape.

The Board owns one Data Acquisition Recording System (DARS), which can be used to digitize video for applications such as scoring targetry used in live-fire exercises. The system is micro-computer controlled and programmed in BASIC. With existing software, the target size, aim point, and impact points are processed to give coordinates of impact points, and the radius and dispersion of the shot group for main gun ammunition in near real-time. Also, gunner tracking and lay error can be evaluated.

The other video system owned and operated by the Board is a Tank Video System (TVS). The TVS is a video based instrumentation system that will provide the capability to gather accurate point-of-aim data. The TVS system is used to accurately measure both the horizontal and vertical angular location of a target with respect to the crosshairs in a gunner's sight picture and the centerline of a gun barrel.

d. Photography.

(1) Motion Picture. (see Table K-1). Movie film (color or black and white) are sent to Redstone Arsenal, Alabama, for processing. Turnaround time is two to three weeks.

The Board has four (4) L&W Model 112-C Film Analyzer Systems equipped for 16mm and 35mm film analysis. These analyzers are microprocessor controlled to output x-y cartesian coordinates and comput angles, offsets, irregular lengths, and areas. They can be programmed to provide an output on paper or magnetic tape.

The Board has a Vanguard Film Analyzer for use in obtaining x-y measurement of film records. The readings are manually recorded.

(2) Still Pictures. (see Table D-1). The Photo Lab of the Board processes both color and black and white films of still cameras. Th lab also produces prints in color or black and white. Turnaround time depends on quantity, backlog, and other scheduled requirements.

(3) Airborne Capabilities. None.

e. Instrumentation Calibration Status. Most instruments are sent to Fort Knox Director of Industrial Maintenance Division for calibration in accordance with a computer maintained schedule. Certain sophisticated special-purpose units (e.g., photometers) are returned periodically to the factory.

f. Other General Instrumentation.

(1) Telemetry. The Board has six each video micro-wave links, (20 MHz BW) and one FM micro-wave link (1 MH BW).

(2) Meteorlogical. Standard airfield-associated units at Godman Army Airfield, Fort Knox. The Board has a weather system with the capability of measuring wind direction, wind velocity, temperature, barometric pressure, and relative humidity. In addition, the capability exists to measure wind direction and wind velocity down range by means of portable instruments.

(3) Survey. The Board has two instruments for surveying use. One system capability measuring distance only, while the other, a Hewlett-Packard Total Station capable of measuring both distance and making angular measurements.

(4) Radio Frequency Interference (RFI). None at Board or Center.

(5) Visibility (Light Level Measurement). The Board has a telephonmeter manufactured by Gamma Scientific. This unit measures ambient light levels to 10-5 foot lamberts.

(6) Sound Measurement and Analysis. The Board has a General Radio Sound Level Meter Type 1551 and five portable cassette-type audio recorders with microphones.

(7) Safety and Security. No instrumentation. Standard procedures such as range guards are used.

(8) Soil Conditions. None.

g. Special Purpose Instrumentation.

(1) Ballistic Data. No special instrumentation for this purpose exists at the Board or Armor Center. Photgraphic methods are used by the Board for this class of data.

(2) Environmental Chambers. None.

(3) Vehicle Performance. The Board has a mobile dynanometer to measure drawbar pull over the range of 500 to 100,000 pounds, and three Ecloyzer carbon monoxide detector kits. Output data is recorded on a visigraph.

(4) Chemical/Biological/Radiation (CBR) Instrumentation. The available CBR items are those normal to TOE/TDA organizations associated with the Armor Center. No special instrumentation for CBR measurements is owned by the Board or Center.

5. Threats/Targets.

a. Ground.

(1) Electromagnetic. None.

(2) Weapons.

(a) Live-Fire Targets. The Board has two remotely controlled, moving target systems. The systems consist of cabledrawn carriages traveling on emplaced tracks in a straight line movement. The remote controls will start, stop, reverse, accelerate, and decelerate the targets. In addition, the Board has II stationary targets which allow remote control of raising and lowering the system. The stationary targets will also lower when hit.

Flat silhouette targets are also constructed from polyethylene material to desired shapes and painted according to requirements; e.g., camouflage.

Some of the training ranges of the Armor Center are equipped with infantry silhouetter target mechanisms, type M30 ("Trainfire"), for a total of approximately 200 mechanisms. These units are remotely controlled via wire to appear, and can be dropped by command or automatically upon being hit. The center also has 43 DART radiocontrolled infantry target mechanisms, similar in action to the Trainfire mechanisms.

Board also has five radio controlled, evasive type, moving targets. The target consists of a M715, 1-1/2 ton, chassis with a three-dimensional target shell. The radio controls include start, stop, acceleration, deceleration, and direction change (serpentive movements). The targets must be visible 100 percent of the time and, therefore, can be operated only during daylight hours and from an elevated position.

The Board also has a programmable wire following moving target vehicle under development.

(b) Simulated Fire Targets. The Board has seventeen SIMFIRE tank tactical kits, six SIMCAT systems, three SIMGUM target kits, and four SIMRAY systems (see Reference 4).

The SIMFIRE tank tactical kit consists of a weapon projector (laser), a control unit, four detectors, a receiver/transmitter, two eyepiece attachments, a flash generator, and a smoke pyrotechnic holder.

The SIMCAT system is handheld weapon projector (laser) and a control unit, which simulates antitank guided missiles.

The SIMGUN target kits consist of two multifaced detectors, a control unit, and a smoke generator. This system is mainly used to supplement the SIMCAT system.

The SIMRAY system consists of a handheld weapon projector and a control unit. The SIMRAY system is capable of interrogating SIMFIRE systems ot determine if the sensors are working, in addition to engaging systems to simulate minefields, missiles, etc.

The SIMFIRE tactical kit was developed for training of tank crews. Interfaces with the equipped tank's system are required to obtain signals of each simulated firing and of the range input to the fire control computer. The crossing speed of the target is inputted as a lead angle via a control box operated by the commander. Upon each firing a pulsed eyesafe narrow laser beam of two seconds duration is emitted by a unit of the system attached to and aligned with the gun barrel, in conjunction with the initiation of a simulated fire signature element. Targets are equipped with several detectors located to cover 360 degrees in azimuth and ±15 degrees in elevation relative to the target. When activated, a target's system element omni-directionally transmit an RF signal and compares it with its outgoing laser signal to derive a measure of the true range to an accuracy of approximatley 300 meters at ranges of up to 2,000 meters.

The control unit of the system incorporates the ballistics of two types of rounds (i.e., heat and APDS); also kill and miss-distance computation circuits.

The system can provide data only if a detector is activated by the beam emitted from an equipped tank. Miss-distances of a simulated round must, therefore, be less than one to two target lengths.

The lead angle inputted to the system, when matched by the gunner and the inputted range, is sufficiently accurate and results in the system indicating a hit or near miss--not that the correct lead was put in.

As presently supplied, the SIMFIRE system is not designed to provide data output of the system's actions; i.e., hit, misses, measured range or the range value used by the crew.

Recorders at, or on-line data transmissions from both the attacker and its target would be required for operational testing. Firing information (hit or miss) and range data are obtainable from the attacker; however, target identification is only available at the target, since correlation of a given simulated firing with assessment of a target hit or miss must be determined from the time relationship between these events. If recorders are used then an accurate time base is required for each recorder, and data must be carefully examined during assembly. When on-line data transmission is used, the data must be tagged with identification of the source.

(3) Radiological Environment. None.

b. Airborne. None at Board or Center.

6. Data Handling/Processing.

a. Data Storage and Retrieval Capabilities. The USAARENBD has data storage and retrieval capabilities at both the point of field data collection and in conjunction with the data analysis effort.

(1) Field data collection storage and retrieval is for the most part done on nine-track magnetic tape in an odd parity ASCII format. The minicomputers which control the TVS and VATTS systems have a very limited removable disk storage capability.

(2) Data stroage and retreival in conjunction with data analysis is virtually unlimited; with public disk space, user set packs and magnetic tape available at the host computer site.

b. Quick-Look Capabilities. The USAARENBD quick-look capabilities are very limited and for the most part only verify that the data tapes do, in fact, contain readable data. Notable exceptions are the DARS and TVS, for which quick-look software is being developed.

(1) Data Acquisition Recording System (DARS). This system has the capability of providing shot group analysis feedback to the project officer in near real-time.

(2) Tank Video System (TVS). This system has the capability of providing printed summaries and limited graphical analysis of field data in real-time.

c. Processing.

(1) System and Model. The USAARENBD receives its principal data processing support from the TRADOC Data Processing Field Office, Fort Leavenworth, Kansas. At this location the Board has access to two systems, a CDC 6500 and Univac 1100/j83. It has, as required, received processing support from other sources to include CSC INFONET (Univac 1108) and the GSA, Macon, Georgia facility (Honeywell 6800).

(2) Language. The Board has an organic software development staff and can support software in FORTRAN; COBOL; BASIC; ALADIN; and IBM, CDC, and Data General Assembly code, as well as high level analysis languages such as SPSS and SIMSCRIPT.

(3) Input/Output Options. The Board has interactive and Remote Job Entry access to all potential host computers. The DPFO, Fort Leavenworth, can be accessed in a secure as well as unsecure mode. RJE input is limited to Hollerith cards while output can be by either card or listing. All magnetic tape must be mailed to the host computer for processing.

(4) Real-Time/Post-Test. With the exception of the quick-look capabilities in paragraph 6b above, all procesing is done in a post-test mode.

d. Distribution (Turnaround Time). Turnaround time is highly dependent on the resources required and the volume of output. The USAARENBD operates the Remote Job Entry terminal in support of the Armor Center which allows for some flexibility in input/output scheduling. Typical host turnaround is three and one-half hours with an overall receipt from user, return to user throughput of four hours. Thrnaround for outputs in excess of 20 disk pages/frames usually exceeds eight hours.

e. Displays (Plotting Boards, CRTs, Etc.). The USAARENBD has both alphanumerical and graphic CRT capabilities. This is augmented with an electrostatic printer plotter capability. Thereis no on-site pen plotter capability and all pen plots must be mailed from the DPFO, Fort Leavenworth.

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9 US Army Armor Center, Fort Knox, Kentucky, Information Map.

ANNEX L

OPERATIONAL TEST INSTRUMENTATION GUIDE

US ARMY INFANTRY CENTER AND SCHOOL
US ARMY INFANTRY BOARD
Fort Benning, Georgia 31905

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ANNEX L

USA INFANTRY CENTER AND SCHOOL
USA INFANTRY BOARD
Fort Benning, Georgia

1. Introduction

a. Overview

(1) Fort Benning is located adjacent to Columbus, Georgia, 100 miles south of Atlanta. It is the home of the Infantry Center. As a major installation reporting to the Commander, US Army Training and Doctrine Command (TRADOC), and to the Commander, US Army Forces Command (FORSCOM), the US Army Infantry Center (USAIC) has major responsibilities for operating elements of both of these commands. Accordingly, the overall missions of USAIC are as follows:

- To prepare troops for combat.
- To train infantry leaders to fight on the modern battlefield
- To conduct basic combat and advanced individual training.
- To provide infantry doctrine and materiel.

(2) The US Army Infantry Board (USAIB) is a major unit located at Fort Benning, Georgia, General Orders No. 360, Headquarters, TRADOC, dated 27 June 1975, as amended by General Orders No. 578, assigned USAIB to USAIC and Fort Benning, effective 1 July 1975.

(3) The Fort Benning reservation encompasses approximately 182,000 acres. The facilities and range areas of Fort Benning are primarily designed for and allotted to the training mission. The Infantry Board, however, utilizes range areas jointly with the training organizations during the performance of its testing mission. Additionally, USAIB does have instrumented areas designed specifically to accomplish testing missions. The instrumentation is designed to collect data on the operational characteristics of the man/weapon system as opposed to the weapon itself.

b. Generic Systems Tested by USAIB

(1) The Infantry Board is the only organization located at Fort Benning that possesses a true operational test and evaluation capability. The Infantry Center and School, being the host organization with control of the majority of test ranges and facilities, is training oriented and does not perform testing or evaluation of new or existing items.

(2) TRADOC assigned the following mission to USAIB.

(a) Plan, conduct, and report on Operational Test I, Operational Test II, Operational Test III, Force Development Tests and Experiments, and other user tests of:

o Equipment and ancillary items to be used by Infantry units for command and control, fire power, target acquisition, ground surveillance, fire control, ground mobility, and training.

o Clothing and equipment for individuals.

o Rations, cooking, and messing equipment.

o Chemical Warfare--Biological Warfare equipment for individuals.

o Clothing, equipment, and rations worn or carried by individual parachutists while jumping from aircraft and then carried by individuals after clearing drop zone.

(b) Assist the proponent school in developing Outline Test Plans/Resumes and the TRADOC portion of the Development Plan.

(c) Review and comment on draft proposed Letters of Agreement, Required Operational Capabilities, Letter Requirements, Training Device Requirements, and Test Support Packages.

(d) Participate in Development Test I, Development Test II, and Development Test III.

(e) Provide advice to proponent agencies and materiel developers on equipment which is either used by, or provides support to, Infantrymen. Data and information derived directly from test experience will provide the basis for such advice.

(f) Plan, direct, and control a comprehensive program in test methodology, test instrumentation, and test facilities to support the testing mission and to provide input to the TRADOC testing program.

(g) Support the operations of TRADOC, Department of the Army, and Department of Defense in test-related areas and provide membership/ representation on boards, panels, committees, councils, working groups, symposia and conferences as approved by Commander, TRADOC.

(h) Participate in the conduct of Development Test and combined Development Tests/Operational Tests as approved by Commander, TRADOC.

(i) Conduct other tests and evaluation as directed by commander, TRADOC.

(j) Perform such other duties as assigned or directed.

2. General

a. Military Units

(1) Army Units. The following list of Army units presently located at Fort Benning will serve as a partial insight to the basic ability and types of support that can be obtained by an outside user. However, many uncontrollable factors, coupled with schedules and routine requirements, limit use of this unit listing. Further investigation of the user requirements as a function of quantity, lengths of need, and time frames required, correlated with existing or planned other user needs already scheduled for these units would be necessary.

197th Infantry Brigade

1/29th Infantry Bn
197th HH Co
3/7th Infantry Bn
2/10th Artillery Bn
15th Cavalry, Troop A
1/58th Infantry Bn
2/69th Armor Bn
72d Engineer Co
179th MI Detachment
197th Support Bn
298th Signal Platoon

34th Medical Battalion

187th Inf Plat (Pathfinder, Abn)
2d Combat Support Hospital
5th Med Det (Optical)
121st Aviation Co
498th Med Co (MAST)
546th Med Co
690th Med Co (Amb)

36th Engineer Group

HQ 36th Eng Group
18th Replacement Det
43d Eng Bn
67th Maintenance Bn
89th Ordnance Det (EOD)
524th Personnel Svc Co
586th Engr Co Float Bridge
15th Finance Section Co
361st Transportation Det
444th Transportation Co

(2) Nearby Government Installations. The following Army installations are within a 200-mile radius of Fort Benning:

Fort Rucker, Alabama
Fort Gordon, Georgia
Fort McPherson, Georgia
Fort Stewart, Georgia

b. Maintenance

(1) Maintenance of vehicles, aircraft, electronics, and weapon systems is available at different levels by organization.

(2) The Infantry Board's vehicle maintenance facility an element of the Test Support Division, has the capability of conducting organizational maintenance only. However, general support maintenance is available for armament repair. Other maintenance facilities at the Board consists of a machine shop and a special tool inventory. A woodworking shop supplies direct support for the Board's ranges only. No aircraft maintenance is available. The Test Facility Operations and Instrumentation Branch, Test Support Division, of the Board provides all necessary electronic and electromechanical repair for range and lab instrumentation. Outside electronic repair for the Board is rarely required except for periodic lab equipment calibration.

(3) The Infantry Center's maintenance capabilities are extensive, including organizational and general support for all types of vehicles, aircraft, and electronic equipment. This Center maintenance system functions basically in the following manner: organizational and some direct support maintenance is performed by the using organization. When higher levels of maintenance are required, the post maintenance division provides this support.

c. Access

(1) Air. Both Columbus Airport (runway length, 7,000 feet) and Lawson Army Airfield (runway length, 8,200 feet) service Fort Benning. Both fields can receive medium transport aircraft and Lawson Field is capable of aircraft of the C141 and C5 category.

(2) Water. The Chattohoochee River provides water access to Fort Benning and its 9-foot channel extends to the Columbus Docks.

(3) Roads. Georgia State Highway 27 passes through the post and links Fort Benning with the interstate networks (see Ref 3, Bibliography). The Lindsey Creek Bypass terminates on the post and links Fort Benning with Interstates 185 and 85.

(4) Rail. Fort Benning is serviced by the Central of Georgia Railroad.

d. Logistical Support Capability

(1) The logistical support capabilities of the host and tenant organizations at Fort Benning are adequate for supporting present operations. Small increases of maintenance/logistical support required by outside users are most probably tolerable without major problems. However, schedules, time of year, etc., are areas to be considered before a comprehensive view of the logistical capabilities could be provided.

(2) Housing, messing, and other personnel support requirements are possible absorbable by the fact that the Infantry School has a constant

influx and processing of trainees.

e. Recurring Commitments. There are few of these commitments at Fort Benning. Presently, there are no ROTC programs and only weekend firings by National Guard and Reserve units. This weekend firing takes place over the year at a rate which would probably cause few schedule conflicts.

f. Special Operational Restrictions. Presently, there are no special operational restrictions governing users of ranges and test areas. Normal restriction and control for aircraft, ranges, and test areas are identified elsewhere in this document.

g. Facility Organization. Figure L-1 presents the organization of USAIB and Figure L-2 is an organization chart of the Center and School.

h. Environment. Fort Benning has a mild climate with an average annual temperature of 60°F with warm, humid summers and short, mild winters. Georgia precipitation (rain, melted snow, and other forms of moisture) averages 49 inches a year. The rainiest months are July and August and the driest are October and November.

MONTHLY WEATHER COLUMBUS/FORT BENNING AREA

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE OF:
53	56	63	73	81	88	89	89	84	74	62	54	High temperatures
36	37	42	51	59	67	70	69	64	53	42	37	Low temperatures
12	11	12	10	9	11	12	11	8	7	8	11	Days of rain or snow
Temperatures are given in degrees Fahrenheit												

Source: US Weather Bureau

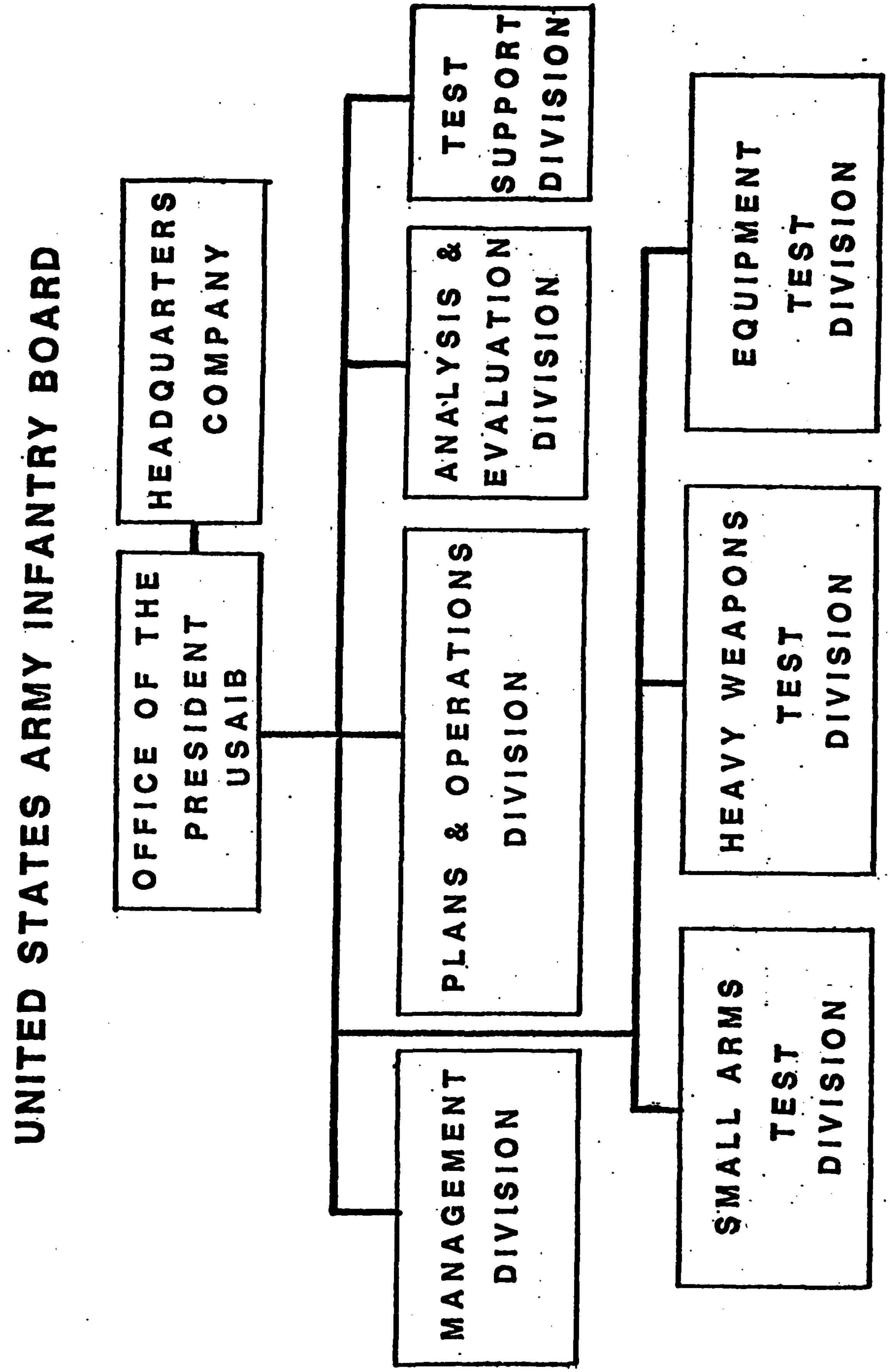

Figure L-1. United States Army Infantry Board

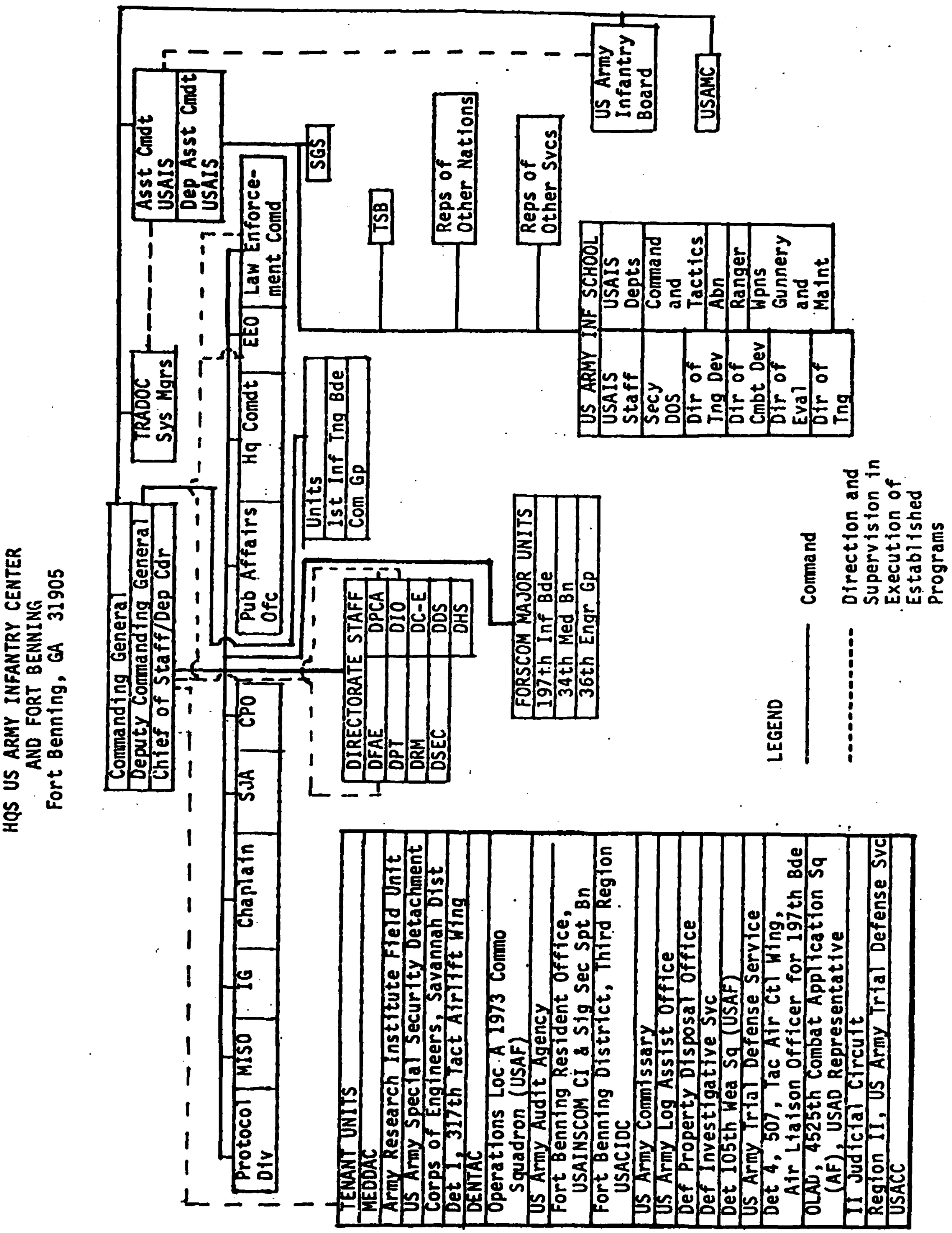

Figure L-2. US Army Infantry Center and School

i. Topography

(1) The Fort Benning region is a hill land of moderate relief which is drained to the Gulf of Mexico, about 200 miles to the south, largely by the Chattahoochee; floods may cause backwater flooding along the lower courses of its tributaries; the larger tributaries are perennial and subject to flash floods after heavy rains. Maximum relief of the area is 600 feet. Flood plains and terrace remnants along the larger valleys comprise the most extensive areas of level terrain. Upland summits provide small areas of slight relief. Hill slopes are as great as 100 percent along some valleys but, in general, are gentle, average about 3 to 7 percent.

(2) Soils are generally sandy or silty with a few poorly drained boggy areas along flood plains or on stream terraces. Where clay or silty formations crop out at the surface, the ground is slippery after rains. Soil erosion is especially active in parts of the area where vertical-walled gullies, commonly as much as 25 or more feet deep, have developed in the poorly consolidated sandy formations.

(3) A more in-depth survey of the topographic conditions of the various test ranges and sites may be obtained from the topographic maps (Refs 7 and 8) listed in the bibliography at the end of this annex.

j. Airspace Restrictions

(1) Military aircraft using Lawson Field as an origin are restricted from flying over all test ranges and impact areas, unless cleared to do so by the range control office. If range control clears an aircraft or flight within the range complex air space, all procedures as specified in Section IV, USAIC Regulation No 210-4, will be in effect (Ref 2, Bibliography).

(2) All commercial, private, or military aircraft are restricted from en route fly-overs of the Fort Benning area in compliance with the FAA Enroute Low Altitude Flight Information Publication Map, Number L20 (Ref 9).

(3) Fort Benning, being located only several miles south of the Muscogee County Airport, is subject to FAA restrictions when any of its originating or en route flights enter the Columbus control areas. These restrictions are also specified on the L20 FAA map.

k. Power Availability. Commercial electric power is available at the USAIB ranges. The Infantry Board and the Infantry Center also use mobile, standard military generators to meet power requirements at the various ranges. Generator sizes vary from 5 kw to 30 kw units at both Board and Center support units.

l. Communications

(1) All communications used by the Infantry Board, Infantry Center and range control installations are either standard military equipment or commercially procured equipment. The Board uses both man-portable and fixed communications for the majority of their requirements. The Center relies on the Army supporting units for communications.

(2) Telephones are installed on most ranges. Table L-1 is a listing of ranges and training areas; telephone numbers to particular ranges are also shown. Range maps (refs 5 and 6 in Bibliography) show telephone drop points by the indication of a T.

3. Dimensions

a. Landscape. Fort Benning comprises approximately 182,000 acres of landspace. The total landspace is divided into two groups: the Main Post installation that consists of buildings, housing, etc., and the test areas, ranges, and impact/dud areas. The majority of the Fort Benning landspace is allotted to the latter group.

(1) Test Areas. See Figures L-3 and Reference Maps 4, 5, and 6 listed in the Bibliography.

(2) Easements. There are presently no easements in effect for any of the test ranges or training areas. Forestry work and hunting are very low priority items and would never interfere with range usage. Airspace and normal operational restrictions are described in Reference 2 to the bibliography.

(3) Impact/Live Firing Areas. Table L-1 lists the different types of firing and training ranges with a brief description of each range and its location by grid coordinates. By referring to Reference Maps 4, 5, and 6 of the Bibliography and using the grid coordinates shown at Table L-1, the precise location of each range can be determined.

The Infantry Board has instrumented the following facilities in the Kunzig Range Complex (Figure L-3) and has been given priority in their use.

Attack/Defense Facility. The Attack/Defense Facility (Griswold, Fig L-4) was designed to accommodate squad-size live firing exercises in attack, withdrawl and defense. The facility has approximately 200 stationary targets and 21 moving targets. Targets are strategically placed from 10 to 1000 meters for realistic portrayal of enemy combat actions. Data collected in this facility include target hits, targets hit, rounds fired each weapon, time to first round, time to first hit and hit assignment. All targets are raised, lowered or moved and data collected by computer. Small arms fire simulators, demolitions and smoke may also be fired by the computer as a

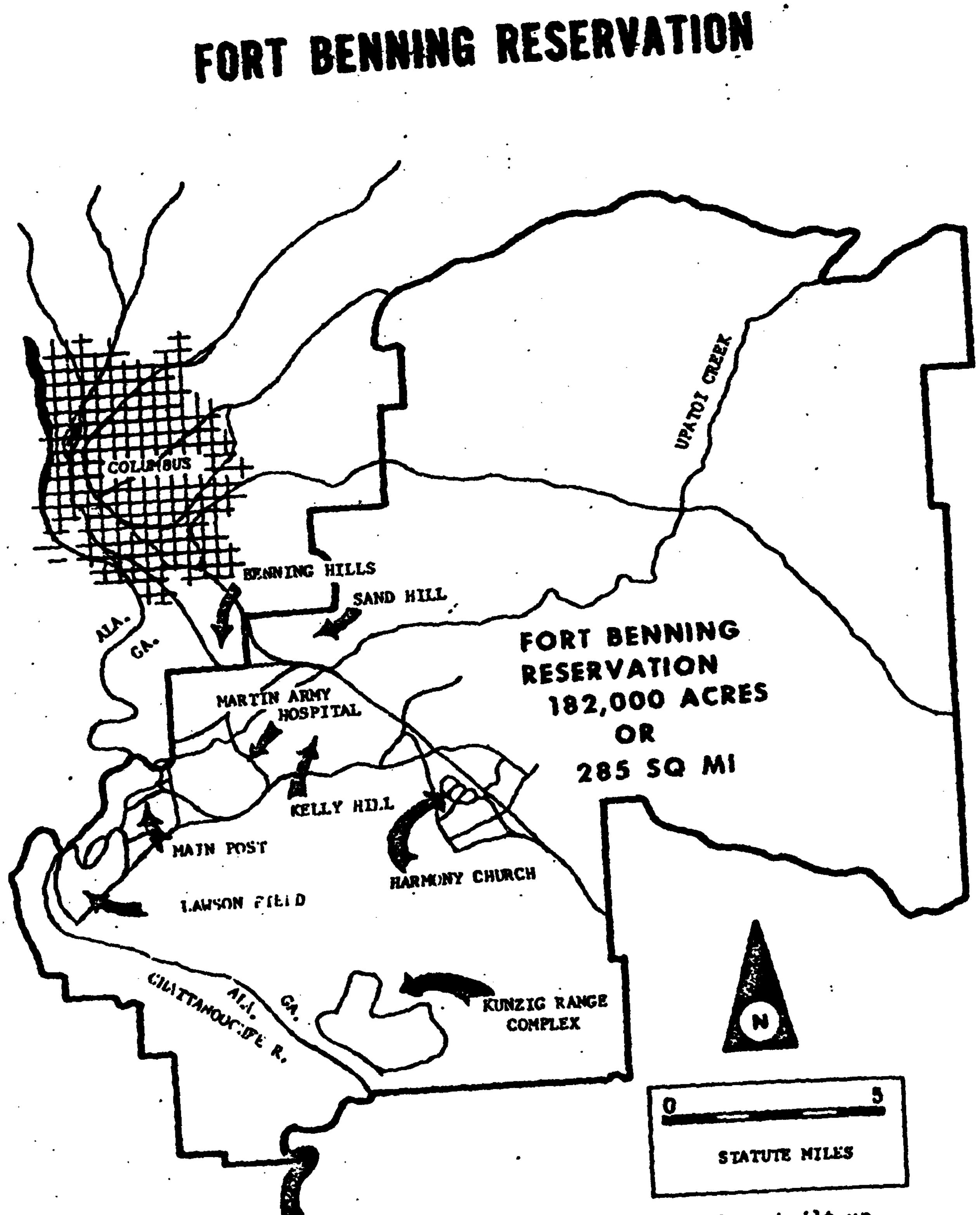

Figure L-3. Overall USAIB schematic showing boundaries, built-up areas and location of Kunzig Range Complex part of the scenario. Small arms up to and including .50-caliber may be fired on this test facility.

Quick Fire Facility. The Quick Fire Facility (Titus Range) follows a meandering trail in a forested area. (Fig L-5) There are targets positioned at various angles of fire on either side of the trail and at various range distances from 20 to 80 meters. Targets are in a down (not visible) position initially. The test soldier moves tactically along the trail and engages each target when presented, as soon as possible. Buried wire coils detect the soldier's presence at firing points and the sequence of target presentation, gunfire noise simulation, hit sensing, time distance measurement information, and targets down are automatically controlled by the Remote Range Control Unit. This is essentially a quick-reaction test course. Accuracy and responsiveness measures of effectiveness (MOE) for the man/rifle combination in a time-stress situation are obtained here. The effects of various items of clothing and equipment on man/rifle performance can also be measured when this facility is used as part of the Clothing and Equipment Test Facility (CETF).

Type of Tng Facility	Priority of Use	No of Firing Points	Communication Phone/Radio	Location Facility
AERIAL GUNNERY				
Ferguson Range	DPT-R	NA	544-1765	156900
ARTILLERY				
*Ferguson Op	DPT-R	NA	544-1765	156900
Hartell Op (Bunkers)	DPT-R	NA	544-1970	145905
Buckner (Sub Cal)	DPT-R	NA	545-7079	945821
* (For Firing Positions, Contact Range Division, 545-5186)				
COMPETITIVE MARKSMANSHIP				
Easley	DPT-Tng Div	26	545-4062	923811
McAndrew	USAMU	70	545-4062	921809
Parks	USAMU	40	545-4963	930808
Phillips	R&P Club	80	689-3371	929808
Hibbs	USAMU	2	545-4869	924806
Trap & Skeet	USAMU	5 Fields	545-1152	931807
Maertens	USAMU	10	545-4969	003818
DEMO AND MINE				
Brown Demo Area	DPT-R	NA	544-6240	037865
Young	89th Ord	NA	544-6255	087842
GRENADE				
Warner (M79/M203)	Inf Tng Gp	10	545-6741	028678
Dianda-Hand Grenade	DPT-R	10	545-2770	972826
Malone 1	Inf Tng Gp	4	544-1171	011894
TACTICAL FIRING PROBLEMS				
Malone	Inf Tng Gp	Attack	544-1267	017931
Garnsey Rd Tng Area	DPT-R	Attack	544-6680	025745
Grandstaff (Inactive)	DFAE	Assault/ Defense	544-4452	937774
Pierce	DPT/Rng Div	Close Combat	545-2953	967823
Malone 26	Inf Tng Gp	Defense	544-2371	038931
Malone 18	DPT-R	Defense (IRETS)	544-3860	063919
Malone 27	Inf Tng Gp	Fire & Maneuver	544-2969	045932

Table L-1. Listing of Ranges and Training Areas

Type of Tng Facility	Priority of Use	No of Firing Points	Communication Phone/Radio	Location Facility
TANK RANGE				
Brann (Zero Only)	Inf Tng Gp	5	544-6755	027757
Brinson (Sub Cal)	DPT-R	NA	544-6747	015811
Turrentine	DPT-R	Tables IV-VIII	Mag Drop	204973
RIFLE MARKSMANSHIP (25 METERS)				
Malone 17	Inf Tng Gp	110	544-2178	061912
Roosevelt	DPT-Rng Div	110	545-4065	911800
Simpson (Upper)	DPT-Rng Div	110	545-3763	916806
Malone 9	Inf Tng Gp	110	544-3880	04888926
Malone 11	Inf Tng Gp	110	544-1681	05558923
RIFLE MARKSMANSHIP (FIELD FIRE)				
Malone 13	Inf Tng Gp	35	544-3884	06118980
Malone 15	Inf Tng Gp	35	544-3667	064903
English	DPT-Rng Div	35	545-1451	913803
RIFLE MARKSMANSHIP (AUTOMATIC RIFLE)				
Malone 2	Inf Tng Gp	35	544-1977	021895
Malone 3	Inf Tng Gp	35	44-3870	027891
Malone 14	Inf Tng Gp	35	544-1867	063901
RIFLE MARKSMANSHIP (RECORD)				
Malone 7	Inf Tng Gp	16	544-2688	04338903
Malone 16	Inf Tng Gp	16	544-1263	063907
Martin	197th	16	544-6379	009819
Simpson (lower)	DPT-Rng Div	16	545-3763	916806
SMALL ARMS FAMILIARIZATION				
Porter	DPT-Rng Div	20	544-3367	996827
MACHINEGUN				
Buchanan (.50-Cal MG)	Inf Tng Gp	15	544-6450	013796
Malone 5 (Field Fire)	Inf Tng Gp	10	544-2479	035891
Malone 12 (Transition)	Inf Tng Gp	10	544-1780	057897
Malone 24 (Predetermined)	Inf Tng Gp	20	544-1489	013901
Galloway (N)(Field Fire)	USAIS	10	544-6692	007779
Galloway (S)(M60-Predetmd)	DPT-R	60	544-6896	007778
Wagner (Transition)	DPT-Rng Div	10	545-3953	938811

(5) Computer Languages. The scenario software is in ASSEMBLY language, data reduction is in FORTRAN IV, and the administrative

Type of Tng Facility	Priority of Use	No of Firing Points	Communication Phone/Radio	Location Facility
MORTAR				
Coolidge	DPT-R	3	544-6246	016783
Coursen (inactive)	DFAE	2	545-5667	947814
Malone 25	Inf Tng Gp	4	544-2589	010919
Area K	USAIS	13	544-4677	156900
Red Cloud	DPT-R	4	545-1366	949816
Eiler Hall (Sub cal)	USAIS	NA	544-1193	945842
NIGHT FIRING				
Hood	DPT-Rng Div	50	545-3354	932807
Malone 4	Inf Tng Gp	50	544-2665	03398930
ANTIARMOR/TOW/DRAGON				
Aparri (Tracking)	DPT-R	10 nonfiring	544-3584	010823
Patton	DPT-R	1 firing	545-5752	976818
Molnar (Tracking) (inactive)	DFAE	1 nonfiring line	545-3761	95107212
North Ruth	DPT-R	1 firing line	544-3680	127997
Brann	Inf Tng Gp	1 firing line	544-6755	027757
Booker (LAW HEAT)	Inf Tng Gp	12	544-3782	982821
Duke (LAW Sub cal)	Inf Tng Gp	23	544-1575	990824
Malone 21 (Sub cal)	Inf Tng Gp	10	544-3486	022935
Lee (Tracking)	Inf Tng Gp	10 (TOW/ DRAGON)	544-3671	075895
TEST RANGES				
Farnsworth	USAIB	6	545-7773	908798
Griswold	USAIB	10	545-3565	976735
Titus	USAIB	1	545-1789	992738
Shea	USAIB	1	545-3468	916797

Name of Training Facility	Assigned	Principal Use	Location
Airstrips	See USAIC Reg 95-1		
AO Eagle	DPT-Tng Div	Inf Qual Test Site	M5 Area
Babbit Field	1st ITB	PT-Parade Field	032822
Black TA	Inf Tng Gp	Indiv Tact Tng	067949, 0-15
Blue TA	Inf Tng Gp	Squad Tactical Tng	056938
Brittin	Inf Tng Gp	NBC-Commo	964933, 0-14
Camp Darby	USAIS	Ranger Tng	195784
Cole Range	Inf Tng Gp	Mortar	031772
Combat Village	Comm Gp	Military Opns in Urban Terrain	029887

Name of Training Facility	Assigned	Principal Use	Location
Confidence Course	1st ITB	Physical Tng	Sand Hill
Craston Hill LN Site	USAIS	Land Navigation	S2 Area
Deese Rng Ln Site	Inf Tng Gp	Land Navigation	022847
Dickman Field	1st ITB	PT/Parade Field	999837
Dixie Village	DPT-R	Leadership Reaction	097779
Engineer Landing	36th Engr Gp	River Crossing Training	882805
Eubanks Field	USAIS	Airborne Training	911817
Exercise Test Site	DPT/Tng Div	IG Test Site	W2&W4 Area
Fiske	USAIS	NCO Tng Site	907794
Fort Mitchell LN Site	USAIS	Land Navigation	V3&W1 Area
French Field	Hunt Club	Recreation Areas	926817
Fryar Field	USAIS	Airborne Drop Zone	X-3 Area
Furman Road LN Site	USAIS	Land Navigation	02 Areas
Green TA	Inf Tng Gp	Squad Tactical Tng	023954, M11,12
Griswold Hill	1st ITB	RAM Indiv Tac	034840
Heliports	See USAIC Reg 95-1		
Kilbourne Commo Area	USAIS	Communication Tng	019863
LAE Drop Zone	NA	Drop Zone	Z5 Area
Land Mine Site	Inf Tng Gp	Mine Warfare	Area U4
Malone 1A	Inf Tng Gp	Target Detection	06409015
Malone 1B	Inf Tng Gp	Target Detection	06308990
Malone 1C	Inf Tng Gp	Target Detection	06208970
McBride Bridge	Inf Tng Gp	Battlefield Survival	049882
Mech TA (PANZER)	Inf Tng Gp	Armd Carr Opn & Maint	019814
Mech TA (STT 8)	Inf Tng Gp	Mech Inf Sqd Attack	E7 Area
Mech TA (STT 7)	Inf Tng Gp	Mech Inf Opns	0-2, 0-3 Area
Mortar Square	Inf Tng Gp	Mortar Mechanical	Area U4
MOUT Site (Stroup Field)	DPT-R	Military Opns in Urban Areas	022837
Obstacle Course	1st ITB	Physical Tng	Sand Hill
Oliver Field	USAIS	Physical Tng	906808
Orange TA	Inf Tng Gp	Indiv Tac Tng	05098003, 4
Patrolling TA	Inf Tng Gp	Patrolling Techniques	99900901, 3
PCPT Course	1st ITB	Physical Tng	Sand Hill
Purple TA	Inf Tng Gp	Indiv Tac Tng	06797204,13,15
RAM Tng Areas 1 and 4	1st ITB	Indiv Tac Tng	Area P1, 2
Red TA	1st ITB	Squad Tactical Tng	02594402, N2
Shelton Range	DFAE	Environmental Activities	918808
Spector Stream Crsng Site	USAIS	Engineering Training	916755
Stewart Field	USAIS	Physical Training	906808
Strickland Range	DPT-Rng Div	Target Detection	965331
Stroup Field	1st ITB	PT/Parade Field	024837
Todd Field	1st ITB	PT/Parade Field	030799
Victory Pond, Ranger	USAIS	Ranger	039829
Wallace TA	197th Inf Bde	NCO Development Course	959545
Watson Field	USAIS	PCPT Course	923806
Wetherby Field	1st ITB	PT/Parade Field	971866
Yankee Road LN Site	USAIS	Land Navigation	Q2&3 Areas
York Field	USAIC	Ceremonies	912809

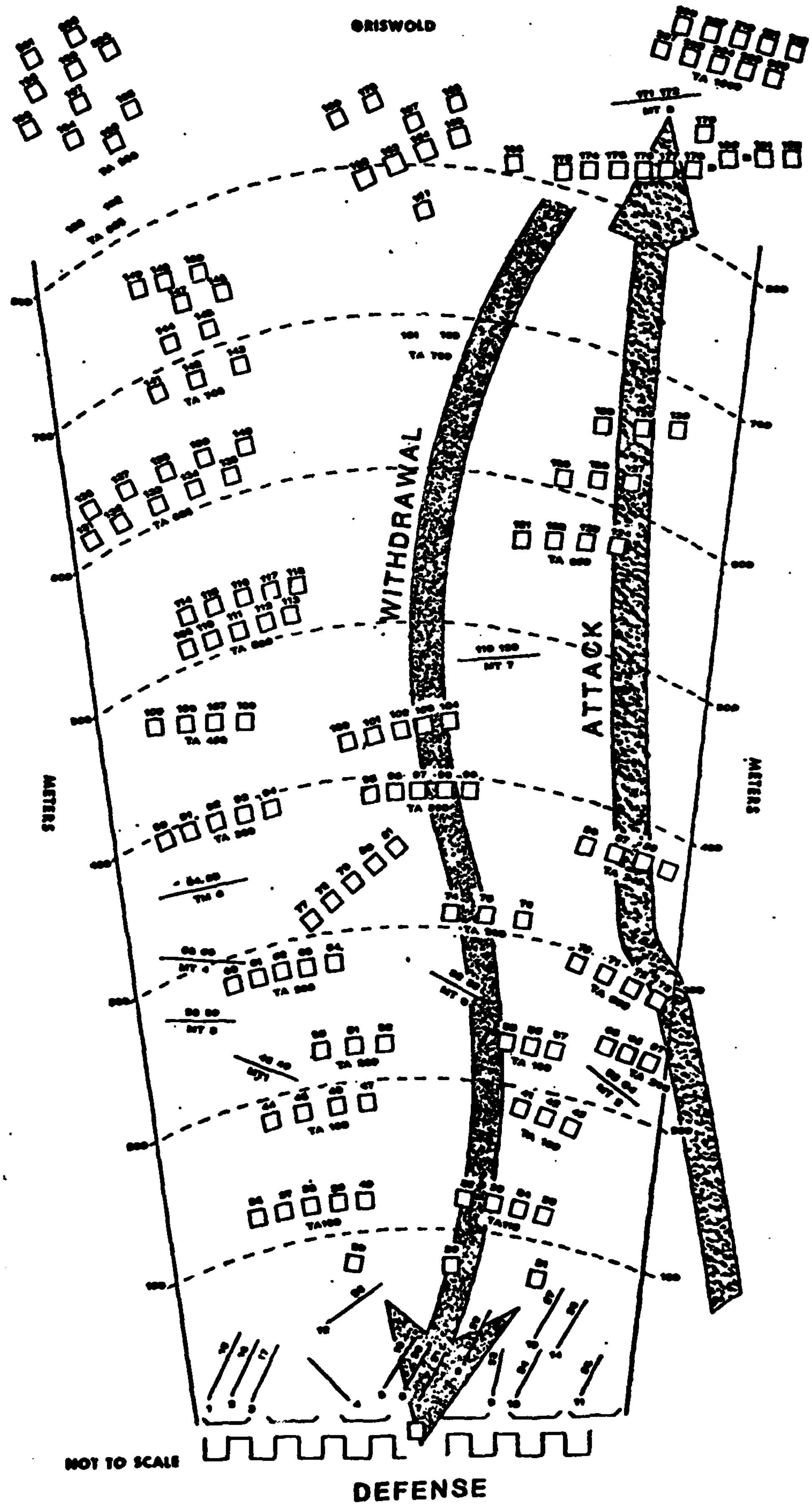

Figure L-4. Griswold Attack/Defense Facility

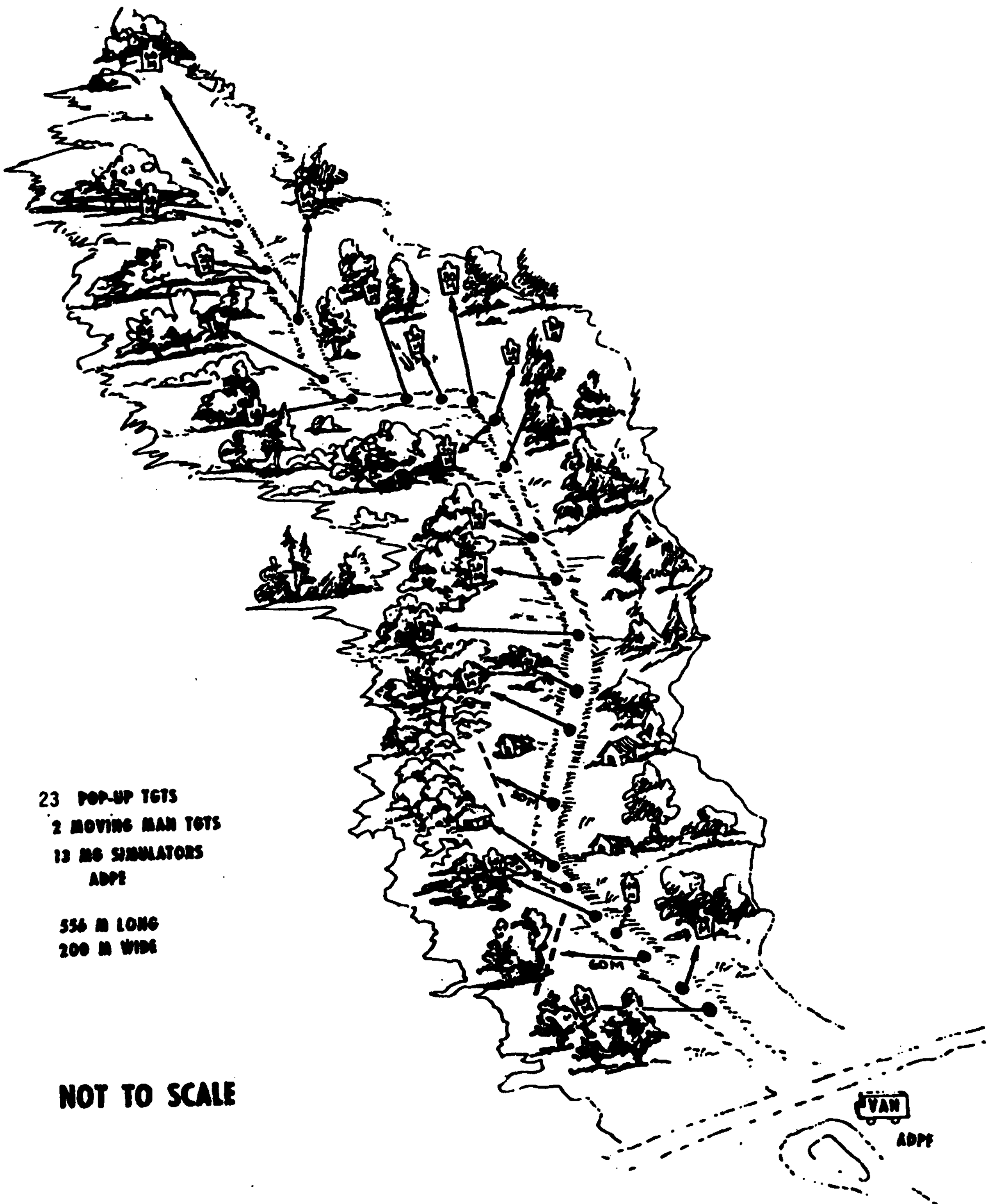

Figure L-5. Titus Quick Fire Facility

Clothing and Equipment Test Facility. The purpose of the Clothing and Equipment Test Facility (CETF) on Wallis Range is to provide objective data regarding the effects of personal clothing and equipment on the individual Infantry soldier and to provide a troop conditioning facility during tests. It consists of:

o A maneuver course.

There are two sets of 50-yard dashes, an obstacle course, an overhead ladder, a debarkation net, a running broad jump, a rope bridge and a crawl event.

o A march/move hilly track, 1 mile.

This course is composed of a number of steep grades and generally rough terrain. It simulates marching conditions cross-country or along wooded paths.

Farnsworth Range. This is a known distance rifle range separated from the USAIB Sandy Patch test area by a paved highway. The 500-meter length, flat surface, and convenient location result in frequent use of this facility for other than small arms tests. The facility is not instrumented; however, instrumentation and data links to the computer can be easily installed. Farnsworth range is used frequently for small methodology and instrumentation experiments.

Antitank Weapons Test Range Capabilities. USAIB has no instrumented antitank facility. Instrumented antitank target systems are on hand. These include 20 stationary pop-up targets (7 1/2 feet X 7 1/2 feet) and six moving target systems. The latter are capable of speeds from 10 to 25 MPH. A total of 7,200 feet of movable track (20-foot sections) is on hand. The preparation required to conduct tests of antitank weapons is dictated by the safety fan and number of targets desired. Three manned evasive target tanks are available. These are highly modified M103 tanks, each with 2-man crew. The tanks are safety certified for live fire with inert warheads of TOW, DRAGON, LAW and SHILLELAGH.

b. Airspace

(1) Landspace/Airspace Relationship. Operations of Army or Air Force aircraft are allowed and performed in many test areas. Section IV, USAIC Regulation No 210-4 (Ref 2), describes aircraft operations and their restrictions. Also, the descriptions mentioned in paragraph 2j, Airspace Restriction, would be helpful for operators in test areas.

(2) Easements (FAA Air Routes). There are no easements except those already mentioned in paragraph 2j, Airspace Restrictions.

(3) Manned Airborne Systems. Ground-to-ground, ground-to-air, and air-to-ground weapon systems are capable of being utilized if proper safety zones are available or necessary range airspace/landspace is sufficient for existing operational procedures governing that particular system or systems.

(4) Unmanned Airborne Systems. See paragraph 3b(3).

(5) Area surveillance equipment is available except standard communications networks necessary for range control operations.

4. Instrumentation (Ref 1 in Bibliography)

a. Space Position and Velocity Vector

(1) Ground Elements

(a) Single element (addition). The Board has a man/checkpoint identifier system that uses inductive coupling between a buried pickup and a man-carried unit to sense the passage of test personnel. The checkpoint can distinguish among 12 individuals by means of the two tones unique to each man-carried unit. This information, as well as the checkpoint number, is relayed by wire back to the computer. The pickups may be emplaced as necessary. This system is presently used on the Titus Quick Fire Facility to cue the computer when to present each event of the course.

The Board also uses pneumatically actuated relays to sense the passage of vehicles and relay the information back to the computer via wire links.

(b) Multiple Objects. The Griswold Attack/Defense Range can be used for obtaining data on up to 11 personnel who are on the course simultaneously.

(c) Relative Position (Miss-Distance). The Board obtains miss-distance data by the use of acoustic sensors installed to the front of fixed location targets and using computer calculations based on the time difference of round arrival data.

Three-inch accuracy over a zone approximately 3 meters in diameter in the plane of the target can be obtained. With many microphones and extensive calibrations, larger areas can be covered and/or the inaccuracy can be reduced to less than an inch under favorable conditions at short ranges (less than 100 meters).

(d) Radar. None used at Center or Board.

(2) Airborne Elements. None at Board or Center.

b. Timing

(1) Primary. None at Center. The Board has time units incorporated in its computer; these are used for control and data collection on the instrumented ranges.

(2) Secondary. Intervalometer for movie cameras equipped with timing lights is available from USAIC.

c. TV Equipment.

(1) Black-White Equipment. The Board and USAIC have Sony Rover Systems, consisting of a camera, video tape recorder monitor, and battery

pack for portable operation. The system is man-portable and can be used for recording testing in areas removed from commercial power. The Board has acquired 500-mm telephoto lenses for use with this system.

(2) Low Ambient Light Level Capabilities. USAIC owns a low light level TV system consisting of the following:

Cameras	COHU 2830	2
	COHU 2820	1
Recorders	Sony 1600	2
Video Switcher	Dynair 151A	1
Truck, Carryall 4x2	Dodge B200 Sportsman	1

Both above-noted COHU units can operate under vibration conditions and can stand a 15-g shock when not energized.

(3) Video For Laser Scoring. A silicon vidicon camera, recorder and monitor are available for video taping of laser operations.

(4) Voice Channels. The Sony recorders have the capability of recording one channel of sound simultaneously with the video from a TV camera.

(5) Video Tape-Recording Facilities. The Sony units mentioned and the silicon vidicon system.

(6) How Presently Used. Because of the mobility of the systems, use is not limited to any particular type of testing.

(7) Designed Operating Environment. The equipment is highly mobile and not terrain-limited, basically. However, the systems are not environmental packaged; therfore, they must be considered for use under near lab conditions.

d. Photography. All photographic capability is consolidated at USAIC.

(1) Motion Picture. Table L-2 shows the type of photographic equipment available at USAIC.

(a) How Presently Used. Gunner reactions, accuracy of fire, effects of fire, conditions of tests, failure/condition of equipment, and results of tests, as examples, are generally recorded by these types of cameras.

Quantity	Nomenclature	FSN
2	Camera, Motion Picture KS-10(1) Bell & Howell #70 KRM	6710-292-2281
1	Camera, 35-mm Nikon F Auto Reflex	6710-K00-0003
1	Camera, Motion Picture KS-10-3	6710-889-3401
3	Camera, Still, Graflex Zeiss Planar 80-mm Lens F/2.6	6720-NSN
1	Camera, 35-mm Nikonos II	6720-67D-0048
1	Camera, Still, Century Graflex	6720-089-9971
1	Camera Equipment PH-104 KS 4A(1)	6720-408-5120
1	Camera, Pentax Spotmatic, 35-mm, w/55-mm f/1.8 Super Tahumer Lens	6720-670-0007
1	Camera, Still, KS-7A	6720-823-9715
1	Camera, Still	6720-823-9722
2	Camera, Still, KS-4A(2)	6720-985-6795
1	Graflex, Still Camera w/80-mm Zeiss Planar f/2.8 w/108-mm Zeiss Sonnar f/4.8 w/58-mm Rodenstock Gradonbon f/5.6	6730-NSN
1	Gray Press Camera w/4-inch f/3.5 Lens w/2-inch f/2.0 Lens w/6-inch f/4.5 Lens	
1	Lens, Camera, Wide Angle/General Type E-6	6760-285-8586
1	Lens, Camera, General 10V, Type L-2	6760-597-5347

Table L-2. Photographic Equipment at USAIC

Quantity	Nomenclature	FSN
1	Lens, 5/8-inch for/Proj Palmer MDL 820	6730-206-3610
1	Lens, 5/8-inch for/Prol 16-mm B&H MDL 300 K	6730-NSN
1	Lens, Zoom f1.5 for/Proj (Pazmar)	6730-NSN
1	Lens, Zoom, B&H Angenieux, Type AVc, 12-mm to 120-mm	
1	Lens, Zoom, B&H Angenieux, F2.2(350)Z	6760-NSN
1	Arriflex, Camera, 16-mm, use w/200/400/ 1200 Mags (quick-change) w/Nicad Battery w/Lens, 2.5 Angenieux, 12-mm, f2.2 & filters	6710-K00-0001
1	Camera, High Speed, 16mm, 100-foot-roll capacity, Fastex (WF3)	
1	Camera, 16-mm, KB, Milliken MDL DBM-1 w/2 25-mm Lenses w/ Boresight w/Sun Gun w/Battery Pack	6710-NSN-002
1	Camera, 16-mm, High Speed, MP	6920-NSN
1	Magazine, 16-mm Film, 400-foot B&H, 16-mm	
1	Generator, Pulse Code Time w/LED Dearing Mod 14, Ser No 005	

Table L-2. Photographic Equipment at USAIC (cont)

(b) Designed Operating Environment. Most of the cameras are general-purpose units, with several exceptions. These general-purpose units are for the most part unable to withstand severe open environment or high shock conditions.

(c) Film Developing Capabilities. Movie film is sent to a contractor for processing. Turnaround time is 10-15 days.

(2) Still Photography. USAIC's photo lab processes both black and white and color film and prints. Turnaround time is dependent on quantity, backlog, and schedule.

(3) Airborne Capabilities. None of the photographic and TV units of USAIC are designed for airborne use.

e. Instrumentation Calibration Capabilities. The Center provides repair and calibration of laboratory instruments (e.g., scopes, meters). Special units are similarly handled by Anniston Depot or Redstone Arsenal.

f. Other General Instrumentation

(1) Telemetry. The Board acquired a short-range RF one-way system originally for a helmet-mounted round count system for use on the quick-fire and attack ranges. This system has been expanded to provide hit data from moving targets as well. The Board also has a vehicle-mounted telemetry system to collect round count data from a moving vehicle.

(2) Meteorological. The Board has wind velocity and direction and air temperature measuring units. Lawson Field has the meteorological instruments normal to airfields. The 2/10th field Artillery Battalion can provide data required for artillery use.

(3) Survey. The Center has a 6-man team that performs surveys to third-order accuracy. The Board has an optical theodolite and associated surveying instruments.

(4) Radio Frequency Interference (RFI)/Electromagnetic Compatibility. There are no field instruments at the Center or Board. The Board performs RFI lab measurements.

(5) Visibility (Light Level Measurement). There are no light measuring instruments at the Center. The Board has a Spectrophotometer (Pritchard) and a Telephotometer (Gamma Scientific).

(6) Sound Measurement and Analysis. The USAIC has a General Radio Sound Level Meter, tupe 1551, for sound measurement. The Center's hospital staff, as part of their biomedical measurements of operational conditions of equipment, performs sound level measurements.

(7) Water Speed and Direction. The Board has instrumentation to measure water speed and direction.

(8) Laser Target Designator Scoring System. This system is used to determine the accuracy of laser target designation and total time of laser

illumination of a target.

g. Special Purpose Instrumentation

(1) Ballistic Data. There is no special ballistic data instrumentation at the Board or Center. The Board uses photographic and TV camera techniques for obtaining trajectory data on large-caliber subsonic missiles.

(2) Vehicle Performance. There are no field use instrumentation items. Maintenance shops have instruments normal to their needs.

(3) CBR Instrumentation. None.

(4) ACCUBAR. The Board has a new ACCUBAR system that represents an increase in capabilities over the old model. The new model is environmentally packaged and capable of remote operation over a pair of signal lines.

(5) Human Factors Kit. This kit contains integrated instrumentation designed to measure ambient environmental conditions and human characteristics performance.

(6) Other. The Board has developed a source of thermal target illumination for use with thermal-type night vision devices.

h. Anticipated Instrumentation Acquisitions

(1) Indirect Fire Projectile Impact Location System (IFPILS). This instrumentation will be designed to score the accuracy of indirect fire projectile impacts or initiations in X, Y, Z coordinates. This will accommodate all types, impact, delay, proximity, near surface and base ejection.

(2) Remote control Portable Target System. This system will consist of stationary and moving targets which are remote controlled and have RF data links with the Remote Range Control Units. The target systems will be battery operated and designed to be used on terrain with minimum preparation.

5. Threats/Targets

a. Ground

(1) Electromagnetic. None.

(2) Firing Realism

(a) Weapons

1 A number of the training ranges of the Center are equipped with targets mechanisms which elevate silhouette targets on command, remotely via wire (type M30 TRAINFIRE mechanisms). The board uses the same mechanisms on their instrumented ranges and has approximately 300 in its inventory.

2 The Board also has 27 remotely controlled movingman Infantry-size targets installed on its ranges. Their straight line movement is approximately 50 meters long. The Board also has remotely controlled moving tank target mechanisms with a total of 7,200 feet of track in 20-foot movable sections. The mechanisms can carry a 7 1/2 by 15-foot panel target.

3 The Board uses small arms simulators (rifle and machine gun), type MG-4 and electronic, on their instrumented ranges to provide target position disclosure fire simulations. These are remotely controlled via wire.

4 For simulations of impacting artillery, the Board uses type 17A1 simulators.

5 Three moving tank target mechanisms were acquired that have electronically variable speed control.

(b) Scoring Capability

1 The Board uses hit sensing Infantry-size targets. Their outputs are fed by wire or an RF channel to a recording location.

2 Round count, i.e., time of small weapon fire, is accomplished with microphones. On the instrumented defense range, the microphones are installed just forward of the muzzle of the weapons; on the attack range, because the soldiers are moving, the microphone is mounted on the helmet of the firers and the data are transmitted via an RF channel.

(c) Destroyable/Nondestroyable. None is performed by the Center or Board.

(d) Physical Realism. No instrumentation is used. Smoke is occasionally used with antitank targets.

(3) Radiological Environment. None.

(4) Other (Computer War Gaming). None at the Center or Board.

b. Airborne. No instrumented targets.

6. Data Handling/Processing

a. Data Storage and Retrieval Capabilities

(1) The Board has two ranges (Attack/Defense and Quick Fire) which they control and record data with digital computers. All input and output data is, therefore, digitized.

(2) The command signals originate with the computer and are in digital form. The recording targets and the microphones that provide the round count and miss-distance data produce pulses which are processed by a signal conditioner unit associated with the computer prior to their being inputted.

b. Quick-Look Capabilities. See Paragraph 6a.

c. Processing

(1) System Description. Data General NOVA 3/12 (3 each).

(2) Major Components

Type	Model	Description	Quantity
(a) Central Control Unit (CCU)			
Data General	NOVA 3/12	CPU (32K)	1
Data General	6021	Tape Drive	1
Data General	6045	Disk Unit	1
Data General	6031-B	Diskette Unit	1
Data General	6042-A	Printing Terminal	1
Data General	4218/2230	Line Printer	1
Documation	LC-50	Card Reader/Punch	1
(b) Remote Range Control Unit (RRCU)			
Data General	8607-G	CPU (16K)	2
Data General	6030	Dual Diskette	2
Data General	4300	Relay Output Unit	2
System consultants, Inc	DDAS	Digital Data Acquisition Subsystem	2
Computer Devices	1203	Printing Terminal	2

(3) Intended Use of System. The Range Control and Data Acquisition System (RCDAS) is used to operate the completely automated test facilities, and collect and process the data.

(4) Functional Use of the System. (a) The RCDAS is designed to control range components; to collect test data and store it; and to process collected data against analysis and evaluation programs. The system includes a Central Control Unit (CCU), utilized for analysis and evaluation of test data and program development, and a series of Remote Range Control Units (RRCU), utilized for range control and data acquisition.

(b) Test scenario programs are generated, compiled, and placed on a removable storage device at the CCU. This storage device is then taken to the RRCU and loaded into the unit's memory. These test scenario programs control and test facilities and determine data to be collected during conduct of the test. Range components controlled by the test scenario include control of targets, time of exposure, and activation of various other devices. During the execution of tests, various input events and output control comments are collected by the RRCU, time-stamped by time of occurrence, and stored on a removable storage device. The collected and stored data are then brought to the CCU for data reduction, analysis, and evaluation.

(5) Computer Languages. The scenario software is in ASSEMBLY language, data reduction is in FORTRAN IV, and the administrative applications are in COBOL.

(6) Administrative Application. All administrative applications are processed by Data Systems Office, USAIS, Fort Benning, GA.

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ANNEX M

OPERATIONAL TEST INSTRUMENTATION GUIDE

US ARMY AIR DEFENSE BOARD
Fort Bliss, Texas

CONTENTS - ANNEX M

LIST OF FIGURES

ANNEX M

US ARMY AIR DEFENCE BOARD
Fort Bliss, Texas

1. Introduction

a. Overview

Fort Bliss is located in the far west corner of the state of Texas, near the city of El Paso, and approximately 4-1/2 miles north of the Rio Grande River (which forms the boundary between the United States and Mexico). Assigned at Fort Bliss is the US Army Air Defense Board (USARADBD).

The primary mission of the Fort Bliss Facility is to maintain the assigned Strategic Army Force units at a readiness condition (REDCON) equal to or higher than their assigned authorized levels of organization within available resources. Fort Bliss also supports the activities of Class II installations assigned there, including the US Army Air Defense Board.

In addition to the Fort Bliss facility itself, several external installations are utilized by the USARADBD for local field testing. These include the Dona Ana Range installation located approximately 27 miles north of Fort Bliss in southern New Mexico, the North McGregor Range facility located 56 miles northeast of Fort Bliss in New Mexico and the Site Monitor test facility located 56 miles northeast of Fort Bliss in New Mexico and the Site Monitor test facility, under command of the US Army Air Defense School, located ten miles east of Fort Bliss (see Figure M-1).

b. Generic systems Tested

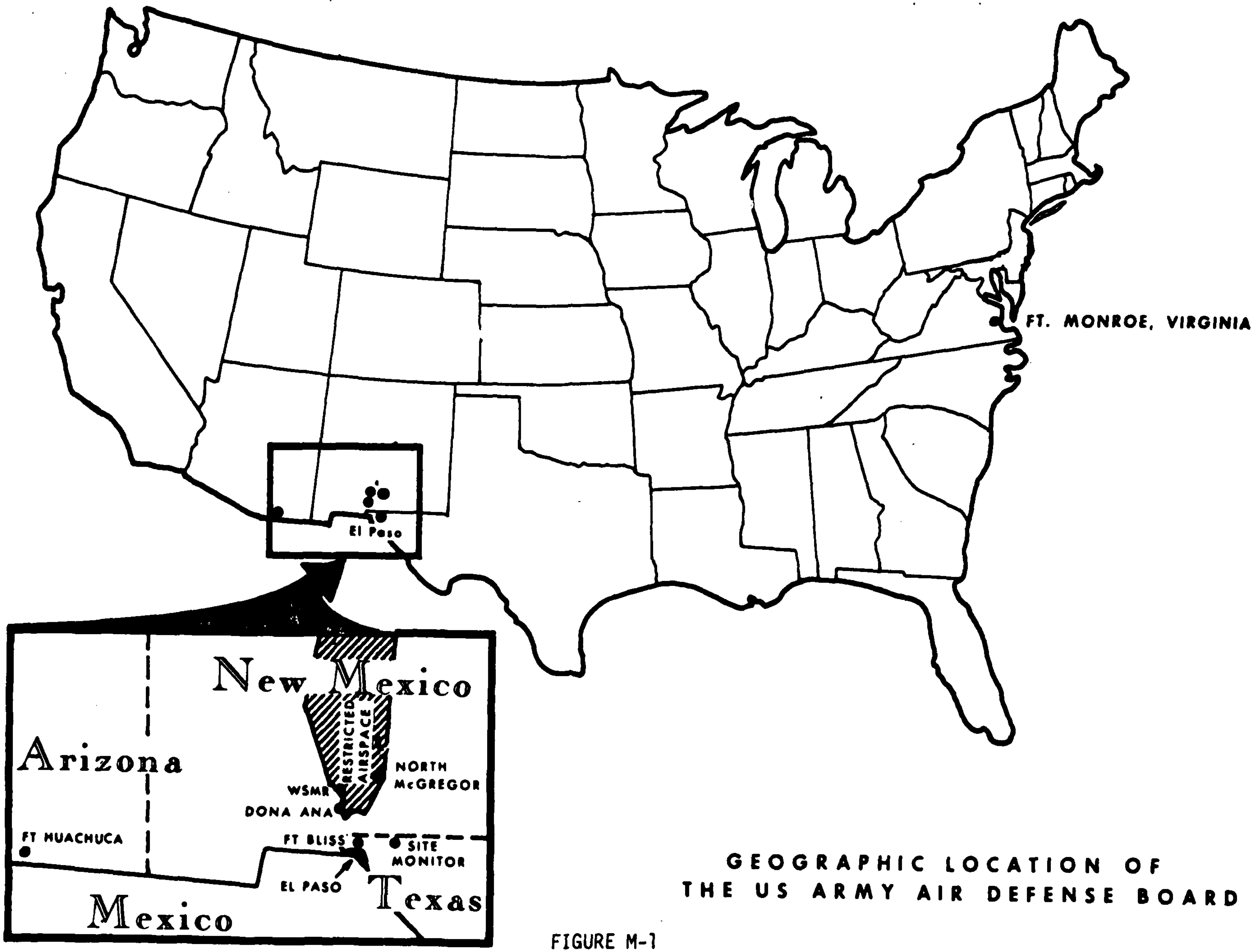
The US Army Air Defense Board plans, conducts, and reports on Operational Tests (OT) and Force Development Tests and Experimentation (FDTE) of air defense weapon systems, fire distribution systems, electronic countermeasures (ECM) and counter-countermeasures (ECCM) of equipment and devices and target devices.

2. General

a. Military Units

(1) Army Units

The following partial list of units presently located at Fort Bliss will serve to provide an initial insight to the basic



GEOGRAPHIC LOCATION OF
THE US ARMY AIR DEFENSE BOARD

FIGURE M-1

capabilities and types of support that can be utilized by the outside user. However, many uncontrollable factors along with schedules and routine requirements limit use of these units. Further investigation of the user requirements as a function of quantity, extent of need, and time frames required, correlated with existing of planned other user needs already scheduled for these units, would be necessary.

(a) 3rd Armored Cavalry Regiment

(b) 11th ADA Brigade

(c) Us Army Air Defense School

(d) US Army Communications Command

(2) Nearby Government Installations

Of major interest is the White Sands Missile Range (WSMR), New Mexico, located approximately 45 miles to the north. An integrated communications system exists between Fort Bliss, its facilities and ranges, and White Sands Missile Range. A detailed description of the WSMR is available in Annex A.

b. Maintenance Capability

Only very limited maintenance is performed by USARADBD itself. This is limited to a small motors branch which maintains mobile motorgenerator sets and mobile air conditioning units. Other maintenance is the responsibility of the Director of Industrial Operations. This is supplied in the standard manner of Army organization.

c. Access

(1) Air

Commercial air transportation is provided at El Paso's International Airport by the following airlines:

(a) American Airlines

(b) Continental Airlines

(c) Texas International Airways

(d) Frontier Airlines

(e) Eastern Airlines

In addition to the above commercial air transportation, Briggs Army Air Field (13,555-foot airstrip) is contigous to the city of El Paso, Texas, and is an enclave of Fort Bliss.

Other air access is available through the WSMR facility (see Annex A.)

(2) Rail

The Southern Pacific Railway Company has tributary trunk lines extending to the Fort Bliss center warehouse area, service areas, and magazine area. In addition, the Santa Fe Railway, Southern Pacific Lines, and Texas & Pacific Railway serve the city of El Paso, Texas.

(3) Road

Fort Bliss is accessible from any distance point by US 54 and US 85 to the north, US 62 and US 180 to the east-northeast, and Interstate 10, which traverses the city of El Paso from east to west and connects with Fort Bliss.

(4) Water

None.

d. Logistics Support Capability

The US Army Air Defense Center, the host organization, supplies all necessary logistical support for present operations. Increases of maintenance and logistic support required by outside users can be supplied without major problems. However, definite requirements are necessary for the comprehensive view of the maintenance/logistical capability that could be provided.

e. Recurring Comments

During the summer, National Guard and USA Reserve units utilize Fort Bliss for training. Such training is scheduled a year in advanced; consequency, USARADBD schedules their tests to conform. In certain instances, this National Guard and USA Reserve unit training can also constitute a special operational restriction.

f. Special Operational Restrictions

Airspace over the Fort Bliss-WSMR firing ranges is restricted. This permits year-round usage for the conduct of forward area weapons and missile test projects. Target flight patterns for EMC/ECCM tests must be planned and controlled to avoid violation of territorial boundaries. Radio frequency radiation must be closely coordinated and controlled at the Site Monitor Test Facility to avoid conflict with the ground control approach (GCA) radar at El Paso International Airport and at the Dona Ana Range to avoid conflict with missile firings at WSMR.

g. Facility Organization

Figure M-2 shows the organizational chart for the US Army Air Defense Board, Fort Bliss, Texas.

h. Environment

Typical of dry areas, Fort Bliss is characterized by low humidity, abundant sunshine, and a wide range in temperature.

A 20-year tabulation of observing temperatures above 90 degrees shows that in April, May, and June the humidity averaged from 10 to 14 percent, while in July, August, and September, it averages 22 to 24 percent. Rainfall is light and insufficient for any kind of growth, except desert vegetation. Dry periods of several months duration without appreciable rainfall are not unusual, which makes irrigation necessary for crops, gardens, and lawns. July and August have the heaviest rainfall which creates street flooding problems. Daytime temperatures in the summer are high, frequently above 90 degrees, and occasionally above 100 degrees. Summer nights are usually comfortable.

Winter daytime temperatures are mild, dropping at night to below freezing about half the time in December and January. The number of days with temperatures of 32 degrees or lower averages about 45 days per year. Temperatures lower than 10 degrees are rare, having occurred only about 25 days during the past 75 years. Small amounts of snow fall yearly every winter, but rarely more than an inch. It seldom remains on the ground for more than a day. While the nearby mountains are not high enough to have any important effect on weather conditions, the cooler air in the valley causes marked short-period fluctuations of temperature.

The flat irrigated land of the Rio Grande in the vicinity of Fort Bliss is noticeably cooler, both in the summer and winter. This makes for more comfortable summer temperatures at night but increases the severity of frost in winter.

Dust and sand storms are the most objectional features of the weather in this area. Wind velocities are relatively high, the soil surface is dry and loose, and vegetation is sparse, causing considerable dust and sand. Tabulation over the past 11 years shows that dust is most frequent in the months of March, August, and September. Dust does, however, occur occasionally at all times of the year. Prevailing winds are normaly from the northweast in the winter months, shifting westerly in the spring, and from the east in the summer months.

i. Topography

The topography of the main installation varies from an elevation of 3,800 feet to 4,250 feet. To the west, the Franklin Mountains rise

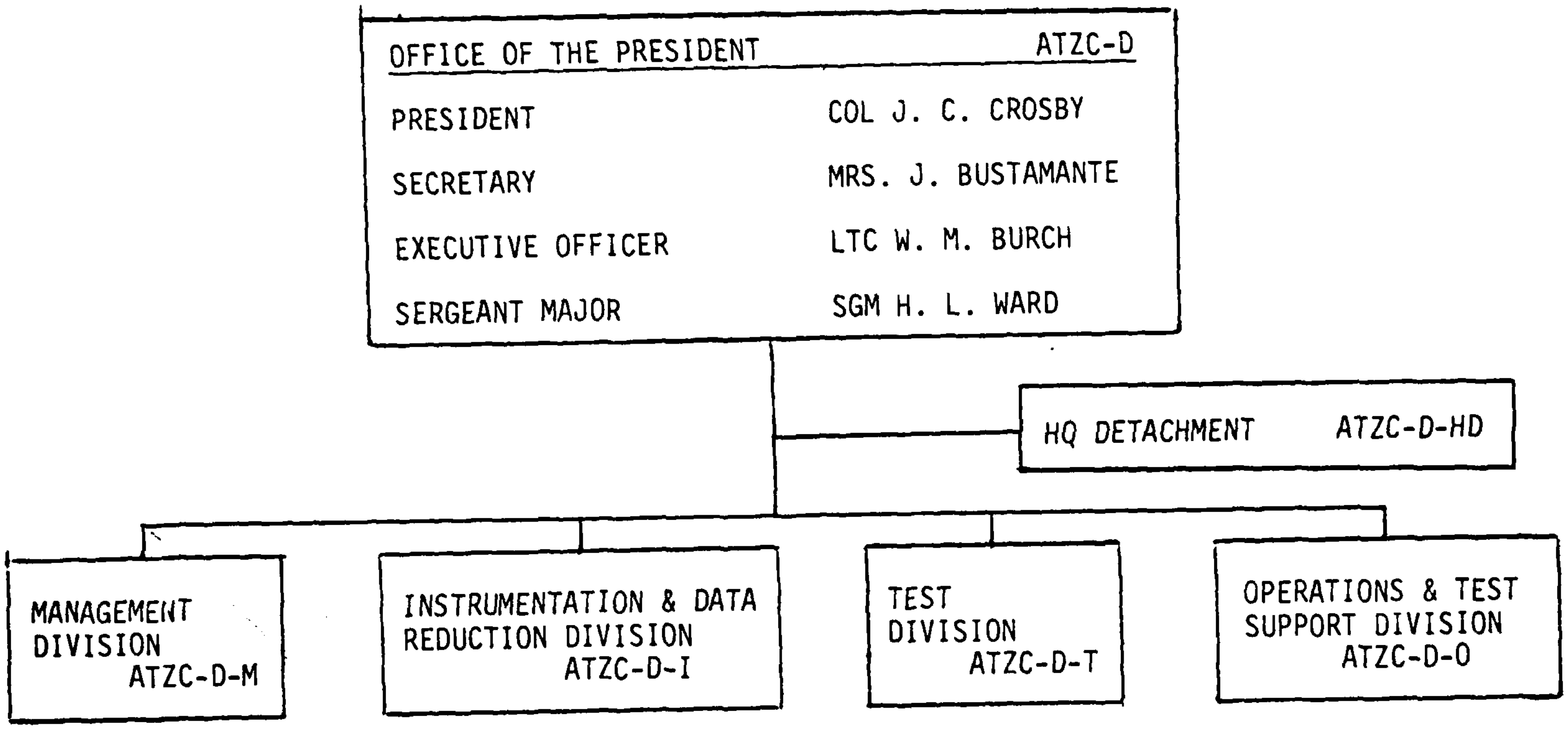


Figure M-2: Organization Chart for the U.S. Army Air Defense Board
Fort Bliss, Texas

(4) HF Radio System

An emergency high frequency secure radio teletype system between Headquarters, Fifth US Army at Fort Bliss and the alternate Fifth US Headquarters is operated by this station. Transmitting and receiving antennas are located near buildings S-3693 and 3785. Underground cable connects the transmitter and receiver station with the Telecommunication Center.

(5) Military Affiliate Radio System (MARS)

Fort Bliss operates and maintains two Military Affiliate Radio Systems (MARS). Transmitting and receiving equipment for Station #1 is housed in Building 3693 and the antennas are located near the building. Transmitting and receiving equipment for Station #2 is housed in Building 3785, again with the antennas located near the building.

(6) Television Distribution System

An 8-channel education television system is in operation at Fort Bliss. The system consists of aerial and underground coaxial cable, pole-mounted amplifier, splitters, and extenders. A shop is located in Building 145 for maintenance of the cable system and television receivers.

3. Dimensions

a. Landspace

The Fort Bliss Military Reservation has an area of almost 1,110,830 acres. This acreage may be broken down as follows:

Areas	Description	Fee Owned	Co-Use	Total Acres
Built-up Areas	Main Post	3,061.00	3.03	3,064.03
	Logan Heights	1,231.13		1,231.13
	Magazine Area	320.97		320.97
Maneuvor Areas	*Maneuver Area No.1	45,815.93		45,815.93
	Maneuver Area No.2		65,920.00	65,920.00
Firing Ranges	Dona Ana-Hueuco Orogrande Complex	297,005.74		297,005.74
	McGregor GM Range	697,472.21		697,472.21
TOTAL ACREAGE		1,044,906.98	65,923.03	1,110,830.01

*Contains Site Monitor Facility

(1) Test Area Contiguity

The El Paso to Alamogordo highway splits the east and west test areas of Fort Bliss. (See reference 6).

(2) Easements

At present, only one test area has any easements in effect. This is Maneuver Area No. 2, in which the owners retain grazing rights.

(3) Impact/Live Firing Areas

The following is a brief description of the major ranges suitable for extensive testing. Reference 6 depicts the various impact areas and safety limits.

(a) Castner Range

This is no longer in use as a firing range. The facilities were relocated to what is now known as G. Ralph Meyer Range at McGregor GM Range.

Castner Range is located about 3-1/2 miles north of the northwest corner of the main post. The area extends east from a line near the crest of the Franklin Mountains to the more level land at the base of the slope. This area contains 8,273.62 acres and is owned in fee simple. The mountain slopes are rocky and sparsely vegetated by the desert growth.

The Trans-Mountain Highway and the North-South Freeway required land that affect the firing and impact areas of the range. A right-of-way for this construction was granted to El Paso by the Federal Government and the cost of relocating this range was borne by the city of El Paso and the state of Texas. This project divided the Castner Area into three sections. The fourth section (northeast section) is a residential development in the city of El Paso.

The southwest section consists of mountainous terrain. Flood control projects sponsored by the Federal Government have been designed to prevent flooding of the northeast section of the City of El Paso and a portion of the military installation of Fort Bliss.

(b) General G. Ralph Meyer Range

Meyer Range is located southwest of McGregor Range Camp and its southernmost tip is near the Texas-New Mexico State boundary. This range

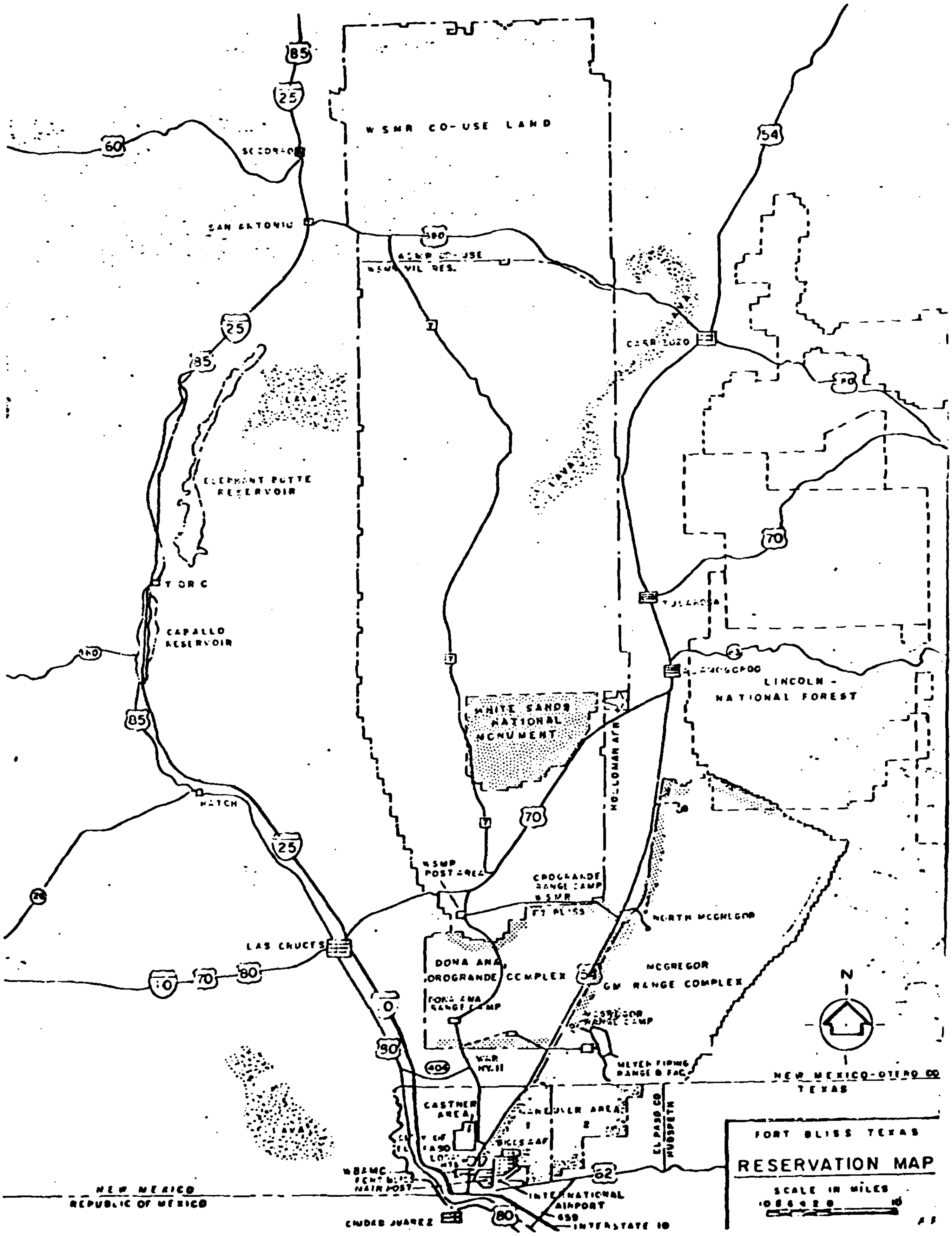


FIGURE M-3: Fort Bliss Test Areas

was constructed in 1965 by the city of El Paso as part of an agreement for the right-of-way for the Trans-Mountain Highway and the North-South Freeway. Meyer Range served as a basic combat training firing range and bivouac area until April of 1970.

It provides the following small arms facilities, of which only part are active at this time. All other facilities are in caretaker status.

Meyer Range

Two 16-point record fire ranges
Four 25-meter corrective ranges
Four 35-point field fire ranges
Two 110-point, 25-meter preliminary fire ranges
One 70-point, 4-position close combat range
One 4-point, 4-position close combat range
One 10-bay live hang grenade range
One 7-station, 10-lane individual tactical training range
One 5-lane assault hand grenade range
One 4-lane, 2-man close combat course
One 40-man wave infiltration course
Two 20-man gas chambers
four 50-point target detection ranges
Six 25-point target detection ranges
One 50-point, 25 and 50-meter pistol range

Active Facilities

One 16-point record fire range
One 35-point field fire and zero range
One 25-point target detection range
One 7-point automatic weapons range

(c) Dona Ana-Hueco-Orogrande Complex

The area referred to as the Dona Ana-Hueco-Orogrande Range Complex contains a total of 297,006 acres. Except for the Organ Mountains to the northwest and the Franklin Mountains to the southwest, which rise to an elevation of 8,000 feet above sea level, the terrain is low, relatively flat, and desert like. Vegetation consists largely of chamiso, mesquite, and various desert plants.

1 Dona Ana Range Camp

This range is located approximately 24 miles northwest of Fort Bliss.

The main camp was rehabilitated in 1966 under the "Augmentation of Active Army" project. Construction of temporary prefabricated sheet metal buildings included 71 barracks (13-man), 4 BOS (7-man), 6 mess halls, 5 lavatory buildings, ' dispensary, 6 adminstrative and supply buildings, 2 storehouses, and 2 tactical equipment shops and facilities. The Dona Ana Range Camp provides facilities for yearly National Guard exercises.

Dona Ana Range. An isolated weapon system firing site and target-tracking installation, located 27 miles north of Fort Bliss in southern new Mexico. A mobile LASER Automatic Tracking System (LATS) will be installed in FY 81. A semi-fixed Improved Nike-Hercules Radar System is used to secure aerial target present position data and for drone target control. IRIG timing signals for range instrumentation are provided by a Systron-Donner remote console that is linked to the Central Control Station at building 1656, Fort Bliss. Telephone communications are provided between Fort Bliss and Dona Ana Range, McGregor Range, North McGregor Range, Site Monitor, and White Sands missile Range by microwave.

Both small arms and conventional artillery firing ranges are available at this complex. Small arms facilities exist as follows:

Range No.	DESCRIPTION	No. of Firing Points	Range Yards
40	Rifle, M16	22	100, 200, 300
41	Small Arms (all)	22	100, 200, 300
45	Small Arms (all)	40	100, 200, 300, 600

Artillery Ranges are as follows:

46	20mm, 40mm and Redeye Air Defense Bd	10	14,000 yards
47	Artillery Howitzer Unlimited	40	Up to 18,000 Yards
49	Air Defense Artillery and AW (inactive)	40	14,000 yards
50	Air Defense Artillery and AW	79	14,000 yards
51	M-79 40mm Grenade Launcher	4-lane 3-position	500 meters
52	M-60 transition	5	800 meters

Range No.	DESCRIPTION	No. of Firing Points	Range Yards
53	M-600 1000 CM	5-position	10 meters
54	M-72 Law	15	1,400 meters
55	Moving Target	20	14,000 meters

2 Hueco Range

Hueco Range is located about 22 miles north of Fort Bliss. Soil erosion created by winds and lack of vegetation is a major problem. On extremely windy days the dust and sand in the air can reduce visibility to the point where training must be stopped. This area is now used strictly for maneuvers, field training exercises, and annual readiness tests.

3 Orogrande Range

Orogrande Range is located about 55 miles from Fort Bliss on US Highway 54. Orogrande Range is one of the few places in the continental United States where it is possible to fire surface-to-surface missiles over land. Because of this capability, it is now used by US troops and by NATO troops who come here for their annual service practice. This expanded mission has made it necessary to completely rebuild the camp. The camp is designed to house 1000 men when it is completed.

The missile firing sites are on the White Sands Missile Range, about 15 miles to the west of Orogrande Camp. A satellite camp formerly containing facilities for launching and maintaining RCAT is about six miles east of the main camp.

(d) McGregor Guided Missile Range

McGregor Guided Missile Range is about 26 miles northeast of Fort Bliss, in New Mexico, occupying an area just to the east of the Dona Ana-Hueco-Orogrande Range complex. McGregor Range is on the east side of the Southern Pacific Railroad right-of-way between El Paso and Alamogordo. The western part of the range is relatively flat and is typically desert in vegetation. The eastern portion of the range extends into the Sacramento Mountain Range with altitudes of up to 7000 feet above sea level. The range extends about 43 miles north from the New Mexico State line and is approximately 29 miles in width at its widest part.

McGregor Range Camp is designed to house 2,000 men. Existing facilities of semi-permanent type construction consists of troop housing (barracks, BOQs, and support facilities), mess halls, headquarters and administration buildings, dispensary, communications, engineer maintenance shop, guided missile maintenance shop, guided missile assemble and test buildings, fueling and storage facilities, and various special services.

Commercial utilities are available at this camp. Future development envisions additional troop support facilities.

Guided missile firing facilities are available for NIKE AJAX missiles and NIKE HERCULES missiles at 26 firing sites, one of which is underground. Each of the firing sites provides at least two launcher facilities. Eight launcher sites are also available for HAWK missiles. Each site has hardstands for two HAWK launchers. A Range Control Headquarters building is located on a knoll west of the missile firing sites, plus two additional control towers.

The access road to the camp, the roads within camp, and the downrange roads are a-1 paved and in excellent condition.

Bulk guided missile storage was provided in a three-mile square area about four miles west of the camp and one mile south of the access road to the camp. Six Yurt-type (stradley) magazines and one storage igloo were built in this area in 1961. An additional storage magazine was constructed in 1969. Planned construction in this area is included in the Intermediate and long range MCA program.

(e) North McGregor Range

This isolated site, located 56 miles northeast of Fort Bliss in southern New Mexico, adjacent to the Tularosa Valley, has been converted to an air defense testing range. Currently, the DIVAD Gun Test is being conducted at this range. Fixed installations at the site included, a missile assembly-type building that can be housed for numerous applications; a remote range timing control installation to provide timing signals to recording systems; cinetheodolites, soon to be replaced by a Laser Automatic Tracking System (LATS); and a Multiple Target Tracking System (MTTS), installed and to become operational this calender year. New improvements to the site include, two 50-ft x 40-ft prefab-type maintenance buildings; area flood lighting for security; multiple pairs of underground data and communication cables; an 8,000-ft runway for light aircraft and/or drone launching; and increased commercial power, 60 Hertz, 3-phase, 4-wire for instrumentation use. Also, there are four cinetheodolite, two MIDI Radar, and eight MTTS A-Station concrete hardstand pads that have been strategically placed to provide optimum geometric coverage of the range, located by first-order survey.

(f) Sight Monitor

An isolated installation, located 10 miles east of Fort Bliss, under command of the US Army Air Defense School (USAADS). The USARADBD uses this installation primarily for testing electronic countermeasures/ electronix counter-countermeasures (ECM/ECCM) and command and control systems. A complete Improved Nike-Hercules

System, consisting of the low-power and high-power acquisition, missile tracking, target tracking, and target ranging radars, is available. Pertinent data are recorded on suitable media by facilities located at the Site Monitor complex during the conduct of ECM and ECCM tests.

b. Airspace

In reference to Section 2.j., the area south of R-5107A and R-5103 provides access to El Paso for airways V-94, V-945, V-15N, V-280. When not in use, these restricted areas revert to the FAA's Albuquerque Control Center.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements

The Multiple Target Tracking System (MTTS) is a field-installed, self-supporting instrumentation system designed to collect valid and meaningful data on the performance of military ground and airborne elements, compute this data and deliver the information to the display for instant display and monitoring and for storage for future use. The system will rapidly obtain the location of men, vehicles, and aircraft with accuracies of 2 to 3 meters in X and Y coordinates and 15 to 25 meters in Z coordinate, depending on geometry. This data is then available for displaying the exact position relationships of various participants as a function of time.

(2) Airborne Elements

(a) Radar System

Multiple Target Tracking System (MTTS) for tracking and recording both aerial and ground targets.

Instrumentation Radar System for tracking aerial targets and recording this data on magnetic tape.

Improved Nike-Hercules Radar Systems capable of tracking aerial targets. These two systems can track two aerial targets per radar system.

(b) Laser

Two Laser Automatic Tracking Systems will be added to this Board's inventory in February 1981. These systems automatically measure azimuth, elevation and range by transmitting a laser pulse to a target and measuring the angle of return and the round trip time. The systems gather space position data on cooperative targets, day or night, during inclement weather of conditions of low visibility. One hundred times a second the infrared laser interrogates the target with a short laser pulse. A retroreflector mounted on the target has an arrangement of three internal mirrors which reflect the laser pulses back to the system receiver with high efficiency. This provides an increased tracking range, to 30kM. the laser, its electronics, and all optics are sealed into an optical package. An infrared TV camera is also sealed in the optical package. Each system is self contained and mounted in mobil vans. The laser tracking provides higher tracking accuracy as follows:

<u>1</u> <u>Azimuth and Elevation</u>

± 0.01 percent of range for target ranges of 200 to 30 KM.

<u>2</u> <u>Range</u>

± 0.3 meters for target ranges of 200 to 10KM.

± 1 meter for target ranges of 10KM to 30KM.

(c) <u>Optical</u>

None.

(d) Relative (Miss-Distance)

A Miss Distance Indicator (MIDI) radar is available on a rental bases from White Sands Missile Range, which can determine vector and miss-distance.

b. <u>Timing</u>

IRIG timing signals for range instrumentation are provided by a Systron-Donner Central Control Station at Fort Bliss. Two remote timing stations are linked, via microwave to the Central Station for field use - one at Dona Ana Range and the other at North McGregor Range.

c. <u>Television</u>

The Closed Circuit Television System is used to support test projects by collecting video data on system under test. The CCTV system is composed of four low light level cameras, five remote camera control units, four pan-tilt units, five video recorders, three mini-studio units with six TV monitors, a video switcher and screen splitter. The system can operate as a unit with up to four remote controlled cameras. One camera and control unit may be extracted and operated as a seperate unit. Any two cameras can be displayed on a single monitor and recorded on a video recorder.

d. Photography

(1) USARADBD has a photographic section that provides photographic field instrumentation data, utilizing target cameras for motion studies, cameras for miss-distance intercept information, cathode ray tube recording in still, cine, for scan-by-scan (PPI) for radar data, and still engineering photography for equipment performance reports (EPR) and final report of test data.

(2) Color motion picture film is developed at WSMR: black and white plus still color film is developed at USARADBD itself. Since the photographic laboratory at USARADBD was designed for such, inhouse photo laboratory turnaround is very fast. The film processed by WSMR has less than a week turnaround time.

(3) USARADBD has no airborne photographic capabilities itself. Airborne capabilities must be supplied externally.

e. Instrumentation Calibration Capabilities

The USARADBD has one of the better calibration facilities of the Army. The calibration laboratory is an enclosed, RF-shielded, pressurized, humidity-controlled room. Oscilloscopes, signal generators and similar type objects are calibrated by the Board prior to and after each test. Some items are sent to WSMR for calibration, The data processing facility (seperate from USARADBD) provides dates when primary and secondary calibrations are due. The Board has some secondary standards, but they are not currently maintained, the standards can be readily activated if necessary.

f. Other General Instrumentation

(1) Meterological

The Board has two automatic meteorological data recording systems that records wind speed, wind direction, relative humidity, air temperature, and barometric pressure.

(2) Survey

USARADBD has a limited capability for making up to third order surveys and secures backup support from the WSMR and the USC&GS facilities, as needed.

(3) Radio Frequency Interface/Electromagnetic Compatibility

Radio frequency radiation must be closely coordinated and controlled at the Site Monitor Test Facility to avoid conflict with the ground control approach (GCA) radar at El Paso International Airport and at the Dona Ana Range to avoid conflict with missile firings at ESMR. Details of the radio frequency interference/electromagnetic capabilities at Site Monitor are classified.

(4) Visibility (Light Level Measurement)

None.

(5) Sound Measurement and Analysis

USARADBD has the following instrumentation:

(a) Noise Level Meter

(b) Octave Meter

(6) Safety and Security

USARADBD has no special safety or security devices. Security at Site Monitor is provided through physical security.

(7) Soil Conditions

Instrumention for the determination of soil conditions is provided by the Post Engineers.

g. Special Purpose Instrumentation

(1) Ballistic Data

USARADBD uses a muzzle velocity radar, on rental from White Sands, that is used to determine the muzzle velocity for approximately the first eight meters of a projectile's flight. Other than this, no specialized instrumentation is provided.

(2) MIDI Radar Tracking and Scoring System

The Miss-Distance (MIDI) radar, available on rental from White Sands, is a mobile system capable of scoring a variety of air-to-surface weapons with projectiles as small as 20mm and firing rates as high as 3,600 rounds per minute. The MIDI radar's primary measurement is the vector miss-distance relative to the target.

5. Threat/Targets

a. Ground

None, other than the normal targets associated with small arm ranges (see Section 3.a.(3)).

b. Airborne

The USARADBD does not have targets in its inventory, however, the Board's Target Coordinator applies to MICOM Target Office, Red Stone Arsenal, and/or New Mexico Air National Guard, Albuquerque, New Mexico for target requirements. The following are targets mainly used by the USARADBD in support of testing:

(1) Manned Aircraft - A7D

This is a single seat, single engine fighter, subsonic strike aircraft equipped with advanced avionics. This aircraft can operate with C-Band and I-Band radar beacon pods, retroreflectors and APX-82 transponder pods.

(2) Drone Aircraft

(a) QUH-1B (Drone Helicoptor) controlled from ground control station. Turns can be made at nominal 3^0 per second. Has left and right sideward flight capability. Target controller must maintain visual contact with target.

(b) QUH-1B (Drone Helicoptor) remotely controlled from van or jeep. The remote control system has a memory function which allows the drone to operate for an indefinite period using the last received command data. Loss of radio signal actuates carrier loss function which places drone in a hover condition at the last command altitude and heading. Target Controller must maintain visual contact with target.

(3) Drone Target - MQM-34D (FIREBEE)

A high speed, subsonic, remotely controlled target. Recovered by parachute recovery system. Can achieve as much as 6g maneuvers. Has capability for towing unpowered tow targets.

(4) Towed Target

(a) TDU-10 nonrecoverable target, dart shaped, length 16 feet, wing span (fin) 5 feet, weight 200 lbs.

(b) TDU-22 recoverable target, bullet shaped. diameter 7.75 inches, length 77 inches, wing span (fin) 22 inches, weight 43 lbs.

6. Data Handling/Processing

The data preparation effort is under the general supervision of the Chief, Data Reduction Branch. A portion of the mission of this branch is to read, analyze, and correlate original data, including film records of different types and light sensitive paper recordings of data from tests of air defense material. Data preparers assist mathematicians in making manual computations and preparing graphs of data for final reports.

Data preparation planning for processing is done by the Data Reduction Branch supervisor and the project mathematician to assure compatability with computer programs.

a. <u>Data Collection</u>

(1) General Purpose Recorder (GPR)

(a) <u>Basic Configuration</u>

<u>1</u> SEL 810A Computer 16K

<u>2</u> SEL 80-615 Magnetic Tape Unit

(b) <u>Accuracy</u>

Range (Yards)	Deviation
0-20K	± 6 yards
20-100K	± 30 yards
100K-200K	± 60 yards

(c) <u>System Capabilites</u>

Operators is only one of the following modes:

<u>1</u> Records slant range (X,Y,H coordinate data) for two radars.

<u>2</u> Records slant range (X,Y,H coordinate data) from one radar and five analog voltages.

<u>3</u> Records ten analog voltages.

In any mode above, 18 discrete on/off events can be recorded.

(d) <u>Input Characteristics</u>

<u>1</u> Analog voltage can vary from -112 volts to +112 volts.

<u>2</u> Input impedance of the analog channels is 750-800K ohms.

<u>3</u> On/off event-shorting NOR gate-to-ground.

(e) <u>Output</u>

<u>1</u> Radar data is recorded on 7-track computer compatible tape every 1.2 seconds in 12 message blocks. (Modernization to 9-track tape is in process.)

2 Data message is also transmitted via microwave through a Lenkurt 260 modem every 1/10 second to USARADBD computer facilities located in Building 1656.

(f) Calibration

1 Occurs automatically once per minute.

2 Standard source is used as a reference.

(g) Quick-Look Capability

Between test runs, previously recorded information can be displayed on the teletype.

(2) Radar Data Recorder (RDR)

(a) Basic Configuration

1 HP 2116B computer

2 Ten HP 3640B voltmeters

3 HP 2020B magnetic tape unit

(b) Accuracy

Analoge Voltage Input	Deviation
0-1- volts	± 0.5 mv
11-100 volts	± 3.0 mv

(c) System Capabilities

1 Records slant range (X, Y, H coordinate data) from two radars.

2 Records slant range (X, Y, H coordinate data) from one radar and five analog voltages.

3 Records ten analog voltages.

In any mode above, 18 discrete on/off events can be recorded.

(d) Input Characteristics

1 Analog voltage can vary from -100 volts to +100 volts.

2 Input impedance of the analog channels is 10 megohms.

3 On/off events-shorting NOR gate-to-ground.

(e) Output

Radar data is recorded on a 9-track computer compatible tape every second in ten message blocks

(f) Calibration

1 Occurs automatically at the beginning and ending of each course.

2 Occurs automatically once per 2-999 seconds, dependent upon teletype entry by the operator, or is operater-initiated at any time.

3 Standard source is used as reference.

(g) Quick-Look Capability

Between test runs, previously recorded information can be displayed on a page printer.

(3) Data Acquisition System (DAS)

(a) System Capabilities

1 Inputs

a 24 analog voltages

b 32 discrete on/off events

c 3 multipurpose inputs (AC, DC, OHMS)

2 Sample rates of 1, 10, 100 times/sec and 1/10 sec.

(b) Accuracy

1 Analog channels with three-scale selection (± 1, ± 10, ±100V -.05 percent of full scale.

2 Resolution, .007 percent

(c) Input Characteristics

1 Analog channel input impedance is 10 megohms.

2 Multipurpose channel inputs

a AC voltage - 0 to ± 1000

b DC voltage - 0 to ± 1000

c OHMS to megohms

3 On/Off Events

a 0 to ± volt - logical zero

b ±3 tp ±32 volts - logical one

(d) Output

1 At every sampling, a 240-character data message is generated.

2 The data message is stored on magnetic tape in computer-compatible format at 556/800 BPI.

3 Data Message is also transmitted via microwave through a Lenkurt 260 modem from the test site to the USARADBD computer facility. Data is transmitted at one sample per ten seconds: one and ten sample per second.

(e) Calibration

1 Occurs automatically or is operator-initiated.

2 A digital word is generated within the computer, output to a digital-to-analog converter, then coupled to the input analog-to-digital converter. A comparison is made of the digital output versus A/D input to establish calibration data.

(4) Electronic Warfare Data Acquisition System

(a) System Capabilities

1 Inputs

a 24 analog voltages

b 32 discrete on/off events

c 3 radar IF inputs; jammer power: measurement made in peak pulse and average and is in synchronism with the radar PRF.

2 Sample Rates

1, 10, 100 times/sec and one sample/ten seconds.

(b) Accuracy

1 Analog channels with three-scale selection (±1, ±10, ±100V) -0.05 percent of full scale.

2 Resolution, .007 percent of full scale.

(c) Input Characteristics

1 Analog channel input impedance -10 megohms.

2 On/off events

a 0 to ±2 volt - logical zero

b ±3 to ±32 volt - logical one

(d) Output

1 At every sampling a 240-character data message is generated.

2 Data message is stored on magnetic tape in compatible format 556/800 BPI.

3 Data message is also transmitted via microwave through a Lenkurt 26C modem from the test site to the USARADBD computer facility. Data is transmitted at one sample per ten seconds:

(e) Calibration

1 Occurs automatically or is operater-initiated.

2 A digital word is generated within the computer, outputed to a digital-to-analog converter, coupled to the input analog-to-digital converter. A comparison is made of the digital output versus A/D input to establish calibration data.

(f) Personnel and Miscellaneous Requirements

1 Normally, two technicians will man and operate this system. During initial setup, a minimum of three technicians will be reqired.

2 March order - two men, one day.

3 Emplacement - three men, one day.

4 Warm-up time - approximately one hour.

5 Power requirements - 115 volt, three phase, 60 cycle, 30 watts.

6 Air conditioning is required in the summer and heating in the winter.

(g) Van size: Width - 8 feet, 14 feet expanded; length - 26 feet, 7 inches; height - 11 feet, 3 inches.

b. Quick-Look Capabilities

The Range Instrumentation Control System (RICS), located at the US Army Air Defense Board, building 1656, receives real-time data, via microwave, from the Radar Data Recorder, Data Acquisition System and the Electronic Warfare Data Acquisition System. The RICS records this information and can provide quick-look information prior to data processing by the Data Reduction Branch.

Film data can be previewed after the film is developed (usually within 24 hours after the test).

c. Processing

(1) System and Model

All data collected, whether digital, analog, or optical (cinethedolite data and light-sensitive paper record are considered optical data), must be put into digital format for data processing. The Board has two "semi-automatic" film readers. There are two 35mm film read heads and two 16mm film read heads available. No 70mm film read heads are available. but the readers have 70mm read capacity.

(2) Language

FORTRAN and COBOL are the languages used to program the computers used in data reduction.

d. Distribution

The quick processing section has a goal of 24 hours turnaround time for "quick-look" data reduction. This is strictly for "quick-look"; any data reduction involving scientific routines requires longer times. The minimum cinetheodolite data turnaround time is 72 hours. The quantity of data to be read and complexity of the task may increase turnaround time to more than a week. The data processing facility outputs plotted data.

e. Displays (Plotting Boards, Crts, etc.)

Available displays are CRTs, digital readouts, hard copy teletype, plotting board, two-arm strip chart recorders, and closed-circuit television. Displays of data are also recorded on film, including pictures of various dials, scope traces, etc.

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ANNEX N

OPERATIONAL TEST INSTRUMENTATION GUIDE

US ARMY AVIATION BOARD
&
US ARMY AVIATION DEVELOPMENT TEST ACTIVITY
Fort Rucker, Alabama 36362

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ANNEX N

US ARMY AVIATION BOARD
US ARMY AVIATION DEVELOPMENT TEST ACTIVITY
Fort Rucker, Alabama 36362

1. Introduction

a. Organization. The US Army Aviation Development Test Activity (USAAVNDTA), located at Cairns Army Airfield, Fort Rucker, Alabama, is one of the field test activities of the US Army Test and Evaluation Command (TECOM), which as its headquarters at Aberdeen Proving Ground, Maryland, TECOM is one of ten major subordinate commands of the US Army Materiel Development and Readiness Command (DARCOM), which has its headquarters in Alexandria, Virginia.

The US Army Aviation Board (USAAVNBD) located at Cairns Army Airfield, Fort Rucker, Alabama, is one of eight TRADOC boards originally chartered as an operational tester.

The Aviation Board was established in July 1976 when a need was recognized by the Office of the Secretary of Defense and by the Department of the Army for user representation during the acquisition cycle.

b. Mission. The mission of the USAAVNBD is to:

- Plan, conduct, evaluate and report on Operational Test I, Operational Test II, Operational Test IIA, Follow-On Evaluation, Force Development Testing and Experimentation, Concept Evaluation Programs, Customers Tests and other type tests of non-major and selected major systems of aviation materiel.

- Participate in Developmental Test I, Developmental Test II (engineering phase) and Developmental Test IIA as directed.

- Provide advice and guidance on test and evaluation matters to materiel developers, materiel procuders, and other services and private industry.

- Participate in flying development test mission profiles in support of testing organizations.

- Conduct other tests and evaluations as directed by Commanding General, TRADOC.

The mission of the USAAVNDTA is to:

(1) To perform the following test phases of the single integrated development test concept (SIDTC) to aviation materiel to include aircraft, aircraft components (time-between-overhaul, time-between-inspection, aircraft subsystems, and aviation-related support equipment, as assigned by

the Commanding General, TECOM.

(a) Plan, conduct, evaluate, and report on the government test elements (Engineering Design Test, Advance Development Verification Test, Prototype Qualification Test, Production Validation Test), except those portions pertaining to aircraft performance, stability, and control.

(b) Provide input to, monitor, and analyze and evaluate the results of Government tests pertaining to aircraft performance, stability, and control, and the results of other Government tests.

(c) Provide input to, monitor, and analyze and evaluate the results of the same contractor test elements.

(2) Conduct other tests and evaluation as directed by the Commanding General, TECOM.

c. <u>Major Functions</u>

(1) Plan, conduct, record, evaluate, and report the results of assigned development tests and evaluations.

(2) Participate in and support the development efforts of the various commodity commands with responsibilities for the development of aviation-related materiel.

(3) Monitor contractor test programs and demonstrations, in whole or in part.

(4) Participate in soldier testing to evaluate HFE, safety, and the man-machine interface.

(5) Provide data concerning operations under extreme environmental conditions.

(6) Conduct procuct improvement tests of fielded aviation materiel to improve system capabilities, reliability, and maintainability.

(7) Review and comment on new equipment training packages, and participate in new equipment training as required.

(8) Participate in the development and review of military specifications.

(9) Provide TECOM test requirements for the coordinated test program.

(10) Plan, direct, and control a program in test methodology, test instrumentation, and test facilities needed to support current and future test requirements within assigned mission area.

(11) Provide aircraft and support as requested to support US Army sponsored tests being conducted.

(12) Provide advice and guidance on test and evaluation matters to materiel developers, materiel producers, other services and private industry.

(13) Provide advice and guidance on test and evaluation matters to materiel developers, materiel producers, other services and private industry.

(14) Participate in the conduct of combined developmental and operational testing, and observe operational tests when directed.

(15) Support field research, studies, tests, and operation of DARCOM, DA, DOD, or other Government agencies as required and directed by the Commander, TECOM.

d. Types of Tests. The USAAVNDTA has the responsibility for the test and evaluation of Army aviation materiel and associated equipment. This includes, but is not limited to, participation in the following type tests:

- o Operational Test - (OT)
- o Advanced Development Verification, Goverment - DT I (ADG)
- o Engineer Design-Contractor, DT I (E1C)
- o Product Improvement Proposal (PIP)
- o Engineer Design-Government, DT I (E1G)
- o Engineer Design-Government, DT II (E2G)
- o First Article/Initial Production - (FAT)
- o Prototype Qualification-Contractor, DT II (PQC)
- o Prototype Qualification-Government, DT II (PQG)
- o Production Validation-Contractor, DT II (PVC)
- o Production Validation-Government, DT III (PVG)
- o Product Improvement - (PI)
- o Support (Other thatn OT) - (SG)
- o Technical Feasibility - (TF)
- o Special Study - (SS)
- o Comparison - (CP)

e. Major Testing Capabilities. The major testing capabilities of the USAAVNDTA lie in the expertise of its personnel. The USAAVNDTA is comprised of experienced military and civilian personnel representing many hundreds of years of combined field and test experience with aviation materiel.

The USAAVNDTA has support and maintenance facilities capable of performing organizational, intermediate, and limited depot maintenance on Army aircraft and aviation electronic equipment. A field test site at Apalachicole, Florida provides necessary environmental conditions to duplicate the types of conditions under which aircraft are operating in the field. The USAAVNDTA has access to an Oil Analysis Laboratory which provides the capability of monitoring appropriate aircraft components during tests. Other capabilities worthy of note are a Class C Photographic Laboratory, a Modular Engine Test System, and a Fairchild Flight Analyzer System which can be used wherever suitable airfields exist to verify STOL aircraft performance. Airborne digital and FM instrumentation recorders are used for data collection. Computer data reduction is available both through the IBM 4331 at the Activity and at Eglin Air Force Base for special tests.

f. Organization History. The US Army Aviation Development Test Activity evolved from along line of test organizations that were formed to accomplish aviation test missions. Changes were dictated by reorganizations within the Army, realignment of test activities, and changes in testing concepts.

In 1946, the Ground Aircraft Service Test Division, AAF Board, Number 1, was established. This unit was later designated Board Number 5, Continental Army Command (CONARC). The stated mission was that of service testing Army aircraft and allied equipment for the field forces.

On 1 August 1955, Board Number 6, CONARC, was established as the Army Aviation Board. The mission was broadly defined as conducting all phases of user testing for Army aviation. User testing was defined as tests performed by the using agency to determine the suitability of an item for military use.

When the US Army was reorganized in 1962, the unit was redesignated the US Army Aviation Test Board under the US Army Test and Evaluation Command as a part of the US Army Materiel Command.

The Test Board of the 1960's represented a changing philosophy and role. Aircraft types were tested to meet a military need. Reliability, availability, and maintainability (RAM) of a fleet of aircraft by an Army unit in the field was addressed in lieu of an aircraft flown under controlled conditions by selected pilots for a one-time mission to set an endurance record. In addition to RAM, some prime areas of interest were safety, human factors, and logistics.

The US Army Aircraft Development Test Activity was formed on 1 July 1976 to fulfill an Army requirement for a unit with the capability of performing Engineering Development, Advanced Development, Prototype Qualification, and Prototype Verification Testing. The user test function became the mission of a new organization, the Aviation Board, assigned to the Training and Doctrine Command.

On 6 June 1979 the US Army Aircraft Development Test activity was renamed the US Army Aviation Development Test Activity (USAAVNDTA); the organization continues in the role of a development tester. The mission encompasses engineering testing to a greater degree. A fallout of this requirement is a need for more improved instrumentation to support the expanded technical testing inherent in the new mission.

The USAAVNDTA continues to utilize the available technical expertise of the Aviation Center Team to accomplish assigned tests as it has since its early days as the Test Board.

2. General

a. The Aviation Center Team. Fort Rucker, Alabama, is the US Army Aviation Center (USAAVNC) -- the home of the Army Aviation School. The Aviation Development Test Activity joins with the Aviation School and other activities located at Fort Rucker to form the "Aviation Center Team." The commanders meet periodically to discuss means of attaining the goals of Army aviation and to enhance cooperation between the units. In addition to USAAVNDTA, the following organizations are members of the Center Team.

The USAAVNC Directorate of Combat Development and the Activity cooperate in establishing test profiles and monitoring new aviation concepts and test programs.

The US Army Safety Center (USASC) provides assistance in evaluating the safety aspects of equipment under test.

The US Army Aeromedical Research Laboratory (USAARL) assists the Activity by measuring, evaluating, and reporting the physiological effects of new equipment operation, to include noise levels and weapons gas contamination.

The US Army Research Institute Field Unit at Fort Rucker assists the activity in evaluating the human factors aspects of new equipment.

The Aviation Board (USAAVNBD) is collocated at Cairns AAF with the Activity and has the responsiblity of representing the user through the conduct of operational testing. The concept of collocated developmental and operational testing enhances close coordination during ongoing testing and facilitates resource management for combined development and operational testing.

b. Land Area and Facilities. The Fort Rucker military reservation is comprised of approximately 60,000 acres of Government land with an additional leased area of 1,672 acres which includes numerous small training fields scattered throughout the surrounding countryside. Physical facilities of the USAAVNDTA at Cairns AAF consist of three permenent hangars with office space (107,716 square feet), a two-story office building (16,690 square feet), the top floor of a three-story office building (approximately 20,000 square feet), and ten miscellaneous small buildings, housing ships, laboratories, and various storage facilities. In addition, 19,260 square feet of open storage and 9,000 square feet of warehouse space are provided on Fort Rucker main post. Two buildings (approximately 3,290 square feet) are located at the auxiliary test site at Apalochicola, Florida. Shell Army Heliport, located approximately 15 miles northwest of Cairns Army Airfield, is available for use as a test site. The field has four runways, each 2,000 feet long. Major buildings are two hangars, each containing 8,471 square feet with adjacent offices; two separate office buildings, one 8,000 square feet and one 12,500 square feet; and several smaller permanent and temporary buildings. This heliport is normally inactive and can be made available for special tests.

c. Access

(1) Road. Fort Rucker lies 94 miles south of Montgomery, Alabama, midway between the capital city and the Florida Gulf Coast (see Figure N-2). From Montgomery, take US Route 231 to Ozark, Alabama; then take Alabama State Route 249 eight miles west to Fort Rucker (see reference 4).

(2) Rail. There is a railhead on post and at Ozark, Alabama, served by the Seaboard Coast Line.

(3) Air. Military aircraft usually land at Cairns AAF, which has runways of 5,000, 4,500 and 4,000-foot lengths. The nearest commercial airport is Napier Field (8,500-foot runway) in Dothan. Taxi service is available from the airport to downtown Dothan, with bus service from Dothan to Ozark.

d. Logistical Support Capability. The 416th Tranportation Company transports aircraft fuel to outlying sites. The 108th quartermaster Company operates refueling points at outlying sites.

e. Recurring Commitments. The major recurring commitment is the School. With centralization of all Army aviation training at Fort Rucker, the training load will increase.

f. Special Operational Restrictions. Due to School training aircraft sorties, airborne restrictions are required to and around Fort Rucker.

Airborne armament carriage is restricted. Firing is conducted in restricted airspace (R-2103). This restricted airspace is only about four miles in diameter.

g. Facility Organization. Organization is presented in Section 1.

h. Environment. Mild climate with warm days frequent, even during winter. Frequent heavy rains during winter, occasionally lasting several days. Occasional morning fogs; freezing weather almost non-existent. Climate is similar to that of Fort Benning and Fort Stewart, Georgia.

i. Topography. Gently rolling, partially wooded hills with elevation slowly increasing from around 200 feet mean sea level (MSL) to 500 feet MSL from south to north. Numerous creeks and rivers are located in the general area, usually with forests on the gently sloping banks that cover the waterways. (See References 3 and 6 for further topography information.)

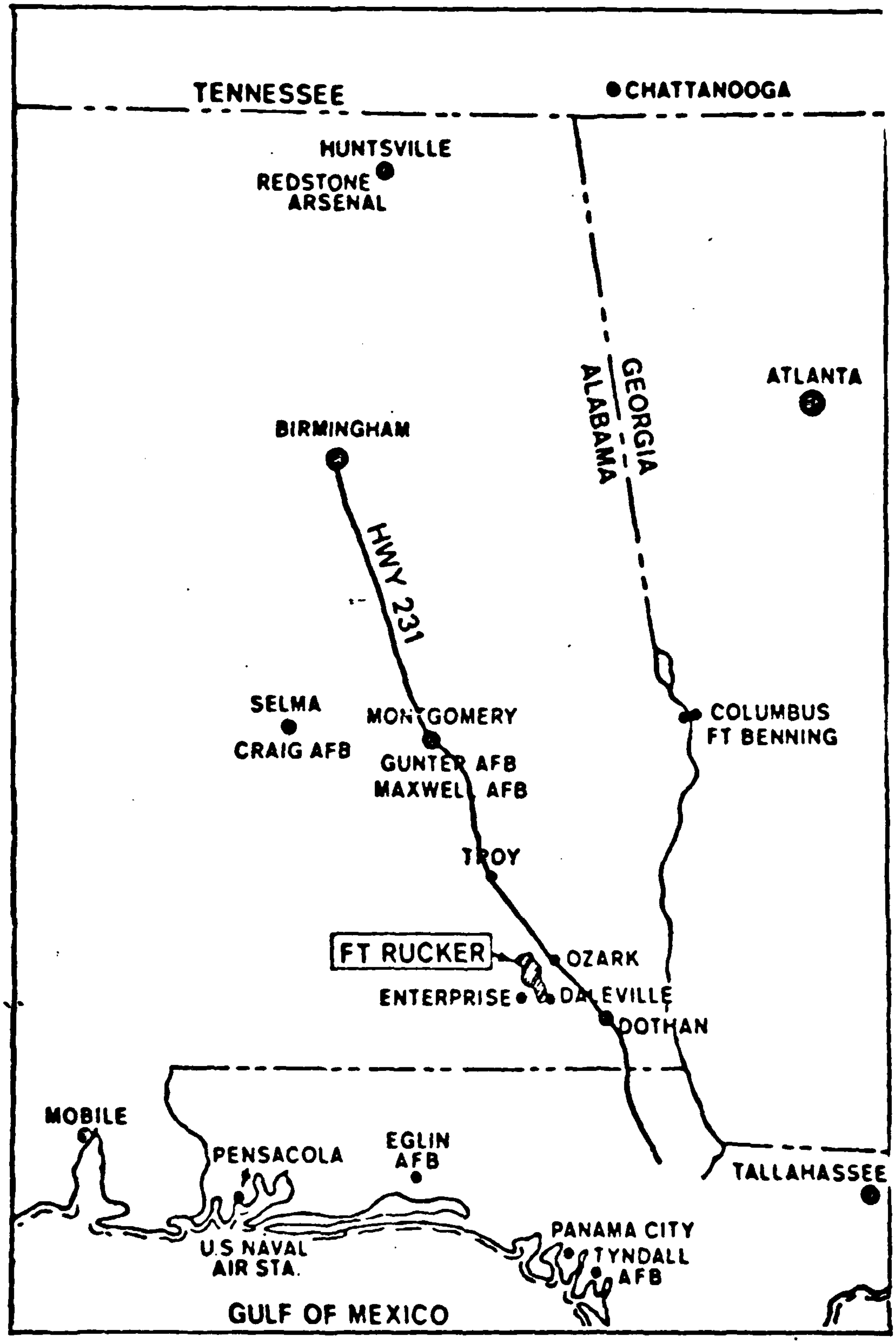

Figure N-2 Location of Fort Rucker, Alabama

j. Airspace Restrictions. Training areas encompass all of the immediate area above and around Fort Rucker (except for an area encompassed by a five-mile radius centered at the Dothan Commercial Airport (Napier Field). A four-mile radius restricted airspace area cented at about 34° 30 latitude and 85° 45 longitude (R-2103 is the only restricted airspace within 50 miles of Fort Rucker). (See Reference 5 of the Bibliography).

k. Power Availability. Standard commercial power.

l. Communications. Commercial telephone, Wester Union, MARS Radio, and AUTOVON.

3. Dimensions

a. Landspace

(1) Contiguous Test Areas. The contiguous landspace at Fort Rucker is approximately 10 by 26 kilometers (64,000 acres). In general, the ground space is laid out with the populated area in the southwest corner and the firing ranges in the northwest corner. (See Reference 3.)

(2) Easements. None.

(3) Impact/Live Firing Areas. The firing and impact areas are shown in the upper left corner of Figure N-3. The firing areas are located on the perimeter of the area and the impact zones are in the middle.

The USAAVNDTA has a firing test area in the vicinity of Apalachicola, Florida, approximately 120 miles south of Fort Rucker.

b. Airspace

(1) Landspace/Airspace Relationship. The only restricted airspace is R-2103 which is a four-mile radius above the northwest portion of the Fort Rucker reservation. Warnings exist for military student pilots all around the area.

(2) Easements. The Aviation School has several aviation easements, primarily for low altitude and nap-of-the-earth training.

(3) Manned Airborne Systems. All airborne operations involving weapons firing are limited to R-2103. Other operations are restricted by School flight corridors and altitudes.

(4) Unmanned Airborne Systems. No areas available around Fort Rucker.

(5) Area Surveillance. All area surveillance handled by FAA.

4. Instrumentation.

a. Space Positioning and Velocity Vector

(1) The Raydist System (operated by USAARL) is used to obtain

aircraft space position data. The system is currently a four-station solution, using four CW transmitter, two CW receivers, and an aircraft navigator and recorder system. The four stations are in a diamond form, 13 miles apart on the other axis. A Honeywell AN/APN-18 (v) radar altimeter is used for Z values. Accuracies were quoted at ±10 feet within the array with resolution to three feet; outside the array, accuracies tend to degenerate. The current arrangement can accept only one aircraft at a time for space position data.

(2) Three Motorola Mini-Ranger MRS III Systems each consisting of one master console, one receiver transmitter and two reference stations. Two of the units have multi-user options allowing for multiple target tracking. Accuracy is ± 3 meters.

(3) Integrated Data Acquisition System (IDAS) (one each). Consists of one Airborne Instrumentation System (AIS) and one Ground Support Unit (GSU).

The airborne instrumentation system (AIS) acquires video, voice, parametric and position data. The AIS records a single closed circuit TV channel with voice channels on a magnetic tape. The closed circuit TV includes an electronically gated low-light-level TV camera. Parametric data is collected on 18 digital channels and recorded on digital cassette tape and on the TV magnetic tape during the vertical retrace portion of the video recording. Data recorded during the vertical retrace does not interfere with the video recording. The 18 digital channels are sampled once per second. The AIS has a built-in self-test unit. Loran provides X-Y position data to ± 25 meters relative accuracy.

The ground support unit (GSU) interfaces with the AIS. The GSU synchronzies the Loran and AIS. Pre- and post-trail operation and calibration checks of the AIS are performed by the GSU. For post-trial evaluation, the GSU provides a printout of unedited digital data.

The IDAS will be mobile and transportable for use at other testing facilities. Data analysis will be performed by a HP 9845 presently being purchased.

b. Timing. Mobile/portable IRIG Time Code Generators with video insertion capability are used for airborne and fixed data annotation.

c. Television. The Activity uses 3/4" and 1/2" format video recording equipment. Seven TEAC airborne video systems with B&W and color capability are available for test support. These units provide 30 minute capability. Three Sony Betomax portable recorders are also available which provide 1 hour record capability.

The Aviation Board users:

-Two Cohu MOD 4510 B&W environmental encased airborne cameras.

-Two EDO Western MOD 1400 B&W environmental encased airborne cameras, with split screen capabililty, one camera modified for AH-1S telescopic sight unit mount.

-Ten RCA model ABN Airborne video recorders with remote control capability.

-Five Sony Model V03800 Ground Video Playback Units.

-Two Sony Model V02800 Ground Video Playback with SM 2 Search Modems.

-Three Sony CMV-115 B&W 19" Video monitors.

-Three Sony CMV-1250 color video monitors.

-One Sony Model DXC-1610 color portable camera.

-Variety of power supplies, lenses and color adapters to support video systems.

-Four GBC Model MV-50 8" mobile B&W monitors.

d. Photography

o Class C Photo Lab (motion picture processing is accomplished at Aberdeen Proving Ground).

o FDA-044 Fairchild flight analyzer

o Nine LOCAMA 16mm instrumentation cameras

o Two Aeroflex cameras

o One 16mm film reader

o Oscillography processing equipment

o Two 50-channel oscillographs

o Three 12-channel oscillographs

e. Instrumentation Calibration Capabilities. Provided by Army Aviation Center and by mobile calibration team, Anniston Depot. No inhouse calibration capability.

f. Other General Instrumentation

(1) Airborne Recording. Ten Teledyne on-board systems are available for aircraft performance monitoring. Each has a 12-bit word with 64 words to the frame. The purpose of each system is to monitor engine temperatures, RPM, flows, vibrations, and other functions during flights as long as 12 hours. Recording is serial; the items are crash-hardened. The ground station incorporates a PDP 11/34 computer with two disk drives and high speed tape capability. A CRT display with hardcopy output is used with this system. Airborne data may also be recorded in direct, FM, or PCM format on Ampex AR700 14 track instrumentation recorders.

The Aviation Board has the following strip chart recorders:

-One Gulton Model TR 222.

-One Gulton Model TR 444.

-One Gulton Model TR 888.

(2) Meteorological. None inhouse. Air Force Weather Detachment located at Cairns Army Airfield.

(3) Survey. None.

(4) Radio Frequency Interference (RFI). Limited AN/URM-85. This is a standard Army radiation meter of limited capability.

(5) Visibility. None.

(6) Sound Measurement and Analysis. Sound vectors time analyzer, Model 1564A and TS-723 audio measurement equipment constitute the total sound measurement instrumentation equipment. This equipment is USAARL property.

(7) Safety and Security. Ranges are swept by chase aircraft before firing; a safety path is used to approach a range. Surveillance radar is also available for safety.

(8) Soil Conditions. Soil penetrometer for measuring California bearing ratio value.

(9) Thermal. Two each, 16-point digital temperature indicators, Howell Model H500-K1. One 60-channel Fluke Model 2240A Data Logger. Data may also be recorded on AR700 instrumentation recorders using resistance sensors or themocouples.

g. Special Purpose Instrumentation. Ten each digital flight data acquisition systems, Teledyne 70-200 (URINC characteristic 573-5); 64 data samples per second; four-second frame rate; excess of 16 hours capapacity. Crack hardened magazine. Ground playback processor generates an IBM computer compatible tape.

The USAAVNDTA has access to an Oil Analysis Laboratory which is operated by the Aviation center for processing test samples from aircraft.

5. Threats/Targets. The only realistic threats/targets are supplied by E Company, 30th Infantry aggressor forces; H Battery, 18th Artillery; and the Alabama National Guard M-48 tanks.

6. Data Handling/Processing. The USSAVNDTA operates a data service center which includes an IBM 4331 Central Processor which can operate stand alone or over wire lined to the IBM 360-65 computer at Aberdeen Proving Ground. It should be further noted that Aberdeen Proving Ground is the Army test bed for the ARPA Network.

Hewlett-Packard calculators are used for reducing mathematical and statistical problems.

The instrumentaton ground station incorporates a PDP 11/34 computer system with 32 K memory.

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*** Introduction the the US Army AVIATION Development Test Activity is currently being revised and should be published in early 1981.

ANNEX O

OPERATIONAL TEST INSTRUMENTATION GUIDE

U.S. ARMY FIELD ARTILLERY BOARD

Fort Sill, Oklahoma

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ANNEX O

U.S. ARMY FIELD ARTILLERY BOARD
Fort Sill, Oklahoma

1. Introduction

a. Overview

Fort Sill Military Reservation, located in Comanche County, Oklahoma, is four miles north of Lawton, Oklahoma. Fort Sill is the home of the "University of Field Artillery," the U.S. Army Field Artillery School (USAFAS). The U.S. Army Field Artillery Training Center and the III Corps Artillery are also located at Fort Sill.

The mission of Fort Sill is to provide command, training, and logistical support for artillery and surface-to-surface missile units. Other responsibilities include the operation of Henry Post Army Airfield. This includes air traffic control, dispatch, aircraft refueling, and the handling of aircraft assigned to artillery units; Headquarters, USAFAS; and transient military aircraft.

b. Generic Systems Tested

The USAFABD stationed at Fort Sill is the only organization at Fort Sill capable of conducting operational-type testing. The Board is a U.S. Army Training and Doctrine Command (TRADOC) test activity. The Fort Sill Post controls the majority of test areas and ranges and is primarily concerned with the training of artillery units. The post does not perform testing or evaluation of new or existing items. However, the expertise of the artillery school is often used to determine the feasibility of developing an artillery item during the early stages of development.

The type of tests that have been performed on the firing ranges of Fort Sill include the following:

Direct Fire - rifles, machine guns, submachine guns, 105mm, 155mm, and 8-inch howitzers.

Indirect Fire - 105mm, 155mm, and 8-Inch Howitzers, and 175mm guns; surface-to-surface missiles such as HONEST JOHN.

Airborne Systems - hel'copters, helicopter weapon systems.

Air Defense - radar and rangefinder systems.

Vehicles - tanks, self-propelled Howitzers.

Command and Control - automated systems for the direction of artillery fire such as the Field Artillery Digital Automatic Computer (FADAC), the Tactical Fire Direction System (TACFIRE), and the Battery Computer System (BCS).

The artillery range can accommodate firing of any standard and approved field artillery weapon and ammunition up to a range of approximately 30 km. Also available are training areas, lakes, streams, an ammunition effects field, and an approximately 20 mile-long cross-country vehicle test course with a fording and swimming area.

2. General

a. Military Units

(1) Army Units

The following list of Army units located at Fort Sill will provide some insight into the facilities and capabilities available to the outside user. However, many factors such as scheduling and routing requirements may limit the use of some of the listed units.

U.S. Army Field Artillery School
U.S. Army Training Center - Field Artillery
III Corps Artillery
100th Supply and Service Battalion
299th Engineer Battalion
TACFIRE/FATDS Software Support Group
Readiness Group VII
USACC - Fort Sill
MEDDAC
Fort Sill Resident Office 902d MI GP
ERADCOM PM FIREFINDER Office
CERCOM New Equipment Training Office
USAMIRCOM Liaison Office, Fort Sill (Pershing/LANCE)
U.S. Army Research Institute Field Unit
Army Logistics Assistance Office - Fort Sill
Fort Sill Field Office 6 RGN CIDC
68th Air Traffic Control Company (FWD)
DET II, 16 WEA USAF

(2) Other

None.

(3) Nearby Government Installations

Fort Chaffee (maintained by Fort Sill)
Altus AFB, Oklahoma
Reese AFB, Texas
Sheppard AFB, Texas
Tinker AFB, Oklahoma

Vance AFB, Oklahoma
McAlister Army Ammo Plant, Oklahoma

b. Maintenance

The Board has a consolidated Maintenance Branch in the Logistics and Test Support Division. This branch is capable of performing Army unit level maintenance on test equipment used by the Board.

Range facilities are controlled and maintained by the Center G3/DPT. Specifically, the maintenance of field artillery weapons and vehicles is accomplished by the Directorate of Industrial Operations. Maintenance of buildings and troop housing is accomplished by the Directorate of Facilities Engineering. Direct support maintenance for most commodity groups is provided by the 100th Supply and Service Battalion.

c. Access

(1) Air

Commercial air transportation is through Lawton Municipal Airport. Two airlines, Frontier and Metro, serve Lawton (runway length: 8,600 feet) which is four miles south of Fort Sill. Military air traffic is through Henry Post army airfield on Fort Sill.

Henry Post Army Airfield now controlled by the Directorate of Plans and Training, Aviation Division, U.S. Army Field Artillery Center and School, contains one 5,000-foot concrete runway, 200 feet wide, which will accommodate a 100,000-pound, single-wheel load. This runway has a connecting taxiway and apron. In addition, a parallel taxiway was constructed in 1961.
There were approximately 150,000 take-offs and landings made each year on this runway.

There is also a sod landing area adjacent to the runway which is used by rotary-wing aircraft and light observation fixed-wing aircraft. There are some 50,000 operations annually (take-offs and landings) conducted on the sod. This is not, however, a landing strip as such since it is not equipped with airfield lights.

In addition, there are 13 authorized field strips and 15 designated helicopter landing sights located on the reservation.

There are five permanent hangars at Post Field. The hangars contain 39,514 square feet; 35,966 square feet; 22,065 square feet; 40,121 square feet; and 9,010 square feet.

Other permanent construction includes a control tower, aviation fueling system, weather station, crash fire station, dispensary, and navigational aids.

(2) Water

There are no waterways serving Fort Sill.

(3) Rail

Fort Sill is served by one railroad system, the Frisco Line, whose company-owned tracks traverse the installation from north to south at the east side of the built-up area. Existing Government-owned trackage is approximately 11 miles and located in the central part of the installation running east and west. This trackage serves all major warehouses and the industrial area.

(4) Road

Highways from all directions interconnect Lawton with other towns and cities both in Oklahoma and the adjacent states. These are U.S. highways 62, 277, and 281. The city is also located on the HE Baily Turnpike (Toll Road) major north-south turnpike. Transportation between Lawton and Fort Sill is by means of private vehicles and taxis utilizing three principal paved routes.

d. Logistic Support

Increases in the maintenance and logistical support for outside users would have to be determined from definite requirements. Housing and community facilities are in short supply. Tents, gasoline, water, and food may have to be provided to support additional troops. Expertise on the use of the test equipment is available from the FA School. In addition, well-trained troops from the III Corps Artillery may be made available through the TSARC process as players units/personnel for tests.

e. Recurring Commitments

One of the major activities at Fort Sill is the U.S. Army Field Artillery School, where more than 22,000 officers and enlisted men are instructed annually by six departments and trained in more than 50 courses on various aspects of the field artillery, howitzers, rockets, and surface-to-surface missiles. These weapons may be required to fire conventional, nuclear, or chemical warheads.

During the summer there are two-week reserve unit training periods. In addition, these reserve units utilize firing ranges and some "maneuver" areas on the weekends.

f. Special Operating Restrictions

Since the maximum firing range is approximately 30 kilometers without firing over U.S. Highway 277, the USAFABD is required to conduct firing on longer range systems at WSMR. Other special operating restrictions are indicated in the Safety Post Range Regulations, USAFACFS Reg 385-1.

g. Facilities Organization

Figure 0-1 presents the organization chart for the Board.

US ARMY FIELD ARTILLERY BOARD
ORGANIZATIONAL CHART

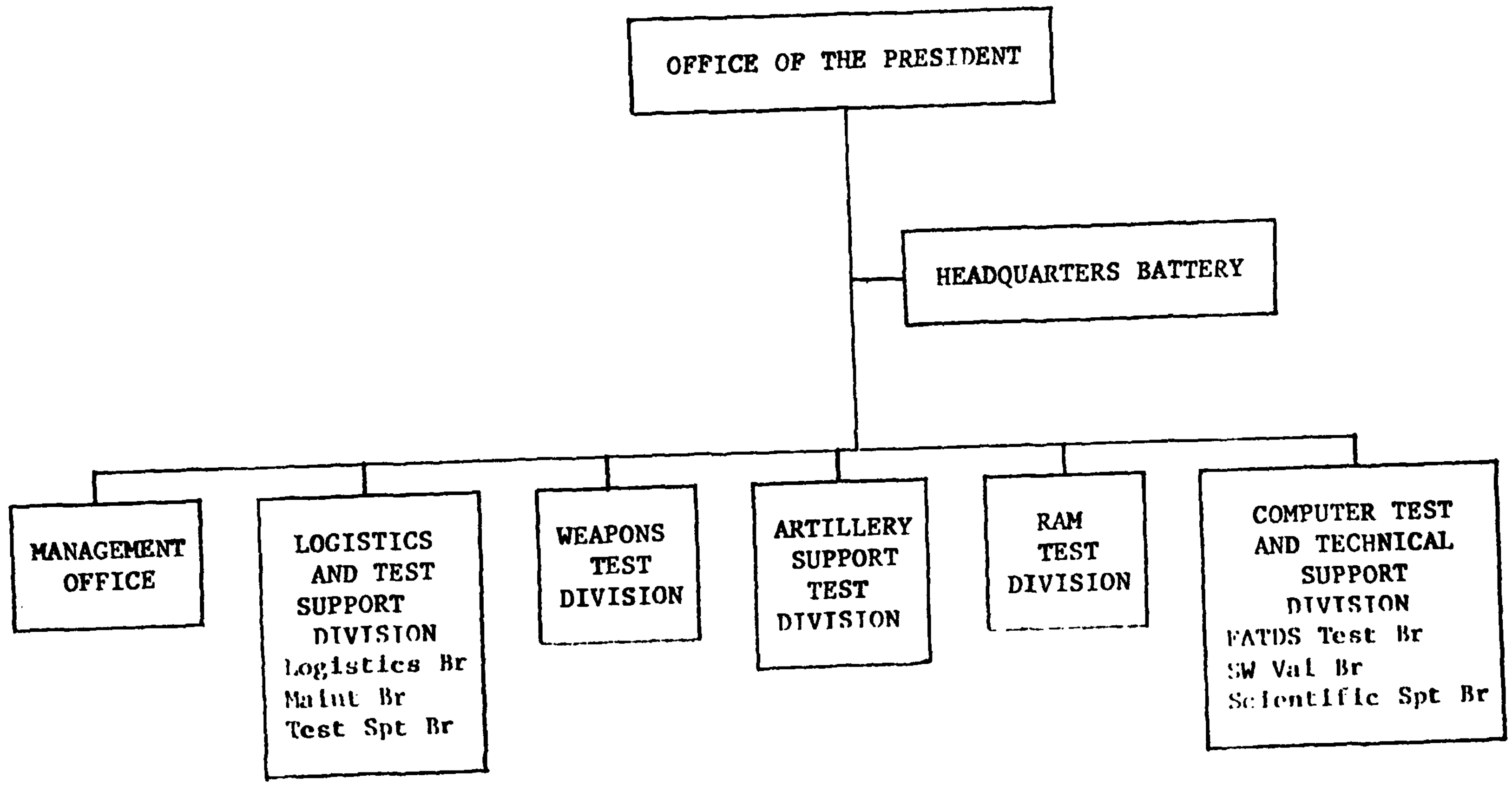

Figure 0-1

h. Environment

Weather Bureau records over a 63-year period show an average annual rainfall of 31.07 inches with an average temperature during January of 40°F and 83°F during July. The average growing season is 215 days. The last killing frost occurs about April 2 in the spring and the first frost in the fall is about November 3.

i. Topography

The occupied area of the installation is built on a level plain south of Medicine Creek and west of Cache Creek with the Wichita Mountains further to the northwest. The Wichita Mountains Wildfire Refuge under the Department of the Interior occupies the main portion of the mountains (a tract of 61,480 acres).

The natural drainage of the area is in three separate water sheds: Blue Beaver Creek on the west; Medicine Creek, north central; and Cache Creek with its tributaries on the east. These creeks and their tributaries are subject to flash flooding during rainy (wet) periods.

The part of the reservation which lies east of the railroads and Highway 277 is a rolling prairie formation, thinly wooded along the small creeks, and more densely timbered along Cache Creek. To the west of Highway 277, starting about a half-mile north of the maintained area of the installation, is the eastern end of the Wichita Mountains, which extend in a belt about 35 miles to the west and average four miles in width.

j. Airspace Restrictions

Airspace restrictions are shown in reference 8, annex O, Bibliography. Airspace Area 5602A covers all that area within the Fort Sill Reservation boundaries, excepting Henry Post Army Airfield (HPAAF), from surface to 23,000 feet above mean sea level (MSL). Area 5601B covers the HPAAF airport control zone which extends five statute miles in all directions from the geographic center of HPAAF and from surface to 23,000 feet MSL. Area 5601C covers the same areas as both 5601A and 5601B and extends 23,000 feet MSL to 65,000 feet MSL. Area 5601D covers the USAF high performance aircraft maneuver area adjacent to and north of Quanah Range (Falcon Range) and extends from 3,000 feet above ground level (AGL) to 16,500 feet MSL. Area 5601E covers the USAF high performance aircraft maneuver areas adjacent to an extending west and south of Falcon Range extending from 3,000 feet AGL to 6,000 feet MSL. Joining R-5601 to the south is the Sheppard Military Operational Area (MOA). This airspace extends from 8,000 feet MSL to 18,000 feet MSL and covers the Sheppard AFB Intensive Student Jet Training Area. Use of the Sheppard MOA requires prior coordination with the Wichita Falls Flight Service Station (FSS). To the southeast of Fort Sill is Sheppard 2 Intensive Student Jet Training Area.)

k. Power Availability

Fort Sill is currently supplied electrical power from a 50,000 kVA substation served by a 66,000-volt transmission line. In addition, Fort Sill has two 13.2-kV feeder lines, one 6,845-kVA substation, a 13,200-volt switching station, and a 1-350-KVAR capacitor station. The two 13.2-kV feeders serve portions of the installation in which they are located. The 6,845-kVA substation serves the underground distribution system and the 4,160-volt overhead lines. In addition, a 7,500-kVA substation has been built to improve the capacity of the 4,160-volt system by supplementing the 6,845-kVA substation. The Government-owned distribution system, both aerial and underground, totals 1,295,861 lineal feet. All electrical distribution is on copper conductors except for a small portion of aluminum conductors which were constructed as a feeder to 21 barracks constructed in 1952 and those in the Wherry Housing development. The serving utility company is the Public Service Company of Oklahoma. Internal combustion engine-powered emergency electrical generators using diesel fuel, natural gas, and gasoline are available at various locations.

1. Communications

Communications used by the USAFABD, artillery units, and range installations are military standard. The Board uses both portable and/or vehicle-mounted radios of various types on a loan or in-house basis for the majority of their requirements. The frequency assignments for all Post activities are made by the Directorate of Communications-Electronics (CE), a branch of USACC. The only RF communications the Post has is an unofficial MARS (Military Affiliate Radio System) amateur radio station. Landlines for telephones are installed throughout the installation.

(1) Telephone

The CE Administration Section, Telephone Exchange, and Telephone Division are located in a permanent building containing 13,240 square feet with the administrative office, plant room, and operator rooms being air conditioned. The telephone exchange is automatic, capable of serving 5,200 lines. The present system has in operation 4,262 telephone lines and 4,311 extensions, or a total of 8,573 stations.

A permanent air-conditioned building located at Camp Eagle Training Area containing 792 square feet, houses a 12-channel carrier system, 200-line automatic exchange, and power equipment. Equipment presently installed is capable of furnishing 12 carrier circuits to Fort Sill and 200 telephone lines for the Camp Eagle areas.

The telephone distribution system contains 83,200 lineal feet of buried armored cable, 79,200 lineal feet of lead cable in ducts, and 391,210 lineal feet of aerial cable.

The telephone systems for the firing ranges contains approximately 1,209 wire miles of open wire circuits, 37 miles of plastic (aerial) cables, and 12 miles of buried cable used for point-to-point communications. Three (3) switchboards located on the East, West, and Quanah Ranges are used to control firing.

(2) CATV and ETV

A permanent building, Building 477, containing 400 square feet, houses the equipment for the CATV system and repair shop for electronic equipment maintained by the Telephonic Division.

The electronic equipment maintained by CE Section consists of CATV and ETV systems with 637,920 lineal feet of trunk and distribution cables. The systems have 4,000 outlets for the connection of TV receivers, 1,009 TV receivers, 38 intercom systems, 200 radio/phonograph combinations, 55 public address systems, 14 electronic organs, one nurses' call system one doctors' call system, and one hospital distribution system.

(3) FM Radio Net Operation and Procedure

Administrative FM radio nets may be used for range control communications. Range control operating frequencies are as follows:

East Range	30.50 MHZ
West Range	34.50 MHZ
Quanah Range	38.50 MHZ

3. Dimensions

a. Landspace

The Fort Sill Military Reservation consists of 94,304.5 acres of landspace. The area is divided in the following manner:

	Impact Areas	Maneuver Areas	Total
Built-Up Area	-	-	4,704.5
East Range	13,000	15,900	28,900
West Range	12,800	33,100	45,900
Quanah Range	7,100	7,700	14,800
		TOTAL ACRES	94,304.5

(1) Test Area Contiguity

The layout of the training areas, impact areas, the Post installation itself, and the immediate area surrounding the military reservation is presented in Reference 9, in annex O Bibliography.

(2) Easements

Firing over State Highway 115

Highway 115 (highway due north of Cache, Oklahoma) is closed only when special test weapons or test ammunition are being fired. When this type of firing is being conducted, the procedure for closing the highway is to post guards on the highway to halt all traffic. Traffic is then halted only during periods of actual firing. Guards are equipped with radio or wire communications with the Control FDC. School buses are not detained more than five minutes. No vehicles are delayed for more than 15 minutes.

(3) Impact/Live Firing Area

Reference 11 indicates the artillery impact areas. These areas include firing points, safety zones, and impact areas from several types of ranges including small arms ranges.

(a) Small Arms Ranges

Small arms and crew-served weapon training facilities and courses are under the control of the Small Arms Range Control Center of the Range Division. The following types of ranges are included:

hand grenade ranges
rocket launcher ranges
rifle ranges - general
trainfire ranges
1,000-inch range
pistol ranges
Blue Beaver Moving Target Range
machine gun ranges
close combat course
infiltration course
indoor rifle range
automatic rifle range
aerial machine gun range
aerial field artillery gunner ranges (2.75-inch rocket)
M79 range
range for the engagement of aerial targets with small arms

General operating restrictions for the use of all small arms and crew-served weapon ranges are indicated in the Safety Post Range Regulations, USAFACFS Reg. 385-1.

(b) Special Effects Fields

In addition to the small arms and crew-served weapon training facilities and courses just described, there is also the Quanah Special Effects Field.

The Quanah Special Effects Field, and area bounded by grids 261357/261367/271357/271367 is reserved for use by the U.S. Army Field Artillery Board for determining of special test effects. This area is shared with the USAF and must be coordinated through G3/DPT Range Control in advance. When this field is to be used the U.S. Army Field Artillery Board is responsible for the following:

Requesting EOD support when required and ensuring that personnel do not enter the impact area without EOD clearance.

Ensuring that prior to entering the special effects field, all personnel are properly briefed by EOD and the OIC on safety precautions to be taken when walking in the field.

Controlling all personnel allowed in the field.

Ensuring that all personnel stay within the limits of the area authorized for use.

Ensuring that access roads into the special effects field have been cleared before using.

(4) Training Areas

With the exception of the impact areas, the entire range may be used for tactical training and maneuvers.

b. Airspace

(1) Landspace/Airspace/Relationship

All aircraft desiring to enter Airspace Restricted Areas R-5601A and R-5601B must obtained permission from G3/DPT Range Control. Pilots must keep in constant communication with Henry Post AAF (Fort Sill Approach Restricted Areas R-5601D, 5601E, and the Sheppard Military Operational Area may be entered only after obtaining prior permission from FAA (Wichita Falls Flight Service Station).

In addition to the above restrictions, the Fort Sill Post Range Regulations list stipulations pertaining to the air lanes over and immediately adjacent to the range. The east air corridor over Highway 277 is bounded on the west by Apache Gate Road, extending south to include the Fort Sill populated area, and on the east by East Cache Creek. The west air corridor over Highway 115 north of Cache, Oklahoma, is bounded on the west by a north-south line one-half mile west of Highway 115, and on the east by a north-south line one-half mile east of Highway 115.

See Reference 8 in Annex O Bibliography for air corridor charts.

(2) Easements

There are no easements other than those mentioned under Airspace Restrictions. No FAA high-altitude air routes exist over the Fort Sill area.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) BALLISTICS MEASUREMENT SYSTEM

(a) Physical Description. The Ballistics Measurement System uses the various range facilities of the Fort Sill Military Reservation in order to provide the USAFABD with the capacity to accomplish evaluation of assigned tasks in the areas of field artillery fire direction and target acquisition. Instrumentation employed in the Ballistics Measurement System is primarily military standard equipment. The essential data collected of easting, northing, and altitude of ammunition functioning points, and time of flight. Time of flight instrumentation is adequate for other than base ejection type ammunition, but burst point location is the Board's greatest shortcomming. The USAFABD locates projectile burst points by use of a flash base and a programmable calculator program which reduces the flash ranging azimuths and vertical angles to the grid coordinates and altitude above mean seal level of the burst point. The flash base consists of four observation posts (OP). The M65, Battery Commander Telescope is used as the flash ranging instrument on each OP. It is estimated that each flash ranging azimuth has a tolerance of ± 3 mils and that each vertical angle has a tolerance of ± 5 mils under typical test conditions. These tolerance can be degraded by unknown amounts by exceptionally uncomfortable conditions at the OPs (e.g., extreme heat or cold, strong winds, rain) and turnover of personnel. Each flash ranging instrument in located to within ± 1/4 meter in easting, northing, and altitude.

(b) Existing Capabilities. This system can:

o Provide accuracy test data for test of target acquisition items. Target acquisition items may fall into one or more of the following categories:

- Flash Ranging
- Sound Ranging
- Countermortar Radar
- Counterbattery Radar
- Surveillance Radar
- Battlefield Illumination Devices
- Optical Devices not in the visible spectrum

(c) Existing Equipment. The following table is a list of the equipment employed in this system to accomplish assigned tasks:

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
Renner, Inc. M-18	Plotting Board	1. Used to plot locations made by flash observation posts. 2. Range: 25,000 meters. 3. Scale: 1:25,000. 4. Accuracy: ±0.5 mil.	1 ea
M65	Telescope, Battery Commander	1. Optical instrument used at flash observation posts. 2. Power of magnification: 10X 3. Field of view: 6 degrees. 4. Accuracy: ±3 mils.	6 ea
Developed by the USAFABD	Burst Time Indicator	1. Used to measure projectile time of flight. 2. Direct digital readout. 3. Maximum: 999.999 seconds. 4. Optical Pickup: Infrared sensing device.	1 ea

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
WANG 720C	Programmable	1. Primarily used to compute burst point locations; also time and delayed firing data derived from test information collection sources. 2. 1,984 program step capability. 3. 248 data registers. 4. 5 level subroutines.	1 ea
M13	Gun Direction Computer	1. Primarily used to computer firing data for field artillery cannons and rockets from information defining and weapon locations. 2. Also used to compute solutions to survey problems, reduce meteorological data, reduce flash data, chronograph muzzle velocity) solution and plan fires and counterbattery operations.	4 ea
Lear Siegler M-90	Chronograph, Radar System	1. Used to measure muzzle velocity. 2. CW Doppler Radar System. 3. Frequency: 10,525 mc 4. Power: 18 to 30 Vdc 5. Accuracy: + 0.2% 6. Direct digital readout (5 digits).	2 ea
AN/GSQ-64	Signal Data	1. Used with M18 computer to load memory. 2. Used with Computer Logic Unit to read test routines from tapes.	2 ea
TT-98B/FG	Teletypewriter	1. Used with M18 computer as output device.	4 ea

(2) SURVEYING SYSTEM.

(a) Physical Description. This system uses optical and electronic survey equipment to provide the USAFABD with the capability to complete assigned tasks in the field artillery survey area and to provide survey information to support any assigned task requiring survey support.

(b) Existing Equipment. The following is a list of equipment employed in this system.

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
Wild T-2	Theodolite. Universal	1. Used to determine horizontal and vertical angles. 2. Magnification: 28X. 3. Objectives lens: 40-mm. 4. Field of view: 29' at 1,000'. 5. Accuracy: +0.4 sec of circle reading.	2 ea
Applied Devices Corp DME (Distance Measuring Equipment), Inc., Model 99	Surveying Instrument, Distance Measuring Equipment	1. Measuring device. 2. Range capability: a. Minimum: 200 meters. b. Maximum: 50 kilometers, approximately 35 mils. 3. Accuracy: 1:250,000.	2 ea
Scientific Instruments of Wisconsin Inc.	Light Signal Surveying	1. Used to illuminate surveying targets during night surveying operations. 2. Power requirements: up to 6 vdc.	2 ea
Hamilton Model 22	Chrometer, Time Measuring Device	1. Used to take astonomic observations. 2. Graduated to 0.1 sec.	1 ea
Hewlett-Packard 9815	Surveying Calculator	1. Programmable primary for traverse, radial survey, coordinate geometry, etc. 2. Self-guiding display. 3. Stores 2,000 coordinate pairs. 4. 115v ac 60Hz.	
Hewlett-Packard 9871A	Character-Impact Printer	1. Full page data output. 2. Field data traverse. 3. Field data dog legs. 4. Radial surveying. 5. Transformation. 6. 115v ac 60 Hz.	
Texas Instrument Model SR56 Model SR57	Pocket Calculator	1. Used in survey computations. 2. 9 digits. 3. 9 memory banks. 4. Programmable.	1 ea
ML-102 P/O AN/TMQ-4A	Barometer	1. Used to measure atmospheric pressure. 2. Aneroid, portable, precision. 3. Range: 22 - 21.5 inches of mercury. 745 - 1085 milibars.	2 ea
Hewlett-Packard	Distance Meter	1. Medium range electronic distance measuring equipment.	2 ea

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
3808A		2. Range capability: 10km. 3. Accuracy: + 5mm/km. 4. Utilizes prism reflectors.	
Hewlett-Packard 3810A	Total Station	1. Short range electronic distance measuring equipment. 2. Range Capability: 1.6km. 3. Accuracy: ±5mm/km. 4. Utilizes prism reflector.	1 ea

b. Timing. Timing based on local reference.

c. Television. (see photography, paragraph 4.d)

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
5332A Hewlett-Packard	Counter	1. Will measure frequency from 0 to 2 MHz. 2. Time interval from 0 to 999.99 seconds.	1 ea
MDA 5001 Model	PreAmplifier	1. HiGain, Low Noise range: 500 - 1000 MHz 43 db Gain, 6 db Noise figure.	1 ea

d. Photography.

(1) Physical Description. The Photo and Graphics Shop is a support facility for the USAFABD and provides the USAFABD with support in the photographic and graphic illustration area. The Photo and Graphic Shop is located in Building 1655 at Fort Sill. Shop space for the Photo and Graphics Shop is adequate for present and foreseeable future requirements.

(2) Existing Capabilities: This system can:

a. Provide photographic support necessary to support the missions of the USAFABD, to include still, motion picture photography and video tape.

b. Assist in preparation of charts, illustrations, graphs, and other graphic devices requiring work of a draftsman or technical illustrator.

c. Provide limited printing capabilities to the USAFABD for test plan/reports reproduction.

(3) Existing Equipment. The following table is a list of the equipment employed in this system to accomplish assigned tasks.

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
Graflex KS-4A	Camera, Graphic,	1. Used in studio and to photograph equipment for EPR's.	1 ea

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
	4 x 5	2. Lens: f 4.5. 3. Speed: Time exposure to 1/400 sec.	
Singer Graflex KS-98-A	Camera, Graflex XL	1. Used to photograph equipment for EPR's. 2. Lens: a. f 2.8 - 80mm. b. f 4.8 - 180mm. c. f 5.6 - 58mm. 3. Speed: Time exposure to 1/400 sec.	1 ea
Burke and James KS-17A	Camera Set Still Picture	1. Used to take studio photographs.	1 ea
Burke and James KS-7-1	Camera Set, Still Pictures	1. Used to copy charts and photography. 2. Lens: f 4-5 305mm.	1 ea
Ernst Leica KS-15-3	Camera Set, Still Pictures	1. Used to take color slides of equipment. 2. Lens: a. f2-50mm. b. f3.3-35mm. c. f4.5-135mm 3. Speed: Time exposure to 1/1000 sec.	1 ea
Rodenstock-Grandagon	Lens, Camera	1. Used as wide angle lens for Graflex XL. 2. Lens: f5.6-58mm. 3. Speed: Time exposure to 1/500 sec.	1 ea
Zeiss-Sonnar	Lens, Camera	1. Used as telephoto lens for Graflex XL. 2. Lens: f4.8-18 0mm. 3. Speed: Time exposure to 1/500 sec.	1 ea
Wollensak LE-6	Lens, Camera	1. Used as wide angle lens for PH-104. 2. Lens: f6.8-90mm. 3. Speed: Time exposure to 1/400 sec.	1 ea
Wollensak LE-2	Lens, Camera	1. Used as telephoto lens for PH-104. 2. Lens: f4.5-254mm. 3. Speed: Time exposure to 1/1000 sec.	1 ea
Polaroid 100	Camera Polaroid w/Flash Attachment	1. Used on test projects when photographer is not available.	2 ea

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
Graflex KS-4A-2	Camera Graflex 4 x 5	1. For use in taking EPR's and still pictures.	1 ea
Hycam Model 41-004	Camera 16mm	1. Used for high speed photography. 2. Frame rate of 20 to 11000FPS. 3. Lens: 1"FL, F1.4. 4. Lens: 2"FL, F1.4. 5. Lens: 4"FL, F2.8. 6. Lens: 8"FL, F3.5.	2 ea
Sony Model #AV-3400/ AVC-3650	Camera Video	1. Used for field instrumentation and data reduction. 2. Lens: Zoom 64mm F.20. 3. Lens: Wide Angle 12.5mm F1.9. 4. Lens: Telephoto 75mm.	2 ea
Sony Model #AVC-3210DX	Camera Video	1. Used for field instrumentation and data reduction. 2. Lens: Zoom 64mm F.20. 3. Lens: Wide Angle 8.5mm F1.6.	2 ea
Ampex QM 902	Monitor, Video, 18"	1. Used with CC 6007 camera.	2 ea
Bolex 16mm	Camera, Motion Picture	1. Used to make motion picture film clips for projects.	1 ea
Omega 200	Camera, Still, 2 1/4 X 2 3/4	1. Field camera lens 90mm f3.5 speed 1/400 sec.	
Honeywell Pentax Spotmatic	Camera, Still 35mm	1. Used for mobility in field for taking black and white and color 2. Field camera lens 50mm f1.4 1/1000 sec.	1 ea
Sony AVC-3650	Video recorder	1. Used for editing and playback of video tapes for obtaining visual data during tests. Can be used in field environment with generators.	3 each
Addressograph Multigraph Corp, Multilith Model 2656	Offset Press	1. Used for printing test reports and SPR's.	1 ea
ITEK Business Products, Plate-	Plate Maker	1. Used for making plates to support printing requirements.	1 ea

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
master Model 12.18			

e. Instrumentation Cabibration Capabilities.

(1) Physical Description. The Electronic Test Shop is a support facility for the USAFABD and provides the USAFBD with support in the electronics area. This shop is located in Building S1508 at Fort Sill. Shop space is presently adequate.

(2) Existing Capabilities. This system can:

Provide limited direct support, and general support maintenance for all tests items of an electronic nature.

Provide direct support for all test support and Table of Allowance equipment assigned to the USAFABD.

Provide limited comparative calibration of electronic test equipment when calibration through normal channels is not possible.

(3) Existing Equipment. The following is a list of the equipment employed in this system to accomplish assigned tasks.

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
AN/URM-25F	Signal Generator	1. Frequency Range: 10 KHZ to 50 MHz in 9 bands. 2. Type emission: AM & CW. 3. Modulation: a. 400 - 1000 Hz. b. 0 to 80% 4. Voltage: 0.1 microvolt to 0.1 v.	1 ea
FR-126/U X532A/B Hewlett-Packard	Wave Meter 12.4 GHz	1. Mounts tc wave guide. 2. Frequency range: 8.2 - 12.4 GHz. 3. Direct reading.	1 ea
430C Hewlett-Packard	Microwave Power Meter	1. Power range: a. 0.1, 0.3, 1, 3, and 10 miliwatts. b. -20 - +10 dbm. 2. Accuracy: +5% of full scale. 3. Frequency range: Dependent on type of bolometer used.	1 ea
AN/USM-81 Tektronix 535	Oscilloscope	1. Frequency range: dc to 10 MHz. 2. Dual trace: 100 KHz chopped or alternate sweep.	1 ea

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OPERATIONAL TEST INSTRUMENTATION GUIDE.(U)
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MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS
		3. Calibrated sweeps. 4. Plug-in Unit: Type CA, .05 - 10 v per centimeter. 5. IL20 Plug-in Spectrum Analyzer Frequency Range 10 MHz - 4.2 GHz in 5 bands. 6. IL40 Plug-in Spectrum Analyzer Frequency Range 1.5 GHz to 12.4 GH in 3 bands.
WV-98A RCA	Voltmeter	1. ac and dc: 0 - 1500 v, six ranges. 2. Resistance: 0 - 10 megohms, five ranges. 3. Vacuum Tube Voltmeter, center zero capability.
TV-7 Hickok	Test Set	1. Electron Tube Tester, military version.
TS-352/U Phaostron	Multimeter	1. Ranges: a. 0 - 5000 vdc, seven ranges. b. 0 - 10 adc, eight ranges. c. 0 - 30 megohms, five ranges. 2. Accuracy: $\pm$ 3%.
Fluke Model 803B	Differential Voltmeter	1. Voltage range: 0 - 500 v, ac and dc. 2. Accuracy: $\pm$ .01% dc and $\pm$ .05% ac.
Sentinal Electronics, Inc.	Multimeter	1. Range: a. 0 - 1000 vdc. b. 0 - 300 vac. 2. Range resistance: 0 - 500 megohm 3. Range frequency: 20 HZ to 700 MH
Hewlett- Packard 5245L	Counter, Voltmeter	1. Range: 0 - 50 MHz. 2. Gate Time: 1 msec to 10 sec in decade increments. 3. Accuracy: (0° - 50°C): a. $\pm$ 0.1% of reading. b. $\pm$ 0.1% of full scale. 4. Input resistence: 10.2 megohms.
Hewlett- Packard 5253B	Converter, Frequency (Plug-in)	1. Used with HP 5245L 2. Range: 50 - 512 MHz. 3. Input voltage: 50 mv to 1 v rms.
Hewlett- Packard	Time Interim Unit	1. Used with HP 5245L. 2. Range: 1 msec to 10^8 sec.

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
5262A	(Plug-in)	3. Accuracy: ± 1 period of standard frequency counted, ± time base accuracy.	
MX-3667/U	Probe, Wave Guide	1. Frequency range: 8.2 - 12.4 GHz. 2. Wave guide size: 1 inch X 1/2 inch. 3. Wave guide type: RG-52/U.	1 ea
Photo-Research Micro-Canella	Meter, Light	1. Range: 10 - 10,000 microfoot-candles. 2. Portable.	1 ea
Trygon H-0-7.5 BOV	Power Supply	1. Output: 0 - 40 vdc at 7.5 amps. 2. Constant voltage mode with adjustable current limiting unit.	1 ea
Tektronix 453	Oscilloscope	1. Frequency range: 0 - 50 MHz. 2. Dual trace. 3. Calibrated sweeps.	1 ea
FE-124 Sencore, Inc.	Field Effect Voltmeter	1. dc voltage range: 0 - 1500 v. 2. ac voltage range: 0 - 1500 v. 3. Resistance range: 0 - 6000 megohms.	1 ea
Model 43 Thruline	Wattmeter	1. RF power range: 5 - 5000 watts. 2. Frequency range: 2 - 1000 MHz. 3. Accuracy: ± 5% of full scale.	1 ea
3300A Hewlett-Packard	Function Generator	1. Used for General Purpose Frequence Testing. 2. Selection Switch for three wave forms: Sinusoid, Square, and Triangle. 3. Frequency range: 0.02 Hz to 100 Hz in seven decade ranges.	1 ea
3302A Hewlett-Packard	Trigger/ Phase Lock Plug-in	1. When inserted into the function generator the unit permits single cycle, free run and Phase Lock Modes of Operation.	1 ea

f. Other General Instrumentation. None.

g. Special Purpose Instrumentation. Electronic clipboards.

(1) Physical Description. An electronic clipboard that is hand held, battery operated and can be used in remote sites for collecting test data.

(2) Existing Capabilities. This system provides the USAFABD with a system for collecting and storing raw data for direct transfer to a computer

system.

(3) Existing Equipment.

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
Kaman Sciences Corporation ADES-1	Electronic Clipboard	Storage capacity for 8 hours, internal clock for time stamping entries, direct interface with data terminal/	30
	Interface Computer	Interfaces the electronic clipboards to the WANG computers so that data can be transferred from the electronic clipboard to the WANG system.	1

5. Threats/Targets.

a. Ground. None listed.

b. Airborne. None listed.

6. Data Handling/Processing.

a. Data Collection. Manual and electronic.

b. Quick-look capabilities - WANG 2200 MVP.

c. Processing.

(1) Physical Description. There is a standard WANG computer system located at the USAFABD.

(2) Existing Capabilities. This system provides the USAFABD with the capability of reducing and correlating raw test data, substantially reducing time and manpower needed for test and evaluation.

(3) Existing Equipment. The following table is a list of the equipment employed in this system to accomplish assigned tasks:

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
WANG Laboratories Inc.	2200 MVP Central Proc. Unit	256K memory	1 ea
WANG Laboratories Inc.	A-Option Extended Configuration Chasis	Allows add on of equipment.	1 ea

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
WANG Laboratories Inc.	Part No. V64256	Memory upgrade 64K to 256K	1 ea
WANG Laboratories 2236 MXD4	4 Part Terminal Mutiplexer	Mutiplexes interactive terminals into the CPU.	1 ea
WANG Laboratories 2236D	Interactive Terminal	User's principal means of controlling system CRT and keyboard.	4 ea
WANG Laboratories 2244B	Card Reader	Hopper feed mark sense/punch card reader with controller.	1 ea
WANG Laboratories 2272-2	Plotter	Triple Pendrum Plotter.	1 ea
WANG Laboratories 22C02	Printer/Drum Plotter/ Controller	Controls line printer and drum plotter.	2 ea
WANG Laboratories 2260BC-2	Solid Disk Drives	Fixed/removable disk units containing a pair of disk platters and 20 megabytes memory each.	2 ea
WANG 2230 MXA-1	Master Daisy Chain Mutiplexer/ Controller	Selective control of solid disk drives.	1 ea
WANG 2270-2	Diskette Drive	Dual removable diskette drive.	2 ea
WANG 2263-2	Printer	Impact printer W1 chain type carrier 600 LPM.	1 ea
WANG 2228B	Telecommunicators Controller	Bisychronous.	1 ea
WANG 2221 W	Printer	Matrix printer - 60 LPM.	1 ea
WANG 2220 PCSII A-B	Computer	Single diskette drive, keyboard, disk multiplex feature and 32K bytes memory.	1 ea
WANG Option 101	Diskette Drive	Additional diskette for PCS II.	1 ea
WANG Option	Communications	Bisychronous.	1 ea

MANUFACTURER AND MODEL	ITEM	CHARACTERISTICS	QTY
62B	Option		
WANG Special Product No. 9092	RS232C Serial Interface	For the serial interfacing of peripheral equipment.	1 ea

d. Distribution - see above.

e. Displays - see above.

ANNEX O -BIBLIOGRAPHY

Reference Documents

1. Safety Post Range Regulations, April 1976, USAFACFS Reg. 385-1.

2. Organizational and Functions, USAFABD Organization Mission and Functions Publication, June 1980. USAFABD Regulation No. 10-1.

3. Annual Utility Survey of Fort Sill, October 1979. (Excerpt B)

4. U.S. Army Test & Evaluation Command Instrumentation Master Plan, January 1974.

5. Analysis of Existing Facilities Fort Sill, Okla., January 1978.

6. TECOM Instrumentation Register, September 1979, Section 1.

7. Climatological Data.

Reference Maps

8. Dallas - Fort Worth FAA Map

9. Appendix A of Safety Post Range Regulations - Map of Fort Sill Military Reservation

OPERATIONAL TEST INSTRUMENTATION GUIDE

OTEA

US ARMY OPERATIONAL TEST AND EVALUATION AGENCY
5600 COLUMBIA PIKE
FALLS CHURCH, VIRGINIA 22041

NOVEMBER 1981

ANNEX P

OPERATIONAL TEST INSTRUMENATION GUIDE

AIR FORCE ARMAMENT DIVISION (AD)
Eglin Air Force Base, Florida
(and 6585th Test Group, Holloman AFB, New Mexico)

COMMENTS - ANNEX P

ANNEX P

AIR FORCE ARMAMENT DIVISION (AD)
Eglin Air Force Base, Florida
(and 6585 Test Group, Holloman AFB, New Mexico)

1. Introduction

a. Overview

The Eglin Air Force Base land area is 465,000 acres. Eglin AFB and its satellite installations extend over a large portion of the Northwest Florida Gulf coast. Extensive space and elaborate instrumentation are available for large-scale air and/or ground testing operations. Contiguous areas of the Gulf of Mexico are available for conducting tests which involve surface vessels. The Eglin water test areas are depicted in Figure P-1.

b. Generic Systems Tested

These systems are primarily Air Force systems, with limited joint Service and other Service system testing. Such testing includes:

Nonnuclear munitions and missiles, EW systems, command and control system, target systems, and intrusion interdiction sensors.

Tactical air warfare techniques.

Foreign systems tested have included the British Rapier and the French Crotel Air Defense Missile Systems.

2. General

a. Military Units

(1) Air Force Units

Headquarters, Armament Division (AD)

3246th Test Wing

SAC Project Office

3201st Air Base Group

3205th Maintenance and Supply Group

39th Aerospace Rescue and Recovery Wing (MAC)

919th Special Operations Group (AFRES)(Duke Field)

2nd Weather Squadron (MAC) - Detatchment 10 (Main Field)

3rd Weather Squadron (MAC) - Detatchment 75 (Hurlburt Field)

Tactical Air Warfare Center (TAC)

1st Special Operations Wing (TAC)(Hurlburt Field)
(NOTE: May be able to assist in special operations; they train counterinsurgency aircraft and gunship crews.)

33rd Tactical Fighter Wing (TAC)

823rd Civil Engineering Squadron, Heavy Repair (TAC) "REDHORSE"

834th Combat Support Group (TAC)(Hurlburt Field)

20th Surveillance Squadron (Site C-6)

1972nd Communications Squadron (AFCC)(Main Field)

2068th Communications Squadron (AFCC)(Hurlburt Field)

4751st Air Defense Squadron (Hurlburt Field)

(2) Army Units

Florida Ranger Camp

Corps of Engineers

(3) Nearby Government Installations

Pensacola Naval Air Station (50 miles)

Tyndall Air Force Base (65 miles)

Fort Rucker, Alabama (100 miles)

U.S. Coast Guard Station - Destin (15 Miles)

b. Maintenance Capability

Extensive aircraft (fixed wing) and avionic maintenance facilities are available; also limited helicopter and M-48 tank maintenance.

c. Access

(1) Road

Florida State Road 85 (dual) passes the base entrance.

(2) Air

Eglin AFB (runway length, 12,000 feet); Hurlburt Field (9,600-foot runway). Republic Airways operates to New Orleans, Atlanta, Washington (Dulles), Newark, and other cities from the Okaloosa County Terminal adjacent to Eglin AFB.

(3) Sea

Flat bottom barge accessability, but no deep water port.

d. Logistic Support Capability

There are quarters for 50 transient personnel.

e. Recurring Commitments

The 919th Tactical Airlift Group of the Air Force Reserve is located at Duke Field.

f. Special Operational Restrictions

Eglin AFB is not suitable for extensive tank maneuvers because of the danger of damage to commercially harvested trees. About half of the 465,000-acre reservation is forested.

Controlled access hunting and fishing are perrmitted on the Ehlin Reservation. It should be noted that potential future problems may occur from FAA airway assignments, offshore oil drilling, resort development, and increased on-base logging operations.

g. Environment

Eglin AFB enjoys a mild, subtropical gulf coast climate, with warm days frequent even during winter. Frequent heavy rains occur during winter, occasionally lasting several days. There are occasional morning fogs, but freezing weather is almost nonexistent. The climate is similar to that of New Orleans and the Mississippi/Alabama gulf coast rather than to that of Southern Florida.

h. Topography

Some of the land is flat and some gently rolling; much is covered with woods and scrub vegetation. The Gulf of Mexico/land interface is highly irregular and includes some marshy areas.

i. Airspace Restrictions

Airspace restrictions applicable to AD are shown in Table P-1 and the Eglin AFB Air Corridor map.

TABLE P-1
ADTC AIRSPACE RESTRICTIONS

Area	Altitude Limits (feet)
R2914	0-50,000
R2915A	0-50,000
R2915B	0-120,000
R2917	0-5,000
R2918	0-50,000
R2919	0-50,000
W151	Unlimited
W152	0-24,000
W153	0-24,000
W154	24,000-unlimited
W168	Unlimited
W470	Unlimited

j. Power Availability

Volume II, Land Test Areas of the ADTC Technical Facilities Handbook (see Reference 1) describes power availability at the various sites.

k. Communications

Complete coverage of the operating areas by radio, hardwire and/or microwave systems is available.

3. Dimensions

a. Landspace

(1) Major Test Areas

AD test areas are shown in Figure P-2. The prefix letters ("A" through "D") indicate quadrant locations referenced to latitude 30°30' and longitude 86°30'. Each individual test area operates independently through a central range control located in Building 104 on the Main Base at Eglin. Integration of one or more of the test areas can be scheduled and is accomplished by means of landline and radio communication. The primary uses of these test areas are listed in Table P-2.

(2) Easements

See 2.f., Special Operational Restrictions.

(3) Impact/Live Firing Areas

The Base test areas are shown in Table P-2.

The Eglin Air Force Base complex is in northwest Florida with more than 720 square miles of land test ranges and facilities. The land complex, consisting of the main base and three active auxiliary airfields, measures 51 miles across and 19 miles north to south. The threer areas where ground operations have normally taken place are listed in Figure P-3. Area "B", surrounding the Rock Hill Landing Zone, is in the same general location as the former "underbrush" range used extensively during the SEA conflict to develop new tactics and sensor usage against representative targets and ground environments. There are two helicopter landing pads in this area, and it has been used as an assault landing strip.

The Florida Ranger Camp has used the western area of the Eglin reservation for ground training maneuvers. The 3d Ranger Battalion trains as average of 200 students per month in counterguerilla operations. The only restrictions on maneuvers in the western area, other than standard central coordination, is that impact areas and threat radar sites will be avoided.

b. Airspace

In addition to the many military airfields in the area, the commercial airport at De Funiak Springs (runway length, 3,200 feet) can be used for helicopters exercises.

(1) Landspace/Airspace Relationship

Airspace restrictions over Eglin AFB (see Table P-1 are located over the east and west portions of the reservation, with the portion of the reservation from north to south left open for commercial operations into the Okaloosa County Air Terminal. (Ref Fig P-5)

(2) Easements

There are no easements presently, but there is a possiblity of a future FAA airway assignment.

TABLE P-2

TEST AREA USE

TYPES OF TESTING	
Airborne Optical Resolution Testing	
Airborne Radar Resolution Testing	
Airborne Reconnaissance Equipment Evaluation Tests	
Airborne Scoring System Static Ground Testing	
Aircraft Mounted Gun Testing	
Aircraft-dispensed Submission Testing	C-52C, B-7]
Air Gun Launching of Submunitions	
Air-to-Ground Gunnery Tests	B-5, C-52E/N/W, B-70, B-75
Air-to-Ground Munition Testing (bombs, rockets, napalm & gunnery)	B-12, C-52C/!
Air-to-Ground Tactical Training (gunnery, rocketry & bombing)	B-7, C-52N, C-62, A-7
Air-to-Water Munition Testing (napalm, gunnery & bombing)	
Antirailroad and railroad track munition testing	
Assault Landings, Takeoffs, and Cargo Extractions	B-5, C-5: Landing Zone East and
Adverse Weather Testing of Seekers	
Base and Installation Security Systems	
Drop Zone for Paratroops and Equipment Tests	
Electro-optical Evaluation Testing (laser and infrared)	B-12, A-22, D-51, C-52A
Environment Testing of Fuzes and Submunitions	
Environment Testing of Small Electronic Equipment	
Experiments with Wareheads & Exploring New Weapon Concepts	
Flare Testing	
Fuel Area Munition Testing	D-51, C-64

TYPES OF TESTING	TEST AREAS
Fuze Testing	A-24
Ground Functional Fuze Testing	C-52C
Gun Performance and Ammunition Testing	A-22, C-64 & C-74L
Gun Firing Demonstrations	A-22
Incendiary and Flame Weapons Testing	C-52C, C-52N, B-70, B-71 & B-75
Interior, Exterior and Terminal Ballistic Studies	A-22
Jungle Environment Ballistic Testing	B-76, C-83, Basin Creek, Turtle Creek, and Pocosin Pond
Laser System Weapons Testing	B-12, A-22, D-51, C-52A, B-70 & C-72A
Lethality & Vulnerability of Conventional Munitions	C-80A/B/C
Mine Field Evaluataion Testing	C-2
Munitions Analysis	A-24 & C-74A
Munitions Container Testing	A-28
Munitions Fragment Analysis	C-80W
Munitions Impact Tests	C-74
Nondestructive Testing	A-22
Side Firing Weapon System Testing	B-7, A-77, A-78 & A-79
Static Ejection of Stores & Store Suspension Systems	A-24
Static Munition Testing	B-12, D-51, C-52B, C-61, C-64, B-70 & C-80A/B/C
Terminal Effects & Experimental Testing (bullet impact, sympathetic detonation, booster and heating tests of live high explosive munitions)	C-64
Weapons-Fuze Combination Testing	C-72

TABLE P-3. RADAR INSTALLATIONS

Site	Qty	Radar Type	Band	Modified?	Function	Remarks
A-3	2	AN/MPS-19	E(S)	YES	FIRE	
	1	SADS IV (SS)	H (D)	-	CONTROL	SIMULATOR
A-7	1	SADS I	E/F(C)	-	-	SIMULATOR
	1	LPISS	-	-	-	SIMULATOR
A-11	1	HPISS	-	-	-	SIMULATOR
	1	SADS VIM/A	-	-	-	SIMULATOR
A-13	1	NIKE AJAX	E(S)	NO	TARGET ACQUISITION	SIMULATOR
	2	NIKE AJAX	I	YES	TARGET TRACKING	
	1	NIKE HERCULES	J	YES	TARGET RANGING	
A-134A	1	SADS III	I(D)	-	-	SIMULATOR
	1	SADS V (SS)	H	-	-	SIMULATOR
	1	SADS VIII (SS)	-	-	-	SIMULATOR
A-17	1	SADS II	G(C)	-	-	SIMULATOR
A-19	1	AN/FPS-67B	D	NO	SEARCH	
	1	AN/FPS-6A	E	NO	HEIGHT FINDER	
A-20	4	AN/FPS-16	G(C)	YES	TARGET TRACKING	
A-21	1	SADS IV	-	-	-	SIMULATOR
B-13	1	HAWK (HPI)	-	-	ILLUMINATOR	
C-12	1	AN/MSQ-77	E	YES	TARGET ACQUISITION	
	1	AN/MSQ-77	I	YES	TARGET ACQUISITION	
D-3	2	AN/FPS-16	G(C)	YES	TARGET TRACKING	
C-10	1	AN/FPS-16	G(C)	YES	TARGET TRACKING	

4. Instrumentation (see References 1 and 2)

Current instrumentation is described below. Large-scale instrumentation includes:

Time-space-positioning systems, over both land and water.

Improved L- and S-band digital telemetry systems.

Improved time correlation between telemetry and multilateral systems.

a. Space Positioning and Velocity Vector Determination

(1) Ground Element Tracking

(a) Single Object

See Multiple Objects below.

(b) Multiple Objects

An AN/TPX-42 (L-band) radar mounted on the RAPCON radar at Eglin main can be usedc to scan the whole range. While intended primarily for on airborne elements, the AN/TPX-42 may also be used to locate ground elements on the range. Up to 128 individual objects can be identified.

(c) Relative Position (Miss-Distance)

No suitable instrumentation is currently on-hand.

(2) Airborne Element Tracking

(a) Radar

The primary tracking radar subsystems, located at four sites (A-3, A-20, C-10, D-3), generate object position data in digital and analog form. The radars used are seven AN/FPS-16, one FPQ-13 (C-band), and three AN/MPS-19 (S-band). The latter type is highly modified WW 11 SCR-584 fire control radar. Remote site selection is accomplished from Master Site A-20.

(b) Laser Tracker

One mobile laser ranging tracking cinesextant (LRTC) is presently operational and can be deployed through the reservation or at other locations throughout the world. The LRTC provides a precision optical time space position measurement of aircraft and various munitions. One additional unit will be operational in May 1980.

(c) Optical

1 Cinetheodolites

There are 30 Contraves cinethodolites which are deployed throughout the AD test areas in 34 fixed installations and three mobile units. The cinetheodolite inventory is broken down as follows:

Six Model EC Digitized.

Fourteen Model E Digitized.

Eight Model FC Digitized.

Two Model C Analog

2 Operational Aids

There are M-2 and M-51 trackers, cinetheodolites, transits, and the skyscreen (a VHF CW interferometer tracking system).

3 Multiplane Harp

A multiplane harp is slighting instrument used at air-to-ground ranges to guide aircraft into the proper delivery conditions for munitions tests and evaluation of weapon system tactics.

(d) Relative (Miss-Distance)

DIGIDOPS is now in use on drone targets. A vector miss-distance system is under development.

(e) Airborne-to-Ground Target Matching (see Reference 1)

Various types of indivisual aircraft cameras and camera pods are available. Some aircraft assigned to Eglin are equipped with onboard TV monitors and video tape recorders, used in conjunction with missile or aircraft-mounted TV cameras.

b. Timing

(1) Primary

There are 25 AD test sites equipped with Inter-Range Instrumentation Group (IRIG) Standard Time Code Generators, each independently synchronized to LORAN-C transmitted signals.

(2) Secondary

IRIG time is also transmitted from Eglin Main Base by VHF radio, servicing approximately 120 land receivers and 22 airborne receivers. The radio transmission also includes shutter pulses and timeing information for use on Contraves cameras.

c. TV Equipment

In addition to the airborne TV systems mentioned previously, there are ground TV installations at Eglin AFB used for various missions including:

Ground RPV control.

Lethal munitions surveillance and handling.

Reception, presentation, and recording of TV signals from aircraft.

Transmission of TV signals to aircraft.

Long-range, low-level automatic TV tracking (from Sites B-4B, C-10, A-20, and D-3) of munitions release and rocket liftoff.

TV remote control operation of four cinetheodolites at Test Area C-72.

d. Photography

(1) Motion Picture Capabilities

(a) How Presently Used

The uses of picture equipment at AD include:

Acquisition of time-space-position data through the use of cinetheodolites.

Engineering sequential photography through the use of wide variety of camera/lens combinations, including ultra-high speed cameras with frame rates to 2.4×10^6/sec (Beckman/Whitley Model 189). Mobile trackers with camera mounts are available.

Documentation photography, using numerous types of equipment, including the mobile trackers also used for engineering sequential photography.

Instrumentation calibration and alignment.

(b) Designed Operating Environment

Both ground and airborne motion picture camera systems are available. Additional photo information or technical advice can be obtained by writing 3246th Test Wing/TERP, Eglin AFB, Florida 32542, or call Autovon 872-4351.

(c) Film Developing Capabilities

Complete capability for still and motion picture film,, color and black and white, is available at the photo laboratory. A photographic camera and audiovisual equipment maintenance capability is also available.

(2) Airborne Capabilities

Several types of airborne cameras are available at Eglin AFB.

e. Instrumentation Calibration Capabilities

These include the Precision Measurement Equipment Lab (PMEL), which has authorized standards with calibration traceable to the National Bureau of Standards (NBS) and the Headquarters, Aerospace Guidance and Meteorology Center (AGMC/AFLC), Newark AFB, Newark, Ohio. Calibration scheduling is computerized. Specal calibration equipment with a beacon and synchronized strobe light to facilitate calibration of range space positioning instrumentation. Laser sensor calibration instrumentation is available.

f. Other General Instrumentation

(1) Telemetry

The AD telemetry complex operates from several strategically located sites, separated by distances up to 125 miles. Automatic (16- and 8 foot dish), manual (2-foot dish), and fixed widebeam antenna systems with associated real time FM/PAM/PCM data processing equipment are located at fixed and mobile facilities, Site B-4A (Bldg 5203), Bldg 130 (Penthouse), Mobile TM Van, and Site A-15A (Bldg 12550). All facilities are capable of receiving data transmitted in the 1435 to 1535, 2200 and 2300 MHz frequency bands. The range is being implemented to support secure telemetry. More complete information is contained in Reference 1.

(2) Meteorological

Available instruments meet the requirements of AWS 104-3, "Environmental Measuring Equipment Used by Air Weather Service in Support of Air Force and Army" and IRIG D110-71, "Reliability and Meteorological Data."

In addition, the first of two Mobile Meteorological Measurement Systems is nearing completion. These systems will monitor special local meteorological conditions affecting transmission of infrared or millimeter wave radiation through the atmosphere so as to evaluate the performance of IR and millimeter wave missile seekers designed to operate in adverse weather.

(3) Radio Frequency Interference/Electromagnetic Compatibility

Radio frequency monitoring capabilities inclued a fixed installation at Site A-6 and a semimobile van at Site D-3, each with a frequency coverage from 15 KHz to 10.75 GHz. There is also a fixed site at A-6 with frequency coverage from 20 Hz to 18 GHz and a mobile chase van.

(4) Electro-Optical Instrumentation

AD has extensive instrumentation facilities to support operational test activities for Laser Guided Weapons, Air-to-Air Infrared Guided Weapons, Air-to-Ground Imaging Infrared Weapons, Television Guided Weapons, and Optical Counter-countermeasure evaluation of all the obove type systems. Facilities include completely equipped laboratory, field measurement, and airborne measurement and support capabilities. Those facilities directly applicable to Operational Test Support are listed below.

(a) Laser Support

Instrumentation to measure laser spot location, power, and time parameters is in routine operation for evaluation during DT&E tests and for groundtruth monitoring during OT&E tests.

Laser and elecro-optical sensors mounted in pods are under test at AD. Instrumenation is available for measurement of laser intensity, pulse spacing, etc.

Grond based instrumentation at AD includes:

Three Laser Support Vans which can measure laser intensity, pulse spacing, spot postition, etc, for testing either airborne or ground lasers.

Several eodyium YAG pulsed, codeable lasers for testing laser seekers.

A precision controlled 26-foot square mobile Infrared Resolution Target System for testing airborne infrared imaging systems operating in the 8 to 14 micrometer range.

Various imaging and nonimaging radiometers for making ground truth measurements at various wavelengths from visible to 14 micrometers.

Instrumentation to produce laser target scenarios for laser guided weapons testing is in place. Practically any type of laser scenario can be produced for DT&E, OT&E, and counter-countermeasure testing.

Laser laboratory facilities including laser instrumentation standards, parametric measurement instrumentation, instrumentation development and modifications, and laser beam diagnostic measurement equipment are in routine operation.

A laser simulator facility capable of producing realistic laser scenarios under computer control and a multigimbal flight motion table operating under computer control is available. The facility is available for parametric measurement, preflight, envelope determination, fault isolation, and counter-countermeasure experiments.

(b) Infrared Support

Instrumentation to completely describe the infrared radiation from ground targets, ground backgrounds, and composite scenes is available in a portable configuration. Instrumentation is available for spectral measurements, band radiometric measurements, spatial measurements and general ground-truth monitoring. Standard controlled infrared radiation arrays and real-world targets with accurate monitoring instrumentation are available in mobile configuration.

Air-to-air and air-to-ground infrared instrumentation is available for radiometric measurements, spatial measurements and captive carriage of infrared guided seekers for lock-on, midcourse, and terminal tractking evaluation.

(c) Photometric Support

Ground-truth measurement instrumentation for visible and near infrared portion of the electromagnetic spectrum is in operation. Instrumentation consists of low-light level photometric, spectrometric, and photographic types.

(5) Safety and Security

Instrumentation includes:

Two radars (AN/FPS-67B, GPN-12) to provide airspace surveillance of the Eglin test area.

A control center that be used in the future for range safety, with its associated IBM 360/65 computer, feeding one of the two CDC 6600 computers at AD.

The possibility of future use of unmanned radars on towers for range surveillance and tracking.

(6) Soil Conditions

Soil analysis is performed by the Army Waterways Experimentation Center, Vicksburg, Mississippi.

g. Special Purpose Instrumentation

(1) Ballistic Data

AD has comprehensive facility and instrumentation capability to obtain blast and fragmentation characteristics data for weapons effects and safe separation analysis of high explosive warheads and dispenser/ submissions.

AD has comprehensive facility and instrumentation capability to obtain gun and projectile data while performing static test firings both in single shot and burst firing modes. High explosive impacts, armor piercing and practice munititions up to 40 millimeter may be evaluated.

A 750-foot indoor gun projectile facility can provide precise positional and angular measurement of projectile trajectories from which aerodynamic parameters may be determined.

(2) Environment Chambers

The climatic complex at Eglin AFB consists of 11 testing chambers, the largest of which has a volume of 3,300,000 cubic feet. Environmental conditions that can be produced include sand, dust, moisture, precipitation, salt spray, and high humidity. Temperatures in the main chamber can be varied from -65° to +165°F.

(3) Vehicle Test Facility

The engine and equipment test facility (part of the climatic complex), while intended primarily for environmental testing of turbojet engines, is sufficient large to permit environmental testing of vehicle performance.

(4) Tower Test Facility

A 300-foot tower is available for mounting test items such as seekers, lasers, radiometers, etc. A turntable near the base of the tower is capable of rotating large tanks for signature measurements.

(5) Security Systems

The Security Systems Test Facility at Test Area C-3 (Fld No 2) provides a dedicated test area for the evaluation of physical security equipment. The test site provides a realistic operational environment in which to perform tests on security equipment and systems. The tests range form conceptual evaluations to engineering and development model testing to full-scale production item testing.

5. Threats/Targets

a. Ground

(1) Electromagnetic

The Electromagnetic Test Environment (EMTE) generates a "hostile" electromagnetic using radars and radar simulators.

Fixed installations: See Table P-3, Radar Installations; and Figure P-4, EMTE Map, July 1979.

Mobile "Victim" Radars:

WEST I	WEST IV
WEST IA	WEST VA
WEST IB/IC	WEST X
WEST II	WEST XI
WEST III	

The Threat Environment Simulation Capability is designed to simulate a target or jammer on the scope of a threat radar. It is now operational at the AD Computer Science Laboratory.

The Synthetic Radar Target Range (SRTR) contains various targets used to evaluate radar performance.

(2) Weapons

Remotely Controlled Armored Target Facilities

M48 tanks and M42 mortar carriages are the principal armored target vehicles remotely controlled at AD. Control from either a helicopter or a tower is possible.

A few P-band (455 MHz) remote control kits (Types ARW-56/65) are on hand. These are old kits salvaged from aircraft. Unit cost is about $5,000. To install a kit in an M48 tank using locally fabricated mounting brackets requires about 12 hours.

Ten C-band (4400 MHz) remote control kits on hand. These are newer that the above items and cost and installation time is about the same. Ten channels of On-Off type commands are provided.

AD also has a remote control wire guided system. The vehicle will follow the pre-laid wire with installed speed commands built in the wire path. Speed commands can also be given from the control console. Time to install the wire path is the pacing item. Onboard equipment cost will be about $10,000. Eight kits are available. If live and damage assessment are contemplated, consider the costs of the remote control unit because of its potential destruction in the test.

A large remotely controlled vehichilar track is available on Test Area C-72. Radar is used to control the speed of an object traveling along the track. The target element must use a beacon to facilitate radar tracking.

TV for vehicle control is being used as requirements dictate.

(3) Radiological Environment

No radiological testing is undertaken at AD.

b. Airborne

Electomagnetic.

Airborne Beacon Simulation (AIBES) is a threat simulation designed for aircraft pod mounting. It has a data recording capability.

6. Data Handling/Processing

a. The AD Computer Science Laboratory (Reference 3) provides data storage and retrieval services, such as:

(1) Film and Oscillograph Reading

Information can be extracted from film and oscillographs and automatically processed.

The data may be recorded on tape on the test vehicle, telemetered to the ground and recorded, or fed directly to Telemag. The Telemag Facility equipment include:

Analog tape machines, 1/4", 1/2", and 1".

Digital tape machines, 1/2" industry-compatible.

Analog signal input capabilities

Digital/analog and analog/digital converters.

Readout devices including stripchart recorders, oscillographs, plotters, and digital tape playback.

PDP-15 digital computer with peripherals.

b. Quick-Look Capabilities

Data from selected Primary Tracking System and Electromagnetic Test Environment (EMTE) radars are fed through the Real-Time Input-Output Terminal Unit (RIOT) subrouting to a CDC 6600 computer with a CRT display. Eleven radars can feed data simultaneously.

c. Processing

The Computer Science Laboratory has the following computers:

Type	Primary Function(s)
CDC 6600 (2)	Primary system for all ADTC scientific computing.
PDP 15 (2)	The primary telemetry computer, handles PAM, PDM, PCM.
Burroughs 3500	Base management support computer.
IBM 360/65	General purpose computer.

Airborne radar data are processed by the 360/65 computer. The real-time data link to the master telemetry site (B-4A) and the Advanced Research Projects Agency (ARPA) network at AD are operational.

Figure P-6 shows a block diagram of the AD computer complex. One CDC 6600 is a secure computer (System 1); the other is used for unclassified material only (System 11). The 360/65 is used as a buffer for the unclassified 6600. The 360/65 furnishes test management displays and range safety plotter information in real-time. Telemetry digital information and radar information are fed into the 360/65 computer.

7. Improvements/Modernization Planning

The following range improvements and modernization plans were obtained from the material contained in Reference 4. Since the nature of Reference 4 is a planning document, the information provided in the paragraphs to follow may be subject to change and should be considered generally as a guide to the direction of the proposed range improvements efforts.

a. AD Mission Support (FY 80-85)

Specific actions proposed are special telephone service for procurement and for the control tower for upgrading the tele-autograph system for disseminating weather information, for funds for Class A tolls, telephone calls, and for upgrading the teletypewriter.

b. Armament System Test Environment (ASTE)

ASTE provides the test support capability for the development and evaluation of nonnuclear air-delivered munitions. Emphasis on development of guided weapons continues to influence the instrumentation configuration and test requirements for ASTE, with unguided munitions and submunitions having a smaller but significant impact on the ASTE capabilities. The direction being taken to date is to provide instrumentation support for this development in the areas of laboratory and ground simulations as will as real-world testing of the developmental items. Continued buildup of the Seeker Evaluation Test Simulation Facility (SETS) is planned and will significantly reduce required airborne and live firings of guidance systems while producing real-world data that describe radiometric and spatial characteristics of a target. A totally new technical capability for millimeter wave is being developed to provide target signature characterization, atmosphere absorption and scatter measurements, meteorological measurements, and countermeasures equipment. It is planned to replace obsolete UHF remote control equipment and to provide new multiple target remote control of targets during a variety of test scenarios. Improvements in the accuracy and launch to impact TSPI and attitude data are planned by augmentation of existing cinetheodolite optical TSPI systems with mobile laser ranger tracking precision tracking mounts. Support system such as data handling, telemetry, communications, and command and control will be augumented to provide and integrated range controlled and operated from the new Centralized Control Facility (CCF).

c. Electromagnetic Test Environment (EMTE)

Upgrading of existing simulations and/or acquisition of new simulations is continuing. A continued effort toward integrating new system, modernizing the instrumentation and developing new equipment to replace obsolete units is also planned.

d. Multipurpose Range Instrumetation

This category instrumentation such as TSPI radars, telemetry, intrarange communications, etc. used jointly by ASTE and EMTE. Effective collection and retrieval of test data are largely dependent on maintaining modern equipment/instrumentation. Most requirements for techical equipment are to update and/or replace obsolete/deteriorated telemetry equipment, TSPI radars, time code generators, TV recorders and reproduction equipment, visual coundown systems, and range slaving equipment. Two lightweight, small portable, self-contained, accurate digital instrumentation radars (DIR) are planned to provide quick response to testing of future air armament systems. The most significant item is a deployable gulf test range instrumenation system to provide TSPI and scoring on air-to-air and air-to-surface missile test over the Gulf of Mexico. This system will extend the present capability which limits testing to within five miles off shore. The TM data transmission system and wide band terminal system on land ranges and the island sites need to be upgraded to be more reposnsive to future test requirements. To function properly under the newly authorized frequency bands, the command, control, and destruction capability of various sites must be modified.

e. Computer Science Laboratory

The Computer Science Laboratory is programming the replacement and/or upgrading of some obsolete items. A minicomputer to handle data collection, formating, and preprocessing is required to reduce the workload on the main computer. Magnetic tape recorders to reproduce data on "high band" recorders used throughout the area are necessary to improve the efficiency of test data reduction. Communication lines to interface remote equipment with the AD central computer are to enable test engineers to use the remote, teleprocessing method of data processing instead of the old punched card/listed output method. Automatic data processing equipment needed to effectively support all aspects of data processing activities includes interactive remote terminals, minicomputers, workload sharing/networking, mass data storage, man-machine communications methods, remote terminal system hardware upgrade, extended core storage, random access storage, microfiche, and replacement of outdated computer systems.

f. Photographic Laboratory

Rapid advances in photographic technology continue to provide sources for new and better equipment. The Photographic Laboratory supports nearly every test program as well as normal base photographic services to AD and tenant units. Consequently, there is a need to repair the facility and replace the photolab equipment. Included in this five-year equipment program are requirements to upgrade/replace color film processors, projectors, printers, still and motion picture cameras, reader conversion kits, ultrasonic cleaning machines, a video tape recorder, and other photographic equipment.

g. Climatic Laboratory

The Climate Laboratory has annual equipment requirements of approximately $150,00 for replacement/upgrading obsolete items.

h. Detachment 10, 2nd Weather Squadron (MAC)

Two specific items that would be operated by the weather detachment are identified. A system for measuring atmospheric parameters which affect electro-optical propagation and an improved low-level atmostpheric sounding system to obtain meteorological test data from the surface to 30,000 feet will enhance AD test support capability.

6585th Test Group
Holloman AFB, New Mexico

In addition to the facilities available at Eglin AFB, the following capabilities are available from the 6586th Test Group assigned to the AD.

1. Introduction

a. Overview

The 6585th Test Group is assigned to the Armament Division at Eglin Arif Force Base, Florida, but is located at Holloman Air Force Base, New Mexico.

b. Generic Systems Tested

The primary systems tested by the 6585th are:

Aircraft Navigation Systems

Missile Guidance Systems

Air Launched Missiles

c. Nearby Government Installations

WSMR, New Mexico

Fort Bliss, Texas

2. General

a. Military Units

(1) Air Force Units

49th Tactical Fighter Wing

6585th Test Group

(2) Army Units

Frequency Control & Analysis Unit (WSMR)

Transponder Group (WSMR)

Frequency Liaison Officer (WSMR)

b. Maintenance

Normal operational and transient maintenance is performed by the 49th TFW at Holloman.

c. Access

(1) Air

The nearest commercial air transportasion to Holloman AFB is El Paso International Airpost (logest runway, 12,100 feet) and Alamogordo Municipal Airport; Military and DOD aircraft may utilize Holloman AFB (longest runway 12,200 feet).

(2) Water

There is no water access.

(3) Rail

The Santa Fe Railway provides freight service to Alamogordo.

(4) Road

U.S. Highways 70 and 54 Interstate 25 (U.S. 85) provide Holloman AFB highway access.

d. Logistics Support

Logistics support is provided by the 49th TFW at Holloman.

e. Recurring Commitments

49th TFW has a NATO commitment requiring overseas deployment annually.

f. Special Operating Restrictions

Tests at Holloman Air Force Base require close coordination with the Area Frequency Coordinator of the WSMR.

g. Environment

See White Sands Missile Range, Annex A.

h. Topography

See White Sands Missile Range, Annex A.

i. Airspace Restrictions

The airspace over the WSMR is controlled.

j. Power Availability

Electrical power is adequate and is commercially supplied. Portable generators are available for use at remote sites.

k. Communications

AUTOVON and local telephone service is available.

3. Dimensions

a. Landspace

Holloman is contiguous with the WSMR.

b. Airspace

Test airspace is in the WSMR complex.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements

There are none.

(2) Airborne Elements

There are none.

b. Timing

Stardard IRIG formats are available.

c. Television

There are extensive television capabilities at Holloman and WSMR.

d. Photography

There is extensive motion picture and still photography capability at Holloman and WSMR.

e. Calibration Capability

A PMEL (Precision Measurement Equipment Laboratory) is located on Holloman.

f. Other General Instrumentation

(1) Telemetry

The high speed test track and the MSMR have telemetry systems.

(2) Meteorological

The 6585th Test Group has an internal meteorological sciences organization.

(3) Survey

First order surveys are performed by the U.S. Coast and Geodetic Survey.

(4) RFI/EM Capability

See RATSCAT, Table P-4.

(5) Safety and Security

Specialized safety and security instrumentation is used to control access to test areas. This includes photocells and CCTV. The WSMR is controlled access area.

g. Special Purpose Instrumentation and Facilities

(1) Holloman Test Track

The test track provides a facility for controlled high speed/high g testing. G levels up to 300, and speeds up to 8,000 feet per second can be achieved. Though the track is primarily a DT&E tool, OT&E required such a facility can be accomodated.

(2) Radar Target Scatter Facility (RATSCAT), Holloman AFB

The Radar Target Scatter Facility (RATSCAT) is an Air Force facility located in the Alkali Flats area on the White Sands Missile Range. The fixed elements of this system consists of a two-story building which house the radar systems, five underground rotatable tables (on which radar targets may be be mounted), and a warehouse shelter for classified targets.

Key features of RATSCAT are:

The potential for performing outdoor radar tests which cannot be peformed at other locations.

The potential for providing savings in both time and money by allowing "breadboard" radars to be quickly assembled, utilizing existing radar modules.

The capability to build and test modules of Foreign and Friendly aircraft not otherwise available.

Characteristics are summarized in Table P-4. RATSCAT can field mobile units for RF measurements.

(3) Central Inertial Guidance Test Facility (CIGTF)

The CIGTF at Holloman AGB is the focal point for independent Air Force testing and evaluation of guidance systems. One of the major test capabilities available at the CIGTF is sled testing of missile guidance systems and subsystems. This unique test offers engineering development and statistical evaluation with dynamic acceleration inputs which simulate the missile environment. These tests fill the gap etween laboratory testing and free flight missile tests which have linited instrumenation.

Other important test capabilities at CIGTF, which are not necessarily directly related to sled testing, are an extensive capability for performing captive flight test of inertial and terminal guidance systems in operational type aircraft. Arrangements for target support at Holloman should be made

TABLE P-4 CHARACTERISTICS OF RATSCAT MEASUREMENT SYSTEM

POWER OUTPUT	1 kW PEAK (NOMINAL)
PULSE WIDTH	0.1 TO 1.0 MICROSECOND
PULSE REPETITION FREQUENCY	500 TO 5000 PPS
NUMBER OF RECEIVING SYSTEMS	TWO PER BAND (ONE MONOSTATIC AND ONE BISTATIC)
RECIEVER MINIMUM DETECTABLE SIGNAL	-94 dBm (-101 FOR 2 MHz IF AMPLIFIER
RECEIVER BANDWIDTH	10 MHz (2 MHz AVAILABLE)
RANGE GATE WIDTH	0.1 TO 1.0 MICROSECOND (50 TO 500 FT)
SHORT TERM DYNAMIC RANGE	TO 70 dB
OVERALL DYNAMIC RANGE	GREATER THAN 100 dB
LINEARITY	$\pm$ 5 dB
EQUIPMENT STABILITY	0.1 dB/HOUR (AVERAGE)
ANALOG DATA FORMAT	POLAR AND RECTANGULAR PLOTS OF CROSS SECTION AND PHASE VERSUS ASPECT ANGLE ANALOG MAGNETIC RECORDER 4 CHANNEL (100 Hz TO 100 kHz)
DIGITAL DATA FORMAT	MAGNETIC TAPE AND PUNCHED PAPER TAPE RECORDED AT 0.1-, 0.2-, 0.4-, 1.0-, 2.0-, 4.0-DEGREE AZIMUTH INCREMENTS. (200 AND 556 BPI RECORDING DENSITY AVAILABLE ON MAGNETIC RECORDINGS.)
ATTENNA REFLECTORS	1-, 2-, 3-, 4-, 6-, 10-, 16- AND 28-FOOT PARABOLIC REFLECTORS
ANTENNA FEEDS	DIPOLES, LOG PERIODIC, AND HORNS ALL WITH VSWR LESS THAN 2.0 TO 1.0
POLARIZATION	ANY ARBITRARY LINEAR POLARIZATION, RIGHT AND LEFT CIRCULAR (AXIAL RATIO 1 dB), ELLIPTICAL, ANY CROSS COMBINATION OF TRANSMITTING AND RECEIVING CONFIGURATION.
BACKGROUND LEVEL	AS LOW AS -65 dBm (FREQUENCY AND TARGET-WEIGHED DEPENDENT)
BACKGROUND REDUCTION	SHAPED COLUMNS, TUNED COLUMNS, VECTOR FIELD SUBTRACTION, PASSIVE AND ACTIVE CANCELLATION.
PHASE MEASUREMENT	ABSOLUTE PHASE, 400 MHz - 12.0 GHz
AZIMUTH RESOLUTION	0.1 DEGREE (.01 DEGREE AVAILABLE)
TARGET WEIGHTS	UP TO 12,000 POUNDS
TARGET SIZE	UP TO 60-FOOT LENGTH
BISTATIC CAPABILITY	VARIABLE RANGE FOR 0- TO 120 DEGREE BISTATIC ANGLE
GLINT MEASUREMENT	4.0 TO 12.0 GHz
FREQUENCY COVERAGE	CONTINUOUS FREQUENCY COVERAGE FROM 30 MHz TO 18 GHz WITH SPOT FREQUENCY COVERAGE AT 24 GHz, 35 GHz, 52 GHz 70 & 95 GHz.

through ADWC.

5. Threats/Targets

A permanent detachment from ADWC, Tyndall AFB, Florida, is stationed at Holloman for purposes of providing PQM-102 and QF-102 support. Arrangements for target support should be made through ADWC. BQM-34A support can be made available by prior coordination with the ARmy at WSMR.

6. Data Handling/Processing

a. Data Storage and Retrieval Capabilities

The Guidance and Control Laboratory at Holloman AFB has high speed (50K bit) and low speed microwave data links to the data reduction facility at Kirtland AFB. This allows digital data from tests run at Holloman to be processed at Kirtland.

b. Quick-Look Capabilities

Quick-look capability exists.

c. Processing

(1) Dual Control Data Corpoaration (CDC) 6600 central processing units with 131,000 (60 bit) words each plus 2,000,000 words of common memory using SCOPE 3.4 and Intercom 4.5 operating system.

(2) Language

Extended FORTRAN is the primary language in use at Kirtland AFB. SIMSCRIPT and assembly language are also supported.

(3) Input/Output Options

Ten CDC 607 7-track tape drives (200, 556, 800 BPI at 150 IPS)

Eight 844-41 disc drives (240 million characters each).

Nine 844-21 disc drives (120 million characters each).

PDP connected into ARPANET.

(4) Control Data Corporation (CDC) 7600 with 131K words of small semiconductor memory and 512 K words large memory using scope 214 operating system.

(5) Input/Output Options

Three 669-2 tape transports (9 track).

Three 667-2 tape transports (7 track).

(6) Storage

Seven 844-21 disc drives (120 million characters).

Four 819-2 disc drives (480 million characters).

d. Displays

The Calcomp 565, FR-80 and Gould 4800 Plotters are available. One 6600 has a 243 graphics terminal.

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ANNEX Q

OPERATIONAL TEST INSTRUMENTATION GUIDE

AIR FORCE FLIGHT TEST CENTER
Edwards Air Force Base, California

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ANNEX Q

AIR FORCE FLIGHT TEST CENTER
Edwards Air Force Base, California

1. Introduction

a. Overview. Edwards Air Force Base is located 100 miles northeast of Los Angeles, California, on the western edge of the Mojave Desert. The base encompasses portions of three counties: Los Angeles, Kern, and San Bernardino. Nearby cities are Palmdale, 40 miles southwest; Bakersfield, 80 miles northwest; Lancaster, 30 miles southwest; and about 20 smaller communities scattered throughout the Antelope Valley.

Edwards AFB is the home of the US Air Force Flight Test Center (AFFTC), the host organization. AFFTC is the Air Force agency responsible for flight test and evaluation of manned/unmanned aircraft systems and aerospace research vehicles; development testing of aerodynamic decelerators; operation of the Air Force Test Pilot School; development, operation, and management of the Edwards Flight Test Range (EFTR) and the Utah Test and Training Range (UTTR); support and participation of Air Force DOD and other Government agencies, foreign, and contractor flight test and evaluation programs.

Under this mission, the Center capabilities include the planning, design, conduct, and reporting of flight test programs; the acquisition, transmission, recording, processing, and display of data from space positioning, telemetry, instrumentation, and communications.

AFFTC activities are primarily concentrated at Edwards AFB, California; Hill AFB, Utah; and the Utah Test and Training Range, Utah. However, AFFTC frequently conducts flight test activities at remote sites and over various designated areas.

b. Generic Systems Tested. The primary mission of the AFFTC is to accomplish and report results of developmental testing and evaluation of manned and unmanned aircraft systems to include aircraft performance, aircraft stability and control, adverse weather operations, functional capability, safety, reliability, maintainability, and compatibility of aircraft systems, subsystems and aerospace ground and airborne equipment under all weather and climatic conditions. AFFTC Lead Center responsibilities include:

o Manned Aircraft Flight Test

o Aerospace Research Vehicle Test

o Aerodynamic Deceleration Testing

o Drone/Remotely Piloted vehicle Test (performed at the Utah Test and Training Range, Utah)

Subsystems evaluations include:

- o Bombing, Navigaton, and Radar Systems
- o Computers and Display Systems
- o Fire Control Systems
- o Propulsion Systems
- o Electrical and Hydraulic Systems
- o Aircraft Arresting Systems
- o Flight Control Systems

2. General

a. Collocated and Nearby Units

(1) Other Air Force Units

- o Air Force Rocket Propulsion Laboratory (AFSC)
- o Det 21, 2d Weather Squadron (MAC)
- o Det 1801, District 18, AFOSI
- o AF Audit Agency (Det 920)
- o Det 28, AFSC MET
- o 1925 Communications Squadron (AFCC)
- o 4200d Test and Evaluation Squadron (SAC)
- o Det 5, 40th Aerospace Rescue and Recovery Squadron (MAC)
- o USAF Judiciary Area Defense Counsel
- o OL-AA, AF Test and Evaluation Center
- o 3306th Test and Evaluation Squadron (ATC)

(2) Other Tenants

- o US Army Aviation Engineering Flight Activity
- o Army & Air Force Exchange
- o Defense Investigative Service
- o Defense Property Disposal Office

- FAA/RAPCON
- NASA Dryden Flight Research Center
- Various Private Contractors

(3) Nearby Government Installations

- Naval Weapons Center (NWC)
- Vandenberg (SAMTO & ESMC)
- Fort Ord (CDEC)
- Point Mugu Naval Air Station (PMTC)
- George Air Force Base
- Norton Air Force Base
- March Air Force Base
- Hunter-Liggett Military Reservation (Army)
- National Training Center (FT Irwin, CA)
- Nellis AFB, NV

b. Maintenance Capability. The Air Force maintenance facilities at Edwards AFB are capable of performing both organizational and intermediate levels of maintenance on a wide variety of fixed and rotary winged aircraft and aircraft systems. The Commander, 6510 Maintenance and Supply Group (6510 MSUG/MA) provides avionics, munitions, field, and organizational maintenance, and performs minor Class II aircraft modifications.

c. Access

(1) Air. All major commercial airlines are available at Los Angeles International Airport (longest runway, 12,0C feet). Golden West Commuter Airlines flies to Edwards AFB (runway length, 15,000 feet) and Palmdale, California (runway length, 12,000 feet), 40 miles south-southwest. The Edwards AFB airport facility can accept all types of military aircraft including fully loaded C-5A's. Civil aircraft can be accommodated with execution of the proper agreements.

(2) Water. Commercial docks for deep draft vessels are available at Long Beach/Los Angeles, 120 miles to the southwest.

(3) Rail. The Boron Station of the Atchison, Topeka, and Santa Fe (AT&SF) Railway is the main rail facility serving Edwards. It connects with the Southern Pacific Railroad at Mojave. The Southern Pacific runs parellel to the western edge of the base and has freight terminals at Rosamond and Lancaster. Both lines continue from Mojave to the national rail networks.

(4) Road. Road access to Edwards via Rosamond Boulevard connecting with State Highway 14 at Rosamond and 120th Street East from the southern Antelope Valley. From the North Gate, there is direct connection with State Highway 58.

d. Logistic Support Capability. The Air Force logistic support capability of Edwards AFB is sufficient to support present programs and additional minor programs. The maintenance facilities are supporting present projects fully. Additional major projects would require a reevaluation of manpower levels and hangar space.

The hangars and shops complex totals 1,521,235 square feet including 19 separate aircraft hangars totaling 22 bays. Table Q-1 shows the types of aircraft that Edwards is capable of supporting. The munitions storage and buildup area totals 125,000 square feet. Base supply warehousing contains 210,816 square feet.

There are 2,130 military family housing units on base. The civilian population lives primarily in Lancaster, with small numbers living in Rosamond, Palmdale, Mojave, California City, North Edwards, and Boron. On-base occupancy is maintained at over 98 percent.

e. Recurring Commitments. Presently, there are no ROTC or Reserve activities at Edwards AFB.

f. Special Operational Restrictions. No explosive ordnance is used on Edwards AFB test ranges. Live ordnance is stored on base. Explosive ordnance ranges are available in the local area (China Lake) and under controlled conditions on Leach Lake.

g. Environment. The location and altitude of Edwards AFB provide fairly distinct seasonal changes. The summer months, when temperatures reach over 100 degrees Fahrenheit, are usually dry and cloudless. The winter months are characterized by increased cloudiness, windstorms, daytime temperatures of about 60 degrees Fahrenheit, and occasional precipitation. The difference between daily maximum and minimum temperatures is about 30 degrees Fahrenheit, summer and winter. Winds over 35 mph are most likely to occur during the period from March through May. Usually one to six rainstorms occur each winter season with measurable totals varying from 0.25 to more than four inches. The annual average is 4.0 inches of precipitation. Over the entire year, the sky conditions vary from clear to broken or overcast clouds over 10,000 feet 94.4 percent of the time. Below 10,000 feet the sky condition is broken clouds (0.5 to 0.9 clouds) to overcast (more than 0.9 clouds) 5.6 percent of the time. The airfield is closed because of low ceilings less thant 0.1 of 1 percent of the time. Weather conditions at Edwards AFB are favorable to testing which requires optical tracking. Visibility is 10 miles or more 96.0 percent of the time. The airfield is closed because of poor visibility (less thant one mile) only 0.2 to 1 percent of the time. Infrequently low visibility is caused by blowing dust or sand, precipitation, fog, and haze.

h. Topography. The area surrounding Edwards AFB is a desert with occasional buttes and mesas. Within the reservation are Rogers, Buckhorn, and Rosamond Dry Lakes. These have a total of 65 square miles of usable

TABLE Q-1

AFFTC AIRCRAFT SUPPORT CAPABILITY

Trainer	Fighter	Cargo	Helicopter	Observation
T-38A	YA-7D	DC-130E/H*	HH-1H	O-2A
	A-7D	HC-1300H*	CH-3E*	
	A-37B	NKC-135	CH-53C*	
	B-52G	YC-141B	HH-53C*	
	FB-111A			
	F-111D			
	F-4C			
	RF-4C			
	F-4D			
	F-4E			
	F-4F			
	YF-4E			
	F-15A/B/C			
	A-16A/B			

*6514th Test Squadron located at Hill AFB, Utah landing area, including runway lengths up to 7.5 statute miles. These dry lakebeds, along with a number of offbase dry lakebeds, are used as planned recovery areas for research aircraft and as emergency landing sites. Surrounding vegetation is mostly desert shrub.

i. Airspace Restrictions. Flight test operations are conducted primarily within the areas discussed in the following paragraphs.

(1) Restricted Area R-2525. This area encompasses Edwards AFB with areas to the north and northeast; it includes airspace from surface to unlimited altitudes. This area is controlled by Edwards AFB, and is used for tests requiring instrumented test support, limited gunnery, impact tests, and hazardous tests.

(2) R-2508 California Area Complex. This area (which includes R-2515) extends approximately 130 nmi north, 80 nmi east, and 40 nmi west of Edwards AFB; it includes airspace from 20,000 feet to unlimited altitudes. R-2508 complex is governed by the R-2508 Complex control Board under a shared-use agreement between Edwards AFB, AF Plant No. 42, George AFB, China Lake NWC, and Fort Irwin. Prior approval for shared use of R-2508 is not required except for specific restricted areas within the R-2508 complex. This area is used primarily for nonhazardous test activities and USAF Test Pilot School Training.

(3) ATC Assigned Airspace Areas (ATTCAAA). These areas underlying and extending outwards from R-2508 were established with operating procedures agreed upon by FAA and users. FAA clearance through Edwards RAPCON is required for use; however, the military assumes responsibility for separation of aircraft (MARSA) when these areas are used for test or training mission. ATCAAAs are used in conjunction with R-2508 complex airspace.

(4) Long-Range Test Mission ae Conducted Outside the R02508 Complex. Edwards out-range technical support installations at Ely, Shoeshone, Cherry Creek, and Goshute, Nevada, as well at the UTTR in Utah, within 200 nmi or line-of-sight of these facilities. The area of Edwards AFB north range is roughly bounded by Lake Mead, Nevada; Fort Bridger, Utah; Jackson Hole, Wyoming; Boise, Idaho, Mono Lake, California; and Santa Cruz, California. In additon, SAMTO(ESMC) and PMTC provide data acquisition capabilities for Edwards long-range test missions conducted in their respective areas.

Table Q-2 presents a list of restricted area and supersonic corridors available for use by AFFTC.

(5) Supplementary Areas. Supplementary range impact areas and air-to-air, air-to-surface gunnery ranges are immediately adjacent and available to AFFTC. These areas are as follows:

R-2524 North	22 x 12 nmi	Air-to-surface only. Surface to unlimited.
R-2524 South	22 x 9 nmi	Air-to-surface only. Surface to unlimited.

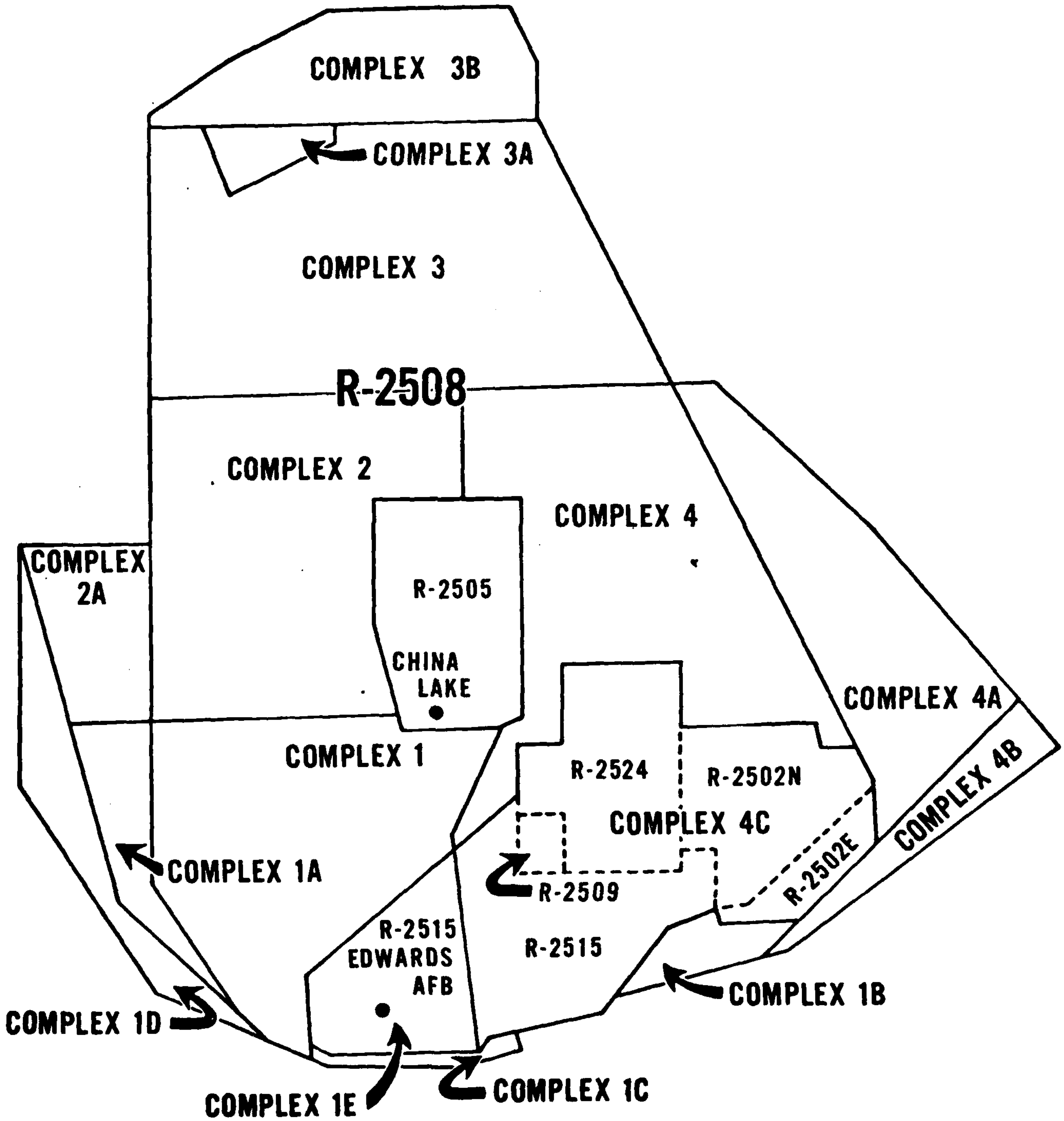

Figure Q-1 California Restricted Area Complex

R-2509	9 x 9 nmi	Air-to-surface only. Surface to unlimited.
R-2502	25 x 9 nmi	Leach Lake Range. Air-to-air and air-to-surface. Surface to unlimited.

j. Power Availability. Edwards AFB is currently serviced by three electrical power feedlines. One additonal feedline services the Air Force Rocket Propulsion laboratory. The servicing company is Southern California Edison. Present power availability is adequate. Natural gas is furnished by Pacific Gas and Electric Company.

k. Communications. The 1925 Communications Squadron is responsible for communications at Edwards AFB. The communications capability under their direct control include a Model 2B Electronic Swithcing System (ESS), Telephone central Office with tieline, Autovon and direct distance dialing access. It functions as the western end of the Air Force tandem switching network. The Squadron also manages 685 CHF/FM radio assets and 160 radio pagers. The central radio facility (Comm Switch) provides dedicated radios for flight test support. It utilizes solid state UHF/VHF radios with 50khz channelization. Access to the Comm switch is through radio control units. This system also controls 115 UHF/VHF/HF microwave audio/telephone circuits; can route up to 200 subscriber lines and provide control to a minimum of 155 intercom circuits. Fifty dedicated AN/ARC 164 (UHF) radios are mounted in vehicles for ground-air communication support. This system is also being interfaced in FY 81 to an R-2508 Radio Communication Switching System at the FAA/RAPCON facility for extending local UHF Radio Communications within the R-2508 complex.

3. Dimensions

a. Landspace

(1) Test Area Contiguity. Edwards AFB comprises over 301,000 acres of land encompassing a land area of approximately 15 by 35 statute miles. This are includes rogers and Rosamond Dry Lakes and their associated runways.

High elevation flight testing is accomplished at the High Elevation Test Complex near Bishop, California. Test sites are available at Bishop (4,118 feet elevation), Long Valley (7,130 feet elevation), and Coyote Flats (10,000 feet elevation). A 3,000-foot, oil-surfaced runway with 1,000-foot overruns is located at Coyote Flats. Operation at this and other remote sites is supported through deployment of portable test and support equipment on an as-required basis.

(2) Impact/Live Firing Areas

(a) Explosive Rounds. With the exception of spotting charges, no explosive rounds are fired on Edwards AFB test ranges.

(b) Inert Tounds

TABLE Q-2

RESTRICTED AREAS AND SUPERSONIC CORRIDORS - ALTITUDES

Area	Altitude	Location/Scheduling Agency
R-2502	Surface to Unlimited	Fort Irwin
R-2505	Surface to Unlimited	China Lake
R-2506	Surface to 6,000 feet	China Lake
R-2508	Flight level 200 to Unlimited	China Lake
R-2509	Surface to Unlimited	George AFB
R-2510	Surface to flight level 500	MCAS, Yuma
R-2515	Surface to Unlimited	Edwards AFB
R-2521	Surface to flight level 400	NAF, El Centro
R-2524	Surface to Unlimited	China Lake
ATCAAA*	Flight level 180 to flight level 600	Edwards AFB/FAA
Medium altitude Supersonic Corridor	10,000 feet to 30,000 feet MSL	Edwards AFB
High Altitude Supersonic Corridor	Flight level 300 to Unlimited	Edwards AFB
Low Level Supersonic Corridors	Surface to 1,500 feet AGL Surface to 10,000 feet AGL	Edwards AFB

* Air Traffic Control Assigned Airspace Areas

1 Precision Impact Range Area (PIRA). The PIRA is located in the southeast portion of the Edwards AFB reservation. The range provides two precision visual bombing targets supplemented with radar reflectors. There are three impact observation towers equipped with transits for each target area for plotting impacts. The observation towers enable the impact position to be determined within 30 to 45 seconds after impact at an accuracy of plus or minus 15 feet. Surveyed impact information can be provided to an accuracy of plus or minus two feet. In addition, there are five other impact targets which are available to satisfy test objectives in which altitude, speed, and mode of release dictate the selection of a specific target for practice bombing. Impact data can be provided from observation towers and/or phototheodolite cameras.

All targets are accurately surveyed with respect to all other range instrumentation. A limited recovery capability exists for those items that must be retrieved. ALPHA corridor is a west-to-east airborne entry into PIRA. ALPHA Corridor begins at the southwest corner of Edwards reservation and extends east to the western boundary of PIRA. It is normally scheduled in conjunction with IRA missions. PIRA can also be entered from the east or west via the high altitude supersonic corridor.

2 Dual Air-to-Ground Gunnery Range (DAGRAG). DAGRAG is a conventional low altitude air-to-surface gunnery, bombing, and rocket range with an associated well defined airspace reservation. DAGRAG is located on the western end of the Precision Impact Range Area. In general, DAGRAG is comprised of a north range (with a right-hand traffic pattern) and a south range (with a left-hand traffic pattern). The division of the north and south ranges are well defined by a four line road running true north and south through the Range Control Tower and a broken separation line running true east and west from the east shore of Rogers Dry Lake through the Control Tower. For all practical purposes, the north and south ranges are identical. Each range consists of one bomb/rocket circle, ten strafe targets, two skip bomb targets, three flank observation towers, and one common control tower. The Mojave B Range, an adjacent range of China lake (NWC) is used for live ordnance testing activities.

b. Airspace

(1) Landspace/Airspace Relationship. Because the test activities conducted at Edwards AFB involve risks beyond the degree associated with normal flying activities, the special ranges, areas, and corridors were established to accomplish hazardous operation with a minimum or risk to the pilot, the test vehicles, or surrounding communities. For this reason, the land surface and commensurate airspace must be considered as a single entity.

(2) Edwards AFB Flight Test Range (EFTR). The EFTR consists of an instrumented airspace corridor approximately 400 miles wide, above 30,000 feet MSL, extending from the Pacific Missile Test Center/SAMTO Complex to the west, to approximately Hill AFB to the northeast. The range instrumentation capability of the EFTR includes radar, optical instrumentation, telemetry, receiving radio, television, timing, and radio communications. A SAMTO interace affords range capability both from SAMTO and from the Pacific Missile Test Center (Navy).

Missile control is performed as an advisory function. Various TM, radar and television inputs are monitored in real-time through which decisions can be made by a Range Control Officer, Test Conductor, and/or Test Pilot. Real-time data processing and computation is available in the RMCC using a Cyber 74 computer in conjunction with the AFFTC Automated Flight Test Data System (AFTDSO. Real-time frequency and flutter analysis is also available via a General Radio Time Data Corporation Analysis Station. Display devices include strip chart and photo-optic oscillographic recorders, X-Y plotters, TV monitors, and digital and computer generated CRT displays. Three mission monitor/control rooms are available which can be employed to accommodate three simultaneous test operations depending on data requirements. The range/mission control areas are contiguous, thus providing maximum operations integration and real-time requirements response.

(3) Range/Airspace Availability. The Edwards Test Complex (R-2515) and the R-2508 California Restricted Area Complex are normally used between 0700 and 1700 hours daily on weekdays. For other times, range and airspace availability is obtained through formal written coordination.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements. Instrumentation at Edwards AFB is dedicated to testing airborne vehicles. The PIRA has facilities for locating projectiles, but these cannot track ground elements.

(2) Airborne Elements

(a) Radar

1 Available Radars. Two FPS-16 radars are the primary source of time-space-positioning data for test programs flying in the Edwards AFB vicinity. Analog or digital data are available from testing accomplished up to 200 miles from AFFTC above 30,000 feet MSL. In recent years, these radars have been upgraded with solid-state electronics and digital range units. Present FPS-16 radars are accurate to within ±75 feet at any point within a sphere whose radius is 30 statute miles. For each additional 30 statute miles radius, the accuracy degrades another ±75 feet; e.g., at 90 statute miles, accuracy is ±225 feet. These radars, in conjunction with those available at PMTC and SAMTO, provide an extension airspace volume with continuous radar coverage. A third FPS-16, operated by NASA DFRC is also available through AFFTC scheduling. The FPS-16 radars have a tracking range of 500 yards to 32 LS nautical miles. Limit is line of sight.

A transportable C-band digital instrumentation radar (DIR) is available to enhance both low altitude and low level radar coverage requirements which cannot be satisfied with existing fixed installations. It is currently installed as a fixed radar capability at the NIKE AJAX RADAR compound at Edwards AFB.

The following radars comprise the existing AFFTC radar facility: two AN/FPX-16, one HAIR RADAR, and a portable TPQ-39 (DIR). An additional AN/FPS-16 owned by NASA DFRC is available on a scheduled basis.

2 Radar Fidelity and Geometric Range (RADFAG). A passive radar reflector range utilizing corner reflectors and Luneberg lenses extends a distance of approximately two miles across the southern portion of Buckhorn Dry Lake. The range is designed to test and evaluate forward - and side-looking airborne radar systems. There are six square pattern arrays of 16 reflectors each for a total of 96 and two "L" arrays with nine reflectors each for a total of 18. The corner reflectors and Luneberg lenses may be readily interchanged and reoriented upon special request. There are tow sizes of corner reflectors with the theoretical reflecting areas being 1 and 10 square meters at X-band (3.2 cm) frequencies. There are six sizes of Luneberg lenses varying in diameter from 12 to 25 inches, each providing 140-degree angular coverage. Their reflecting areas vary from 65 to 1,045 square meters, respectively, at X-band frequencies. The geometric arrays are surveyed to an accuracy of greater than 1 part per 5,000 (3rd order).

Another RADFAG range located on Rogers Dry Lake provides targets for high resolution radar testing against a very low background reflectivity (approximately 35 dB). The range consists of two straight line arrays placed in parallel planes with Luneberg lenses and one "L" array with corner reflectors. The target sizes range from .1 M2 to 1000 M2.

(b) Low Altitude Ground Speed Calibration Courses. Three such courses are located on Edwards AFB. One is on the South Base ramp; the second is on Rogers Dry Lake, parallel to and east of runway 17/35; and the third is parallel to and northwest of runway 4/22.

(c) Laser. There is presently no instrumentation at Edwards AFB utilizing lasers.

(d) Optical

1 Available Equipment. The Optical Data Acquisition Facility provides fixed Askania and mobile contraves cinetheodolites, mobile trackers, plotting boards, targets, and communication equipment at 23 primary locations dispersed throughout the AFFTC reservation. Support of documented test programs is based on an ability to obtain extremely accurate measurements of the behavior of airborne targets from data provided by the Askania and Contraves cinetheodolites. Data are recorded on film by these cameras in the form of elevation and azimuth angles, fiducials, and binary time of day in addition to a photograph of the test object. Mobile Contraves are available for off-base operations. Mobile trackers using high speed motion picture cameras can be employed to supplement the primary cameras or provide documentary coverage.

The following major items of equipment are used to obtain optical data:

15 Askania Cinetheodolites (2 mobile)

8 Contraves Cinetheodolites (all mobile)

1 Photosonics Optical Tracker

1 Scientific Atlanta Optical Tracker

1 Modified M-45 Tracker

2 Photo Resolution and IR Range. The Edwards AFB Photo and IR Resolution Range is part of a reconnaissance test range located in the AFFTC. The range consists of 18 bar-type resolution targets, one tri-density target, five circles, and 14 chick cross patterns. All are located in the southeast portion of the Edwards AFB reservation. The range covers an area two miles wide by 21 miles long.

In addition to the Photo and IR Resolution Range on the AFFTC reservation, there is a Photo and IR Resolution Range off-base. This range is in the vicinity of the Edwards Flight Test range (formerly High Range) which extends toward the northeast into Nevada from the Flight Test Center. There are eight targets on a flight path 130 miles long.

An off-base IR and Photographic Geometric Fidelity Range consisting of 147 manmade and natural targets distributed over an area 50 by 150 miles long, is located between Edwards AFB and Indian Springs, Nevada.

Both the on-base and off-base Photo and IR Ranges are part of the controlled Range Network.

(d) Relative (Miss-Distance). See subsection 4.a. (2)(a).

(e) Airborne-to-Surface Target Matching. Instrumentation is not available.

b. Timing

(1) Primary. The primary timing course is the AFFTC Master Timing Station locked onto Universal Time (UT) via WWV. The time synchronization is transmitted by rf transmission to all users. Airborne timing is provided via IRIG Time Code Generators locked onto UT at the Master Timing Station. The Master Timing Station employs redundancy to assure timing in the event of primary system failure. AFFTC also has two mobile timing vans for use at remote locations.

Plans are to change from WWV to Loran-C as the UT. This changeover will put Edwards AFB on the same time lock as the other west coast test facilities.

(2) Secondary. The secondary timing sources used by the AFFTC are IRIG Time Code Generators. These may or may not be locked onto WWV, depending on the test. The USAAEFA used airborne IRIG generators as primary timing sources telemetering time code in IRIG formats to data stations on the ground.

c. Television. Closed circuit television (Flitevision) is transmitted to several areas on the air base. Some tracking instrumentation at Edwards AFB is equipped with television cameras so that test vehicles can be observed at key command points on the Center. This provides decision makers with real-time visual control. A mobile television studio is available for on-the-spot real time event surveillance with recording capability. Studio video data can be real time, line-of-site and is micro-wave transmitted to the center for CCTV network distribution. Elapsed time can be superimposed on the video which gives engineering personnel the ability to quickly determine event elapsed time.

d. Photography. The Photography Branch is well equipped to handle all kinds of photography. Short turnaround is possible. The airborne capabilities of the AFFTC Photography Branch are excellent. Several photographers are experienced in airborne photography and provide photographic coverage of flight tests.

e. Instrumentation Calibration. AFFTC has a complete calibration facility. The AFFTC has an extensive capability to design, install, maintain, and calibrate test instrumentation, including flowmeters, accelerometers, pressure transducers, displacement and motion transducers, and bending beams.

f. Other General Instrumentation

(1) Telemetry

(a) Facilities. AFFTC RF telemetry capability at Edwards AFB, CA includes a primary telemetry acquisition site at Building 5790, a flight line telemetry acquisition site at Building 3940, and six (6) mobile telemetry vans. AFFTC RF telemetry capability at the Utah Test & Training Range includes a single antenna telemetry acquisition site at Grassy Mt, Granite Pk and Hill AFB, UT. Between these two areas, AFFTC fills the telemetry coverage with acquisition sites at Ely and Shoshone, NV. WSMC, PMTC and NWC provide the telemetry support as requested. Real-time telemetry processing and display is currently accommodated at Building 3940, Edwards AFB, CA, and Building 1274, Hill AFB, UT. Building 3940 is being replaced with a new Flight Test Mission Control Center, building 1440. This facility should be in operation in FY 81. Complete instrumentation to support all IRIG telemetry formats can be accommodated. Display can be provided in real-time engineering units with interactive analysis.

Six mobile vans containing TM ground stations for real-time or data tape demultiplexing are also available. Though these are not all exactly alike, each is at least capable of FM/FM and PCm format accommodation. Ancillary to these vans is a Mobile Telemetry autotrack Antenna System (MOTAAS) which can operate with any of the six vans.

USAAEFA has telemetry to support Army testing with a telemetry/facility located in building 1820 and telemetry/computer mobile vans.

(b) The Data Acquisition and Transmission System (DATS). The DATS interconnects range instrumentation sites from Edwards AFB north to Wendover, Utah, and the Utah Test and Training Range (UTTR). It consists of wideband microwave data links as well as narrow band voice/data circuits. Providing for the real-time transmission of radar, telemetry, radio, timing, TV, and TACDACS signals, it permits the mission control centers at Edwards AFB and Hill AFB to perform their functions. The West DATS extends the microwave to WSMC at Vandenberg AFB where it connects to PMTC.

The microwave transmission provides an overall data bandwidth of 10 MHz. Multiplexed on this baseband are 1.5MHz and .5 MHz TV channels in various combinations and a larger number of 3 kHz channels for radar, radio, intercom, and sundry, controls signal transmission. Thus, unless the baseband is reconfigured, the maximum bandwidth TM signal which can be accommodated is 1.5 MHz.

Subsection 6 (following) describes the telemetry capabilities of the AFFTC preprocessor system.

(2) Meteorological. Edwards AFB Tower provides normal airport meteorological data such as wind speed, wind direction, relative humidity, temperature, cloud ceiling, and cloud cover. In addition, runway 04/22 has a sonic anemometer every 1,000 feet that gives the wind velocity parallel and perpendicular to the runway, and temperature at ten feet above the runway. The group of 15 anemometers make up the Runway Meteorological System (RMS). The data from these instruments are fed to a computer where they are processed, averaged, and printed out every three minutes. If fewer points are printed, the printout time decreases.

Det 21, 2d Weather Squadron, provides meteorological and associated services to all organizations including designated contractors. Weather forecasting services are available for aircraft operators, diffusion of toxic propellants, and severe weather warnings.

(3) Survey. The 6510th Civil Engineering Squadron provides third order surveying functions at Edwards AFB. Higher order surveying is the responsibility of the Air Force Mapping, Charting, and Geodetic Service, Vandenberg AFB.

(4) Radio Frequency Interference/Electromagnetic Compatibility. Radio frequency interference and electromagnetic compatibility tests are made using a mobile frequency control and analysis facility. The equipment in this truck-mounted facility has a 15 kHz to 18 GHz capability.

(5) Visibility (Light Level Measurement). Light meters are used to measure ambient light for photographs and work area illumination.

(6) Sound Measurement and Analysis. Instrumentation is available through the Human Factors Branch.

(7) Safety and Security. No safety or security instrumentation is used. However, recent security improvements include fencing and control point access to the general flight line area and buildings. The security police squadron provides normal security functions for all assigned and tenant organizations.

(8) Soil Conditions. Instrumentation is not available locally, but can be obtained.

5. Threats/Targets

a. Ground.

(1) Real. Scrap aircraft and vehicles are used on the Photo Resolution and IR Range to test target identification.

(2) Simulations.

(a) Static/Dynamic. DAGRAG is equipped with target panels for bomb/rockets, skip bombs, and strafing.

(b) Electromagnetic. No electromagnetic threats or targets are available locally, but can be arranged.

(c) Scoring Capability. Present bullet scoring is by use of an AFFTC inhouse design. Canvas targets (20 feet x 20 feet) are used for strafing. Turnaround time is 24 hours for scoring 20 targets to an accuracy of three inches. All other scoring is manual.

Electronic bomb/strafing scoring systems are being considered for possible use on the PIRA.

(d) Destroyable/Nondestroyable. No destroyable/nondestroyable target simulators are available.

(e) Physical environment. No physical environment simulations are available.

(3) Computer War-Gaming. No computer war-gaming simulations are available.

b. Airborne. Drones and airplanes are used to test target acquisition of weapon systems. Tow targets are used to test air-to-air missiles and gun systems. Electronic scoring is employed. Missile firings can be done on adjacent NWC ranges.

c. Electronic Countermeasures (ECM). No ECM simulations are available at Edwards. Some support can be arranged at NWC.

6. Data Handling/Processing. The TACDACS facility provides for the collections of azimuth, elevation, and range data from space positioning/tracking systems in digital form. It is in concept a real-time computer-controlled, sampled data system. TACDACS performs the following functions: target acquisition, tracking, recording, real-time monitoring, and real-time data control. It has the capability to manipulate and transmit, in real-time, the data from one or more radars so that other tracking instruments, which are tracking the same target, will be directed to their acquisition coordinates. The facility supports radar, cinetheodolite, and telemetry tracking systems. It is also buffered to interface with similar services at SAMTO (WSMC) and NASA Dryden Flight Research Center.

7. Improvements/Modernization Planning

a. General. The information provided in the paragraphs to follow may be subject to change and should be considered generally as a guide to the direction of the proposed range improvement efforts.

b. Instrumentation Improvement Plans

(1) Airborne Instrumentation. The AFFTC has completed the basic development of a general-purpose Airborne Test Instrumentation System (ATIS) specifically designed for test and evaluation of Air Force weapon systems. The basic system consists of modular components which provide the user a versatile instrumentation system which may be tailored to size, capability, and cost in interfacing with transducers/sensors, tape recorders and telemetry transmitters. ATIS is used as the primary instrumentation system in meeting requirements now and in the future at AFFTC.

An ATIS product improvement program has been established in order to improve and enhance the system. Active development items include:

- Multiplexed synchro-to-digital convertor
- Format control Unit, design improvement to provide increased bit rate and channel capacity.
- Avionics (MIL-1553A) Data Bus Interface Unit
- Transducer Excitation Unit

A continuing program is being pursued to procure improved flight test instrumenttion components, such as accelerometers, rate gyros, pressure transducers, tape recorders, TM transmitters, etc. to meet test flight instrumentaion requirements.

(2) Instrumentation Radar. AFFTC has two long range fixed FPS-16 C-BAND radar systems and one mobile TPQ-39 digital integrated C-BAND radar system (DIN). the FPS-16 radar systems have analog and digital data acquisition capability.

(a) The AFFTC fps-16 radar systems are class A radars. The radars have a tracking range from 500 yards to 32,000 nautical miles. The tracking limitations are sky screened areas due to terrain. These areas are covered in most cases by other radar systems operated by associated ranges on a reciprocating basis. Real-time data can be transmitted from the other ranges through the North and West micro-wave systems. The data can be routed directly into the AFFTC computer systems and used to provide acquisition data to local systems. The AFFTC FPS-16 radars are equipped with aided tracking systems which enable the radar operations to track targets off the deck to all altitudes.

(b) The AFTC TPQ-39 Digital C-BAND Radar (DIR) is a short range radar with a tracking capability at 500 yeards to 126 nautical miles. This radar is transportable and has 350 degrees continuous azimuth rotation and an elevation range of -5 degrees to 185 degrees.

(3) Photography Facility. The present photographic facilities are acceptable.

(4) Range/Mission Control Center. It is planned to update this facility with semi-automatic and automated equipment which will increase the

quality of range and mission control, broaden the capabilities of the systems, and reduce nonproductive time to a minimum. Long range plans reflect replacement of the present RMCC with a new Flight Test Mission Control Complex (FTMCC).

(5) Telemetry Systems. During FY 82, it is planned to procure a second mobile telemetry autotrack antenna system to assist in low altitude TM coverage. and in FY 81 it is planned to procure a mobile telemetry ground station for use in the same manner. Two major deficiencies exist in this support area. Additional low altitude/remote telemetry coverage is required beyond the capabilities of the one mobile telemetry autotrack antenna system that is presently available at the Center. Such coverage is required for the increasing number of project-required low altitude flight missions. In addition, a new mobile telemetry ground station is required for remote support of this type of test flight activity. These two units, working in conjunction, will provide telemetry coverage not available from the fixed telemetry stations presently installed at the AFFTC.

(6) Ground-Based Instrumentation and Test Equipment. In the past several years the AFFTC has acquired a number of major ground instrumentation systems for support of the flight test mission. However, additional new systems with different/increased capabilities are required for future support. In addition, improvements to existing systems are required, as well as replacement of a number of systems that have served beyond their useful lifespan. In the telemetry area it is planned to procure a Mobile Telemetry Ground Station, which will be used in conjunction with a mobile antenna system to be procured in FY 81, for flight test telemetry support in remote areas that cannot be provided coverage from fixed stations. In FY 82 the existing CORTS telemetry vans will be updated to a contemporary configuration. Improvements will continue to be made to the Central telemetry Facility in order to remain supportive of data systems installed in flight test aircraft. Four major efforts are planned in the Optics/Flitevision systems:

(a) Continuing upgrading of our mobile tracking systems.

(b) Replacement of the AFFTC's Flitevision system which is well past its usable lifespan.

(c) Procurement of additional laser tracker units.

Future improvement of the AFFTC's Data Acquisition and Transmission System (DATS) will include replacement of the DATS microwave equipment and ancillary items, and procurement of a mobile data transmission system for relay use between remotely located data acquisition units and the Center's Range/Mission Control Center. Center radar support will be further improved by acquisition in FY 80 of one to one encoder systems. In FY 80/81 it is planned to update the Center's DIR. A longstanding requirement for PPI radar information will be fulfilled by procurement of a Surveillance Radar Information System which will present FAA-provided surveillance radar information to the FIMCC. Two major new systems, (1) Takeoff and Landing System and (2) On-Axis Track System - FY 81, are required in future years to provide adequate space positioning service to flight test missions. Future weapons delivery scoring support at the AFFTC will be provided through procurement of a Bomb Scoring System and a Straffing Scoring System either in FY 80 if funds become available, or in FY 81. Upper-air weather information gathering, which is presently provided by a World War II vintage radiosound, will be improved by acquisition of a Mobile Meteorological Sounding System, to be phased-funded in the years FY 80-81.

(7) Meteorological Facilities. Using phased funding, a range meteorological sounding system capable of meeting the technical requirements of today's flight testing, and with greatly improved maintainability and reliability was procured with FY 79 funding.

(8) Miscellaneous

(a) Strafing Scoring System. It is planned to procure and install an automatic scoring system for support of aircraft undergoing firing tests in FY 80.

(b) Mobile UHF Air-Surface Radios. Mobile UHF air/surface communications for such units as mobile Askania, vans, radar vans, control vehicles, etc., is presently provided with 51 AN/URC-73 vehicular radios. It is planned to procure 40 airborne type UHF air/surface radios as replacements for the existing units.

(c) Bombing Scoring System. It is planned to procure an automatic electronic scoring system that will provide scoring information in real-time, as well as provide a data recording capability for use in postflight and computation.

(d) Mobile Data Transmission Sustems. To relay data from a remote data acquisition system (radar, telemetry, etc.) to the AFFTC RMCC or other local control area, a mobile data transmission system will be procured in FY 81.

(e) Improved Airborne Navigational Systems Evaluation Capability. It is planned to procure in FY 79/80 an airborne system that will provide accurate positioning data, with information update being provided whenever the aircraft is within range or surface supporting instrumentation sites.

(f) Range Mission Control Center. Present effort is the procurement of a range control system which will provide for the integration and management of the AFFTC range complex from the RMCC, and of an automated switching capability for the RMCC communications sytems. In addition, an Integrated Flight Data Processing System (IFDAPS) is being procured in FY 80-83. This system will provide decommutation, playback, processing to engineering units (EU), and display processing to support aircraft flight and ground missions.

Building occupancy date for a new Flight Test Mission Control Complex (FTMCC), was May 80. The mission and range control functions, as well as AFTDS, scientific computer, etc., will move from RMCC to FTMCC in FY 81.

(g) Simulator for Aircraft Flight Test and Development (SAFTD). This item is a surface-based simulator using computer hardware programmed with algorithms to simulate aircraft flight in real-time with a pilot operating simulated aircraft control. All SAFTD items except for the motion base system have been delivered and installed. The motion base is scheduled for installation the second quarter of FY 81.

(h) Suitcase Inertial Positioning System. Procurement of this system in FY 80 will provide a capability of accurately locating mobile/transportgable range instrumentation equipment without the requirement for a first-order survey.

(i) On-board Precision Space Positioning System. This item is an on-board instrumentation system updated with navigation satellite data, which provide all of the positional/attitude data presently available from surface-based instrumentation. Funding required will be $1,000,000 in FY 80 and $1,230,000 in FY 81.

(j) Moving Target Simulation System. The purpose of this item is to provide a moving target range to facilitate the evaluation of look-down capability radar systems, particularly Moving Target Indicator (MTI) radars. Development of this range in FY 80/81 would result in a method for accurately evaluating the ability of a radar system to break out moving targets against a specified background of radar returns.

(k) Integration Facility for Avionics Systems Testing (IFAST). This FY 81 MCP will provide a facility for support of test programs on aircraft that have an avionics system that is controlled by a central computer. A capability is needed to effectively operate and bench check computer integrated avionics systems and associated software alternations make necessary by problems arising during flight testing. The IFAST building is being requested in the FY 81 MCP program.

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ANNEX R

OPERATIONAL TEST INSTRUMENTATION GUIDE

MARINE CORPS BASE
Camp Pendleton, California

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ANNEX R

MARINE CORPS BASE
Camp Pendleton, California

1. Introduction

a. Overview. The Marine Corps Base, Camp Pendleton, was established in October 1942. It is located in the northwestern corner of San Diego County, approximately 40 miles northwest of the city of San Diego and approximately 70 miles southwest of the city of Los Angeles. The camp comprises approximately 125,411 acres with the Pacific Ocean as its western boundary and the Santa Margarita Mountains (highest elevation 3,189 feet above sea level) as its eastern boundary. The camp is roughly rectangular, measuring 18 miles long and 12 miles wide. The cites of San Clemente and Oceanside are continguous to the northern and southern boundaries, respectively.

The mission of Camp Pendleton is to provide housing, training facilities, logistical support, and certain administrative support for Fleet Marine Foce units and other units assigned; to conduct specialized schools and other training as directed; to receive and process trainees and conduct individual combat training as directed; to train and organize replacement units for shipment overseas as directed; and to provide logistical support for other Marine Corps activities as directed.

b. Generic System Tested. Marine Corps tactical System Support Activity (MCTSSA) is the only organizationlocated at Camp Pendleton which possesses a true operational test and evaluation capability. MCB, Camp Pendleton, being the host organization, controls all the test ranges and areas and is primarily oriented toward infantry training.

MCTSSA, with the cooperation of the units stationed at Camp Pnedleton, is capable of evaluation in the following areas:

- o Test and Evaluation of Tactical Data Systems
- o Maintenance and Operation of Tactical Data Systems
- o Test and Evaluation of Amphibious Vehicles
- o Simulation of Tactical Fire Systems
- o Simulation of Tactical Control Systems
- o Air Control Systems
- o Air Defense Systems

2. General

a. Military Units

(1) Base Organizations. The following base organizations are

permanently assigned to MCB, Camp Pendleton:

Headquarters and Service Battalion

Correction Battalion

M. P. Battalion

Infantry Training School

Schools Battalion

Base Materiel Battalion

Field Medical Service School

(2) Tenant Units. Table R-1 lists some of the tenant (deployable) units presently assigned to MCB, Camp Pendleton.

b. Maintenance Capability. Refer to logistic capabilities, Section 2.d.

c. Access

(1) Road. Interstate Highway 5 provides road access to Camp Pendleton. Iterstate 5 runs between San Diego and Los Angeles, along the western edge of Camp Pendleton. An exist on/off exists at the main gate, Pulgas Gate, and San Onofre gate to the base.

(2) Rail. Camp Pendleton has its own railway yard including the following:

- o Locomotive, Railway, 60-80 ton class.
- o Car, Railroad, Switching, Self-propelled.

The base has a spur line which connects to Atchison, Topeka and Santa Fe rail lines.

(3) Air. Air access to Camp Pendleton is relatively limited. The runway at the base is asphalt, 6,000 feet long and capable of sustaining a C-130 type aircraft. Transient facilities are minimal with only JP-5 fuel available.

Major air traffic is handled by Los Angeles International (longest runway, 12,100 feet) or San Diego International (longest runway, 9,400 feet).

d. Logistic Capabilities. The logistic capabilites of the 1st Force Service Support Group are:

(1) Maintenance.

(a) Internal. Capable of providing organizational maintenance support (1st and 2nd echelon) for all tactical equipment authorized organiz battalions.

Table R-1

TENANT UNITS AT MCB, CAMP PENDLETON

(1) 1st MARINE DIVISION FLEET MARINE FORCE (FMF)

1st ANGLICO

1ST MARINES
5TH MARINES
7TH MARINES
11TH MARINES
1ST TANK BATTALION
COMM SUPT. CO.
DIVISION SUPPORT GROUP
3RD ASSAULT AMPH. BN

(2) OTHER FLEET MARINE FORCE UNITS

HQ, 1ST MARINE AMPHIBIOUS FORCE
FORCE SERVICE SUPPORT GROUP
MARINE AIR CONTROL SQUADRON - 7
DETACHMENT, MARINE AIR GROUP 16

(3) TENANT UNITS OTHER THAN FLEET MARINE FORCE

SUB UNIT #1, HEADQUARTERS & HQ. SQUADRON - 1, MCALF
MARINE CORPS TACTICAL SYSTEMS UPPORT ACTIVITY (MCTSSA)
NAVAL ELECTRONICS LABORATORY CENTER, SAN DIEGO
LORAC NAVIATION STA., NAVAL UNDERSEA CENTER, PASADENA, CALIFORNIA
NAVAL REGIONAL MEDICAL CENTER
WEAPONS TRAINING BATTALION
NAVAL REGINAL DENTAL CENTER
MCMCC

(b) External. Capable of providing overflow field maintenance support (3rd echelon) of Marine Corps furnished tactical items for units of the Marine division, and of providing field maintenance support (3rd echelon) for force troop units, and of providing field maintenance support (4th echelon) of Marine Corps furnished tactical items for units of the Marine Division, Marine aircraft wind (other than radar and aviation peculiar items) and force troops.

(2) Medical. Support provided by the regimental Medical Section.

(3) Transportation. The Group has transportation incident to the accomplishment of its primary mission. The Truck Company, Headquarters and Service Battalion, Force Service Support Group, provides the heavy motor transport support to all units of the Group. For displacement of maintenance installaion, augmentation support will be required from other sources.

(4) Supply. Capable of providing supply support. 2nd, 3rd, and 4th echelons repair support is provided by the maintenance shops through the Shop Stores Platoon.

(5) Messing. Support is provided by the food Services Platoon, Headquarters and Service Battalion.

e. Recurring Commitments. Tables R-2 and R-3 list training and non-training commitments of Camp Pendleton. Weekend training occurs at Camp Pendleton.

f. Special Operational Restrictions

(1) Fire Danger. A severe brush fire hazard exists at Camp Pendleton during the period from May to November. This danger may preclude the use of flammable weapon system (napalm, flame throwers, etc.) flares and restrict troop movement.s

(2) Crossings. Crossings, troop or vehicular, of ground level utilities or hard surfaced road or railways are restricted to designated areas.

g. Facility Organization. Figure R-1 shows the organizational structure of MCB, Camp Pendleton.

h. Environment. The climate at Camp Pendleton is typical of southern California. The mean temperature at Camp Pendleton is 60°F with a mean humidity of 64 percent. Approximately 13.5 inches of rain falls during the period from November to May. Fog is common beginning after sunset and generally lifting by noon.

i. Topography. The Camp physiographically is in the Peninsular Range Province of California which may be characterized as a rather broad, highly dissected land mass with westward traneding slopes. Topography varies from coastal terraces which parallel the ocean to sediments of the San Onofre Mountains (highest elevation of 1,725 feet), then eastward to the higher elevation of the Santa Margarita Mountains.

Table R-2

UNITS ASSIGNED FOR TRAINING ON A ROTATIONAL BASIS

1. U. S. MARINE CORPS RESERVE
2. MOBILE CONSTRUCTION BATTALIONS, USN
3. NAVAL WEAPONS ORIENTATIN GROUP, COMPHIBPAC
4. DEVIL PUPS
5. NROTC
6. U. S. ARMY RESERVE
7. ARMY ROTC
8. NAVAL ACADEMY MIDSHIPMEN
9. U. S. ARMY
10. RESERVE MOBILE CONSTRUCTION BATTALIONS, USN
11. MCJROTC
12. NATIONAL GUARD
13. NAVAL LEGAL JUSTICE SCHOOL
14. MARINE DETACHMENTS (AFLOAT)
15. CHAPLAINS SCHOOL

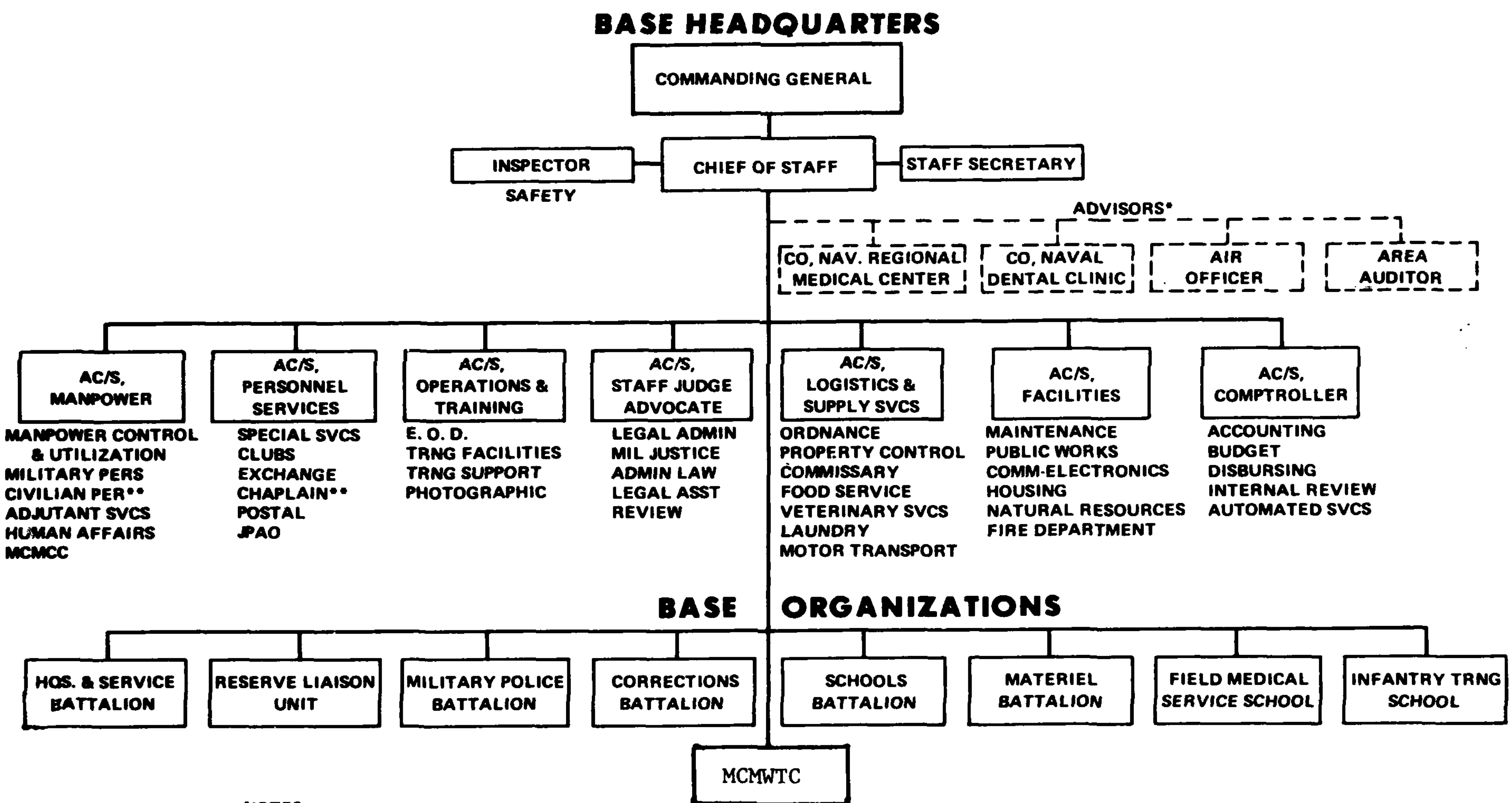
Table R-3

ORGANIZATIONS/EVENTS TO BE HOSTED BY THE BASE

(For other than training purposes)

1. WESTERN DIVISION MATCHES
2. AMPHIBIOUS WARFARE PRESENTATION
3. CALIFORNIA REGIONAL RIFLE, PISTOL AND SMALL BORE TOURNAMENTS
4. FOOD SERVICE OFFICERS CONFERENCE

MARINE CORPS BASE
CAMP PENDLETON, CALIFORNIA



NOTES:
* COLLATERAL DUTY OF TENANTS. NOT UNDER OPERATIONAL CONTROL OF BASE COMMANDER.
** AUTHORIZED DIRECT ACCESS TO CHIEF OF STAFF WHEN REQUIRED BY REGULATORY DIRECT ON AND PROCEDURE.

Table R-4
ELECTRIC POWER SYSTEM SUMMARY

LOCATION	CAPACITY (KVA) (Transformers Property of SDG&E)	CONSUMPTION (Avg KWH/month)
Haybarn Canyon	15,000	6,183,870
Lan Pulgas	1,500	433,890
Las Pulgas Well #41621	100	4,258
Las Pulgas Well #41611	150	7,548
Las Flores Creek Area	15	71
Las Flores	500	165,000
Del Mar	1,500	606,520
San Onofre Beach Club	100	23,121
San Onofre	2,000	523,320
Well - 52011	75	9,862
San Onofre Sentry Gate	10	6,681
Basilone Overpass Lights	5	325
Cristianitos	300	6,311
Horno	1,500	415,320
Basilone Road Booster Pumps	150	12,406
Horno Well #2	150	30,745
San Mateo	1,500	538,640
San Mateo Well #61512	112.2	38,828
San Mateo Well #61522	112.2	14,143
San Mateo Sentry Gate	15	1,322
Wire Mountain Housing No. 1 & 3	880*	321,583

Table R-4 (Cont'd)
ELECTRIC POWER SYSTEM SUMMARY

LOCATION	CAPACITY (KVA)	CONSUMPTION
Wire Mountain Housing No. 2	730*	241,900
Edson Range	420*	193,231
Del Mar Officers Housing	240*	104,083
Las Pulgas Well No. 1	75	2,914
Las Flores Ranch House	3	83
Horno Well #3	112.5	0
Pulgas Sentry Gate Light	3	199
San Mateo Well #61532	45	3,586
Range 207, San Onofre	10	2
Helicopter Pad, San mateo	10	1,463
MTACCS	1,120*	517,500
San Mateo Well #626221	60	2,951
San Onofre Housijg	250*	500,800
San Onofre Mobile Park	100	3,485
San Onofre Mobile Park	25	655
San Onofre Mobile Park	15	0
San Onofre Mobile Park	20	533
Oceanside MP Station	45	1,054
San Mateo Sewage Lagoon	15	6,311
Horno Sewage Lagoon	15	9,668
South Mesa	1,000	283,500
Sterling Homes, Oceanside	250	165,830

*Services connected directly to 12 kV System-Capacity determined by size of large 69 kV-12 kV Substations.

j. Airspace Restrictions. Two restricted airspaces are associated with Camp Pendleton. Restricted area R-2503 overlies the ZULU, WHISKEY, and SIERRA impact areas from the surface to 15,000 feet above mean ea level. Restricted area R-2533 was established 25 July 1968 to replace the area known as Oceanside Maneuver Area. R-2533 extends westward from R-2503 approximately three miles seaward and extends from the surface to 2,000 feet above mean sea level.

k. Power Availability. Table R-4 is a summary of the electric power availability to camp Pendleton from San Diego Gas and Electric (SDG&E).

. Communications. All communications at MCB, Camp Pendleton are standard military units. No special communications facilities are presently available for possible OT&E usage.

3. Dimensions

a. Landspace

(1) Test Area Contiguity. The majority of the firing ranges are remotely located and connected by hard sufaced roads.

(2) Easements. Livestock grazing is permitted over lagre areas. Precautions are taken to insure the safety of the livestock.

(3) Impact/Live Firing Areas. The facilities available at various live fire ranges vary greatly. For more information, consult the Camp Pendleton Training fAcilities Regulations (Reference 3).

The following areas are designated as impact areas for the impact of Ordnance of the frequent conduct of training involving the use of high explosives.

- ZULU
- X-RAY
- WHISKEY
- SIERRA

b. Airspace

(1) Landspace/Airspace Relationship. R-2503 overliew the Camp Pendleton impact areas from the surface to 15,000 feet above mean sea level. R-2533 overlies both land and sea to 2000 feet mean sea level.

(2) Easements. Standard peripheries of Federal Airways ovelie most of Camp Pendleton contiguous to R-2503 and are governed by FAA regulations pertaining to the continental control area.

(a) Victor 23 from Dana Point Intersection to Oceanside (VORTAC) covers the southwestern portion of Camp Pendleton outside of R-2503.

(b) Victor 208 from Ocenasie (VORTAC) to Julian covers the southern portion of Camp Pendleton outside of R-2503.

(3) Manned Airborne Systems. Fixed and rotary wing aircraft can operate above Camp Pendleton and engage in air-to-ground gunnery over designated firing ranges and impact areas.

(4) Area Surveillance. the airspace overlying Camp Pendleton is monitored and controlled by the base Training Facilities Office. MACS-7 also monitors the airspace within an approximate 200 mile radius of the camp. Visual sightings of smaller aircraft are heavily relied upon.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements

(a) The Tactical Warfare Simulation, Evaluation and Analysis System (TWSEAS) is a computer-assisted tactical command and control system, with multiple capabilities for supporting virtually all types of tactical exercises conducted in the Marine Corps. TWSEAS is not a combat system; its role is training support. The system is designed and configured for sustained operations in the field with tactical units during training exercises. it is a mobile facility that can be taken into the field, set up rapidly, and function as a control center for exercise operations. it can also be readily used to support staff exercises, such as map maneuvers, which are not necessarily conducted in the field.

TWSEAS has been designed as a dynamic system with potential for improvement in capabilities and expansion of system applications. Its development will in no sense be concluded when the initial operational configurations are fielded. Further developmental effort will be concentrated initially in the area of software. More efficient and flexible system software will be sought. Marine Amphibious Force (MAF) level simulation programs will be developed and provisions will be made for expanded aviation play and combat service support play in TWSEAS exerises. Developmental effort will also concentrate on new methods for performance evaluation and exercise analysis and reporting.

TWSEAS is a member system in the family of Marine Corps Tactical Command and Control System (MTACCS). It utilizes techniques and tactical equipments which are similar in many rspects to those which will be incorporated into the combat systems being developed under the MTACCS concept. Thus, although developed primarily for training applications, TWSEAS systems will play a significant role in preparing Marines for the advent of these new systems. Their employment in tactical exercises will provide an important experience base with the key concepts of computer assistance for command and control of combat operations.

The Marine Corps plans to deploy three TWSEAS systems initially, one for each Fleet Marine Force (FMF) and one for the Marine corps Development and Education Command (MCDEC). Two systems are now being readied for service use and action has been initiated to acquire a third system. A

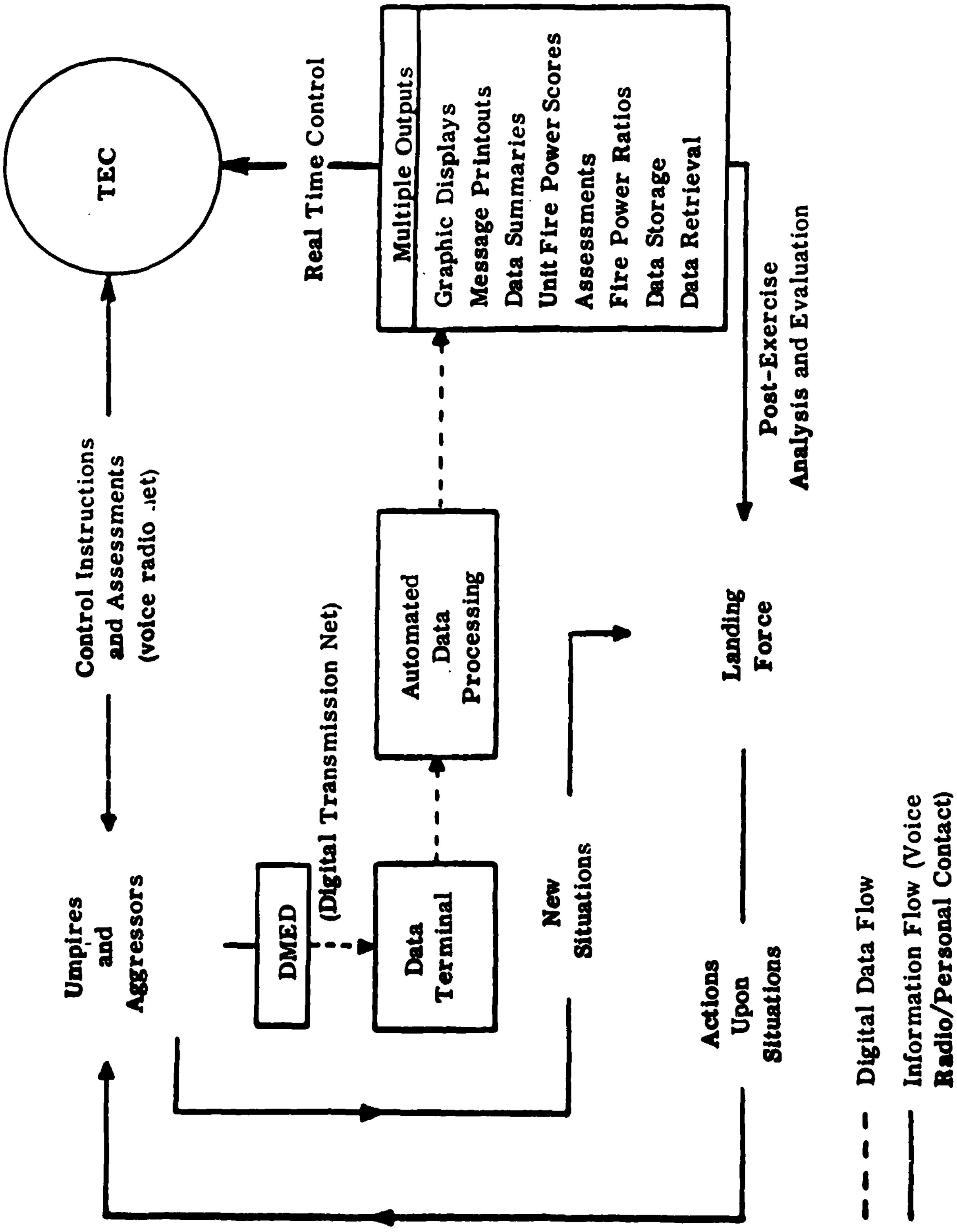


Figure R-2: Functional Flow of TWSEAS Data functional flow diagram is shown in Figure R-2.

(b) <u>Radar</u>. The following counter-mortar radars are available within the tactical units:

AN/MPQ-4
AN/MPQ-10A

(2) <u>Airborne Elements</u>

(a) <u>Radars</u>. The MACS-7 radar capabilities are:

<u>1</u> AN/TPS-32

Frequency = "S" Band 2900-3100 MHz

Power out = optional 60KW-2.2 MW

= 4 modes of operation

Range = 2.5-300 N. Miles

Antenna = 6 RPM Phased Array

PRF = Variable

Power Reg = 2 45 kW Gen

<u>2</u> AN/VPS-1

Frequency = "L" Band 1250-1350 MC

Power out = Peak 1 Megawatt

Range = 2-275 miles

Antenna = Variable 1-15 RPM

PRF = 267 or 800

Power Reg = 1 30 kW Gen

<u>3</u> AN/TPS-22

Frequency = "L" 406-450 MH

Power out = 2 Megawatts

Ranges = 2-256 miles

Antenna = 6 RPM Cosecant squared

PRF = 295

Power Reg = 45 kW Gen

= 4 modes of operation

MCTSSA has similar radar capabilities to MACS-7 with a TAOC/Radar detachment stationed at Camp Pendleton, California.

b. Timing

(1) Primary. The primary source of time correlation at Camp Pendleton is IRIG time code obtained from Pt. Mugu via lease line. This lease line provides standard IRIG formats correlated to WWV via the Point Mugu master timing station.

(2) Secondary. Portable time code generators set to time of day are used for local time correlation.

c. Television. One mobile van with cameras, recorders, editor, switcher, film/slide chain and audio record/playback. Requires externally supplies AC power, 200 amps of 230 volt AC 3 phase at 60 hz.

(1) Two RCA TK 44B three plumbicon color cameras, equipped with extended red plubicons, capable of being utilized 300 feet from the production van.

(2) Chromo process module with bias light application and use of extended red plumbicon allow accurage color renditions without streaking at levels as low as six foot candles. Variable NANo amplifiers for each plumbicon tube and neutral density daylight filters in an internal filter wheel allow daylight application. Cameras are currently aligned to 125 feet candles.

(3) Audio unit will accept three microphone inputs and three line inputs from external sources. Three internal playback channels are available (two cassette and one reel-to-reel).

(4) Two RCA TR 60A recorder/playback units, one unit equipped with an RCA TS51 editor's console and editor; additionally, this monbile unit is equipped with an RCA TP55 multiplexer utilizing a TK 27 film chain camerra to accept from a tP66 16mm film projector and a TP 7B two-channel 35mm slide projector. Cameras and film chain feed through and RCA TS51 switcher equipped with special effects generators from the TE 60 effects panel.

(5) This unit is being utilized to produce instruction tapes for Marine Corps training and schooling.

(6) This unit is contained in a mobile, air conditioned van.

d. Photography.

(1) Motion picture unit is limited to 16mm filming.

(a) Twelve B&H Filmo, hand-held field cameras.

(b) Five Arriflex long-run cameras, with signal generators for double system synchronous sound recording.

(c) One Arriflex silent operating production camera, capable of either single system magnetic strip sound recording or double system sound recording.

(d) Three Nagra III and one Nagra IV, 1/4" magnetic tape recorders for use with signal generating cameras. Sound recording section has a 16mm magnetic film system with one channel record/reproducer and three cvhannel reproducers through a sound mixer. Optical sound transfer must be done by the Naval Photographic Center or a commercial contract.

(e) 100 kW, truck-mounted, generator used to provide DC power for lighting. This unit has five arc lights, three 10,000 watt lights, and numberous lights from 5,000 watt to 1,000 watt and television type lights.

(f) Motion picture unit is used to produce Marine Corps training films and recruiting/public information films; technical training films and filming for testing and evaluation of new or proposed equipment/techniques in the field, on location, or on the sound stage.

(g) This unit has no film processing/print capabilities. A commercial contract (3-day rushes) or the Naval Photographic Center (20-day rushes) are used for processing and printing.

(2) Still photography: All normal still equipment is available - 35mm color/B&W, 120 color/B&W. Black and white prints to 20 x 24, color prints to 16 x 20. Automatic film and paper processing is available. Copy cameras and slide reproductions and aerial photography (limeted to hand-held 120/35mm).

(3) A limited airborne capability is utilized. This is accomplished by use of a Tyler helicopter mount or use of a dynalens image stabilizer. High performance filming is limited to hand-held B&H 70 DR's or Arriflex "S" cameras from the "back seat/"

e. Instrumentation Calibration Capabilities. The Maintenance Battalion, First Force Service Support Group, has the calibration capabilities of the AN/TSM-119 calibration complex as listed in Table R-6. Listed below are the AN/TSM-119 capabilities that cannot be supported by the First Force Service Support Group.

Optical Instruments	No capability
Dimensional Instruments	No capability for test belts or barrel erosion gages
Radiac	No capability
Pressure	No capability above 5000 PSI
Torque	No capability above 1000 ft/lbs

Frequency Generation	No capability above 12.5 GHz
RF Power	No capability above 500 watts at frequencies above 30 MHz

f. <u>Other General Instrumenation</u>

(1) <u>Telemetry</u>

<u>Data Links</u> (TADILS's)

TADIL A is an omnidirectional netted link which can be used with the moving ships of the Navy. *TADIL B is a point-to-point data link which is* used with Army and Air Force units. TADIL C is the remaining standard used for aircraft control.

TADIL D link would be the interface provided by a DTAS-like system with digital burst transmission of air support requests going to FSCC and DASC. TADIL D has not yeat been fully prescribed by JCS Pub 10.

(2) <u>Meteorological</u>. The Marine Corps Auxiliary Landing Facility (MCALF) can provide 24-hour meteorological surveillance for the air facility at Camp Pendleton. The meteorological equipment available at MCALF is listed below.

- o 1-Cabinet-Display Board, Meteorological Data
- o 1-Wind Direction-Velocity Indicator
- o 2-Alden Helix Recorders
- o 1-Aneroid Barometer
- o 1-Recorder, Wind Direction and Speed RD-108B/UMQ-5
- o 1-Microbarograph
- o 1-Mercurial Barometer ML-512/GM
- o 3-Teletype Machines
- o 1-Meteorological Plotting Board

Standard meteorological equipment is located within the tactical units tenated at Camp Pendleton. This equipment inlcudes the following.

o AN/AMM-1	Radiosonde Baseline Check Set
o AN/TMQ-SC	Radiosonde Recorder
o AN/ANG-1A	Rawin Set
o AN/AMT-4	Radiosonde Set

Table R-5
CALIBRATION CAPABILITIES - AN/TSM-119

ALTERNATING VOLTAGE (ACTIVE)	FREQUENCY STANDARDS (PASSIVE)
ALTERNATING VOLTAGE (PASSIVE)	FREQUENCY RESPONSE (ACTIVE)
DIRECT VOLTAGE (ACTIVE)	FREQUENCY STANDARDS (ACTIVE)
DIRECT VOLTAGE (PASSIVE)	FREQUENCY STANDARDS (PASSIVE)
ALTERNATING CURRENT (ACTIVE)	VSWR (ACTIVE)
ALTERNATING CURRENT (PASSIVE)	VSWR (PASSIVE)
DIRECT CURRENT (ACTIVE)	ATTENUATION (ACTIVE)
DIRECT CURRENT (PASSIVE)	ATTENUATION (PASSIVE)
RESISTANCE (ACTIVE)	POWER (ACTIVE)
RESISTANCE (PASSIVE)	POWER (PASSIVE)
INDUCTANCE (ACTIVE)	NOISE/DISTORTION
INDUCTANCE (PASSIVE)	TORQUE
CAPACITANCE (ACTIVE)	
CAPACITANCE (PASSIVE)	
FREQUENCY STANDARDS (ACTIVE)	

o AN/RMQ-14 Meteorological Station

o AN/TMQ-17 Meteorological Station

(3) Survey. The tactical units tenated at Camp Pendleton have the standard military field surveying equipment. This equipment includes astronomic and field artillery surveying sets.

The Survey Unit of the Public Works Office provides lower order surveying. Second order surveying is accomplished by the U. S. Geodetic Team stationed at Pt. Mugu.

(4) Radio Frequency Interference. None.

(5) Visibility. None.

(6) Sound Measurement and Analysis. None.

(7) Safety and Security. None.

(8) Soil Conditions. None.

g. Special Purpose Instrumentation

(1) Ballistic Data. The M36 (AN/GPS-25) Radar Chronograph is used to measure muzzle velocities.

(2) Environmental Chambers. None.

(3) Vehicle Performance. None.

(4) Chemical/Biological/Radiological. Geiger counters are available on post for radiological measurements. No chemical/biological instrumenation is available.

5. Threats/Targets

a. Ground. Although all ranges at Camp Pendleton possess either stationary, moving, or pop-up targets, only Range 408 has a tactical simulation system.

Range 408 is intended for basic and advanced field training; attack tactics against forces of different strengths deployed as strong points, supporting each other; proper deployment of attacking forces and use of squad or platoon as reserve.

It is used to test a leader's ability to read terrain, determine applicable tactics, and coordinate activities of a combat team; to train members of a combat team to work as a unit, to react to the unexpected, and to advance over various types of terrain under fire.

The Combat Rifleman Environment Training Range provides facilities for coordinating the remote control of three target sets, 10 small ares simulators, and 15 artillery and demolition simulators permanently emplaced on suitable terrain features to form four defended objectives in depth. The training range provides for realistic combat training at the squad, platoon, or company level under conditions imulating battleground realism.

Instructors, control operators, and observing personnel are stationed in two control towers from which the entire tactical operation may be observed and controlled. An intercommunication system between the towers, together with a high-powered public address system and warning sirens, provides for complete coordination of all oprations on the training range. The training range is a permanent installation used for familiarization and training of troops in battle tactics for objectives of various types and complexities.

The training range includes two control towers which provide observation and control of training problems. Located in concrete bunkers at strategiv points are 30 remote-controlled targets, 15 demolition simulators, and 10 small arms simulators to provide a realistic environment for the training problem.

Individual target sets can be activated as desired. Hits on individual target sets are automatically recorded. Individual small arms simulators can be activated as desired to simulate either rifle fire or machine gun fire.

Individual demolition simulators can be activated as desired to simulate artillery or land mines.

Terrain features of various types provide for development of many types of tactical problems to be solved by the combat team.

b. Airborne. The MACS-7 squadron located at Camp Pendleton has an extensive training simulation facility and inherent ECCM capability in their radar systems.

(1) Simulator. The Trainer, Device 15A19, was designed to avoid the problems of placing many aircraft in the Marine tactical Data System (MTDS) locale, which could normally be required to properly train Air Defense Control Officers for training would be expensive (to say nothing of the danger of flying them down to 1000 feet altitude at speeds of 1200 to 1500 knots), and the electronic countermeasures (ECM) they might generate for training is most undesirable in the continental United States (the adverse effects upon radio and television reception, etc.). The trainer was designed to avoid these problems and yet provide this tactical training.

By computer programs and electronic equipment, the trainer provides training in real-time simulated raids consisting of up to 60 simultaneously maneuverable targets. Target specifications follow.

(a) There are a maximum of 60 programmed aircraft target tracks, 12 of which have IFF/SIF capability and can be either manually maneuvered by operators, or automatically maneuvered by Air Operations Central (AOC) intercept computer commands (course, speed, altitude) as desired.

(b) There are a minimum of 12 programmed airborne video target tracks.

(c) There are a minimum of 12 programmed video target tracks, simulating any combination of false targets or airborne aircraft.

(d) Any three of the targets in specifications (a), (b), or (c) can simulate ECM simultaneously.

(e) Any three targetrs mentioned in specifications (a) or (b) can simulate four false targets simultaneously.

(f) Any number of targets mentioned in specificatios (a), (b), or (c) can simulate incoming or outgoing crosstell and handover conditions with an adjacent AOC, or with the local AOC as desired.

(g) Fuel status is displayed for the 12 manually or automatically controlled target tracks of specification (a).

(h) Maximum velocity of Mach 4.0.

When the trainer is connected into the MTDS tactical equipment, it can be used to demonstrate top students the fundamentals taught in the classroom, as well as the application of these fundamentals to complex air space situations portraying ECM conditions and air raids containing friendly and hostile targets at various altitudes and speeds. A selection of training situations can be inserted into a CP-808/TYK Computer. These training programs can be selected to reflect the desired tactical situation. The degree of complexity can be controlled during the pre-programming phase. A problem is started by the instructor. The traine the proceeds to produce realistic targets for the student. The program provides real-time movement of the targets and the students perform accordiningly. The instructor has the ability at his console to call up and see on the cathode ray tupe (CRT) exactly what is on any of the student displays for monitoring purposes. The instructor can: create problems of variable difficulty through his control, modify the initial situation as desired, and interrupt a problem by freeze action and provide corrective instruction during the freeze.

This trainer can be operated in conjunction with and without interfering with the actual air control functin of the AOC.

(2) Electronic Counter-Countermeasures (ECCM). Designed into the radar systems associated with the TAOC are extensive ECCM facilities. These facilities can be used to train attack pilots in EW and evasive techniques. Additional informaton on the ECCM features of the TAOC may be found in the following classified documents:

(a) AN/TPS-32
TM-04001A-14/3
TM-04401A-14/8

(b) AN/TPS-22
TM-02466-15/2
TM-02466-15/3

6. Data Handling/Processing

a. Camp Pendleton Facilities. The automatic data processing (ADP) equipment owned by Camp Pendleton includes:

- o IBM 360/50 using OS/MFT with 512K or memorv
- o 26 - Potter 5314 Disc Drivers
- o 12-9 Track 800 BPI tape transports (2401 type or equivalent) with 2 controllers
- o 2-High Speed Line Printers
- o 202540 Card Read Punch
- o 1-2701 Data Adapter Unit (Communication Controller)
- o 6-10528 Remote Terminals
- o FORTRAN/COBOL languages

In addition, a Farrington 3030 Optical Card Reader (off-line) and off-line card handling equipment (key punch, verifier, sorters, etc.) is available.

At the present time, the system is utilized two shifts per day, five days a week. The primary usage is for inventory control. The system could easily handle a 30 percent increase in workload without serious degradation of the present 24-hour turnaround.

b. Fleet Marine Forces (FMF). A deployable data processing system is available via the 1st Marine Division. The FMF system consists of:

- o IBM 360/65 using OS/MFT with 512K memory
- o 2 - 1401-N1 line printers
- o 1 - 2540 card read punch
- o 1 - 3707 communication controller
- o 2 - 2922 remote job entry terminals (one at El Toro, one at Twenty-nine Palms)
- o 12 - 3430 disc drives
- o COBOL/ALC/Retrieval IV languages

The FMF system is used extensively for inventory control and could [illegible]ndle a 30 percent increase in workload. The present turnaround time is 24 [illegible] The FMF system is a part of the Force Information System.

[illegible]MCTSSA. The Marine Corps Tactical Systems Support Activity (MCTSSA) [illegible]er facility for development, testing, and maintenance of [illegible]rams used in tactical data systems. The facility is essentially a PDP-11/70 with three militarized tactical computers as slaves, and associated peripherals (disc and tape drives, printer, card reader, and console). The system is being modified to include interactive programming and graphics capabilities through CRT terminals. Present compilers handle CMS-2, FORTRAN, COBOL, and BASIC.

Other militarized computers and peripherals are used in testing developmental systems, primarily for data reduction, simulation, and interoperability tests.

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ANNEX S

OPERATIONAL TEST INSTRUMENTATION GUIDE

UTAH TEST AND TRAINING RANGE (UTTR)

HILL AFB, UTAH

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ANNEX S

UTAH TEST AND TRAINING RANGE (UTTR)
HILL AFB, UTAH

1. Introduction

Overview. A new major range and test facility (MRTF) to be known as the Utah Test and Training Range (UTTR) was activated January 1979 under AFFTC management. This MRTF consolidated under single management of Hill and Wendover AF Ranges, a portion of the Dugway Proving Grounds, the airspace over Hill Wendover, and Dugway ranges and adjoining military operating areas (MOA) and air traffic control assigned airspace areas (ATCAAA). The 6545th Test Group, composed of the 6514th Test Squadron and the 6501st Range Squadron, was activated to provide AFFTC field operations for unmanned vehicle testing and management of the new MRTF. The 6501st Range Squadron has on-site responsibilities for range operation, maintenance and operational engineering and will receive matrix management support from the AFFTC in the major areas of development engineering, budget, and programs.

The general area of the UTTR is contained within the Great Salt Lake Desert. This dry lake is about 86 miles wide and 192 miles in length. The area has certain ideal geographical features desirable in a range. A major asset is that it is remotely nearby; that is, it is distant enough from population centers for hazardous testing, yet it is sufficently close to sources of manpower and materiel for logistic support.

The UTTR is composed of separate Air Force owned and Army owned land, which is managed by the Air Force Systems Command. The Air Force-owned land areas consist of the Hill Air Force Range to the north, located above Interstate I-80, referred to as North UTTR, and the Air Force Wendover Range to the south and Dugway Proving Ground (DPG) which are referred to as South UTTR. The Air Force manages only the Army land west of 113 20' on the Dugway Proving Ground.

Michael Air Field, a 13,000-foot runway equipped with arresting gear, is located at DPG. The runway is used by Air Force for staging range exercises and as a diversion station for aircraft arriving with hung ordnance. The UTTR comprises more than 1,700,000 acres of land--the largest DOD-owned land areas in the United States. In conjunction with this land area, there are approximately three million acres covered by special-use airspace. In addition, special operating areas extending into the State of Nevada increase the total usable airspace to cover just under 5,000,000 acres.

Major development test and evaluation projects being supported are the ALOM, GLCM, Maverick Alternate Warhead, and GBU-17. Future programs are expected to include ASALM, AMRAAM, WAAAM, B-1 Penetrativity, and LOCUST. Major service test and evaluation projects are the F-16 and the F-4 OFP software validation and verification efforts, tactical operations training scenarios utilizing realistic target systems such as CORONET REAL and DESERT STRONGHOLD; desert, water, and mountainous topography; and generous airspace resources are provided to support the tactical Air Command, Strategic Air Command, and tactical units from the Navy, Marines, Air Force Reserve, and the National Guard.

The 6501st Range Squadron will manage UTTR enhancement. The 6501st Range Squadron also manages the airspace over the UTTR and the range support resources.

2. Dimensions

a. Airspace. The airspace over the North UTTR and the adjoining BLM land results in an enlarged, irregular polygon. The east boundary of 19 NM remains the same, the west boundary becomes 25 1/2 NM, the south boundary 33 NM and the north boundary 44 1/2 NM.

(1) Landspace/Airspace Relationship. Figure S-1 denotes the airspace over the UTTR.

(2) Joint-Use Facilities

(a) Special-Use Airspace. A joint DOD/FAA agreement has been established for release of the special-use airspace to FAA when not used by DOD agencies.

(b) Areas Under Joint-Use. The following areas within the UTTR are under a joint-use agreement with FAA.

R-640A Surface - FL580
R-6405 Surface - FL580
R-6406 Surface - FL580
FAA joint use above 7.5 MSL continuous.
R-6407 Surface - FL580
FAA joint use above 15 MSL continuous.
R-6402 Surface FL580
FAA joint use above 15 MSL continuous.

(c) Montello Assigned Airspace

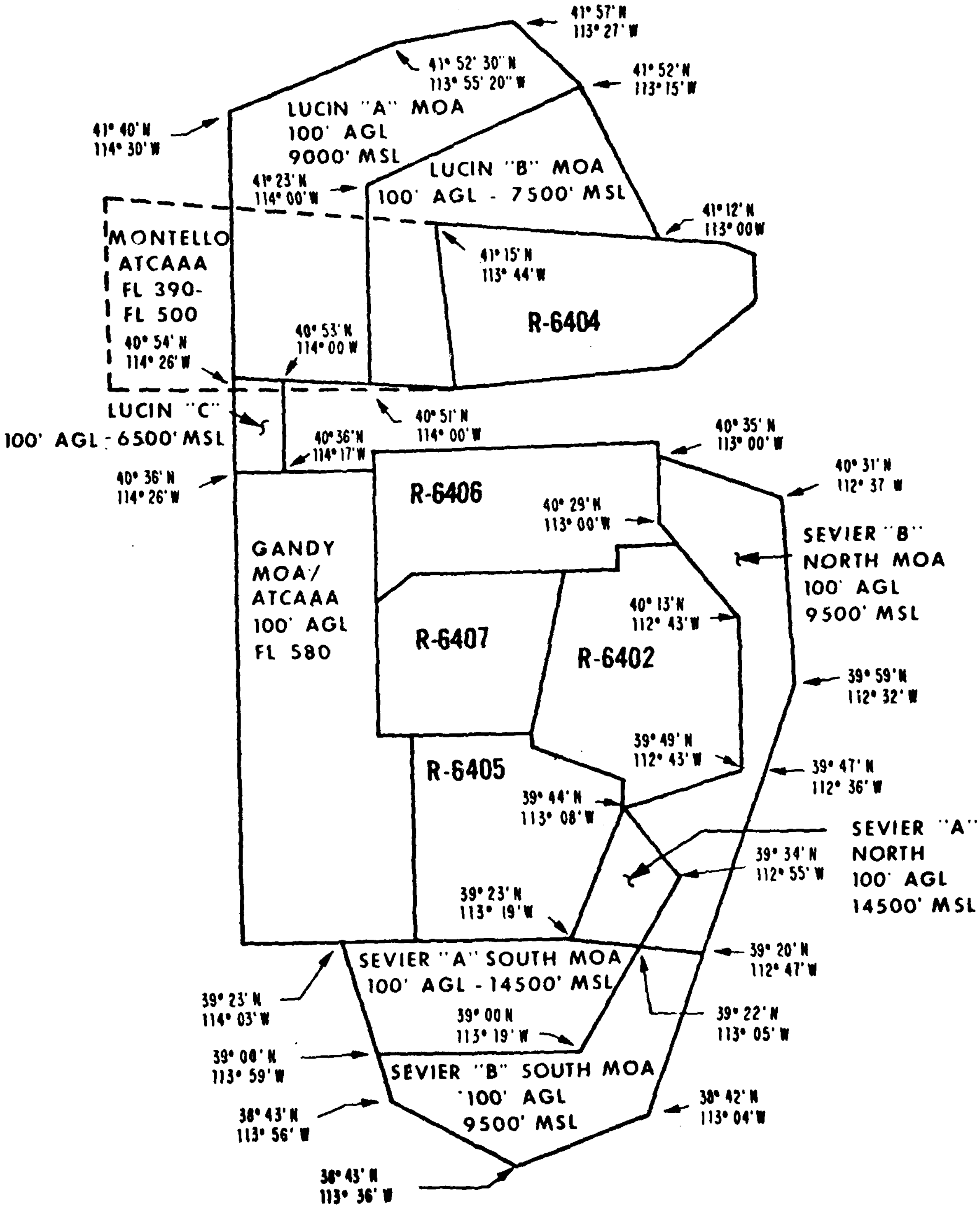
Available FL390 - F1500

(d) Gandy Extension. The Gandy Extension is an FAA Air Traffic Control MOA assigned Airspace 1500' AGL - FL580 and will be released by the Salt Lake City Center upon request.

(e) Supersonic Airspace (R-6402, R-6406, and R-6407). 5.0m AGL FL580 continuous.

UTAH TEST AND TRAINING RANGE AIRSPACE

MILITARY OPERATIONS AREAS (MOA)
ATC ASSIGNED AIRSPACE AREAS (ATCAAA)



b. Landspace

(1) Major Test/Operations Areas

(a) North UTTR, R-640A. Figure S-2 illustrates the configuration of the North UTTR. Range R-6404 is an irregular polygon covering a total of 351,539 acreas. The east boundary is 19nm, the west boundary 26 1/2 nm, the south boundary 33 nmi, and the north boundary 44 1.2 nm. The northern portion of the range, R-6404B and C, contains both administrative and test structures/facilities to support static and air-to-ground testing. R-6404 is generally divided into live and inert testing. The airspace for this range is larger than the surface area. R-6404A is used for low and high altitude bombing, air-to-surface gunnery and rocketry, radar bomb scoring, ground testing of high explosives, munitions disposal, and service engineering testing.

R-6404B is used primarily for static testing of rocket motors, high explosives, propulsion evaluation, and testing of inert munitions.

R-6404C is used for air-to-surface tactical training, specialized equipment testing, and for explosive ordnance disposal. Tactical targets include armored vehicles located throughout the area in fields, canyons, and roads.

(b) South UTTR, R-6406, R6407, R6405, R6402. The South UTTR R-6406, is basically rectangular, 42 x 21 nm, consisting of 576,157 acres. Most of the land area is salt flats completely devoid of rocks, soil or plant life. The range area is unmanned and has been used in the past primarily for air-to-air and air-to-surface gunnery, rocketry, missile firing, and visual and radar bombing. Figure S-3 depicts this range. R-6405 is also part of the South UTTR but there is no DOD land under the designated airspace.

(2) Inert/Live Firing Areas. Inert and live testing is authorized on various areas of the range complex except in the immediate vicinity of permanent structures.

3. General

a. Military Units

(1) Air Force Units. The following Air Force units located at Hill AFB use or support range test programs:

6501st Range Squadron - Operation/Management
6514th Test Squadron - User
6545 Test Group - Parent Command of 6501st & 6514th
2849th Air Base Group, Det 2 - Support
508TFG, 301st Tactical Fighter Wing - F-105 Fighter/Bomber Testing, Air Force reserve - User and Support
299th Communications Squadron, Utah Air National guard (Salt Lake City) - Support
151st UANG - Support
1881st Communications Squadron - Support

Det 6, 15th Weather Squadron - Support
388TFG - User
2701st Explosive Ordnance Disposal Squadron - Support
Det 4, Helicopter Wing - User and Support

(2) Army Units. Dugway Proving Ground.

(3) Navy Units. None.

(4) Other. AFFTC, Edwards AFB, CA. 6510 Test Wing - Parent Command of 6545th Test Group

b. Access. US Interstate 80 and Interstate 15 connect the UTTR with the national highway network. Two major interstate freeway systems and four major railroad systems intersect in Salt Lake City. The Salt Lake City International Airport is serviced by major commercial airlines. Both Hill AFB and DPG have airfields for military aircraft use. The Wendover AF Auxiliary Field is now owned by the City of Wendover, but can be used for emergency landings.

c. Logistics Support Capability. Lakeside operation, North UTTR, provides dormitory sleeping quarters for approximately 120 personnel.

Complete ammunition storage, handling, and operating facilities are provided with the test facilities. This includes magazine storage, components-holding buildings, agent transfer facilities, safety controls, assistance, and administrative control of the testing facilities to assure security of the customer's test items.

d. Recurring commitments. On a scheduled basis, Air Force, Army, and Marine Reserves use the ranges for testing, training, and operational type activities.

e. Environment. The climate at the UTTR is generally arid with no extended periods of extreme cold, heat, snow, wind, or rain. Excellent flying weather prevails - 96 percent of the hourly observations show ceilings of 3,000 feet or higher, and visibility of three miles or greater.

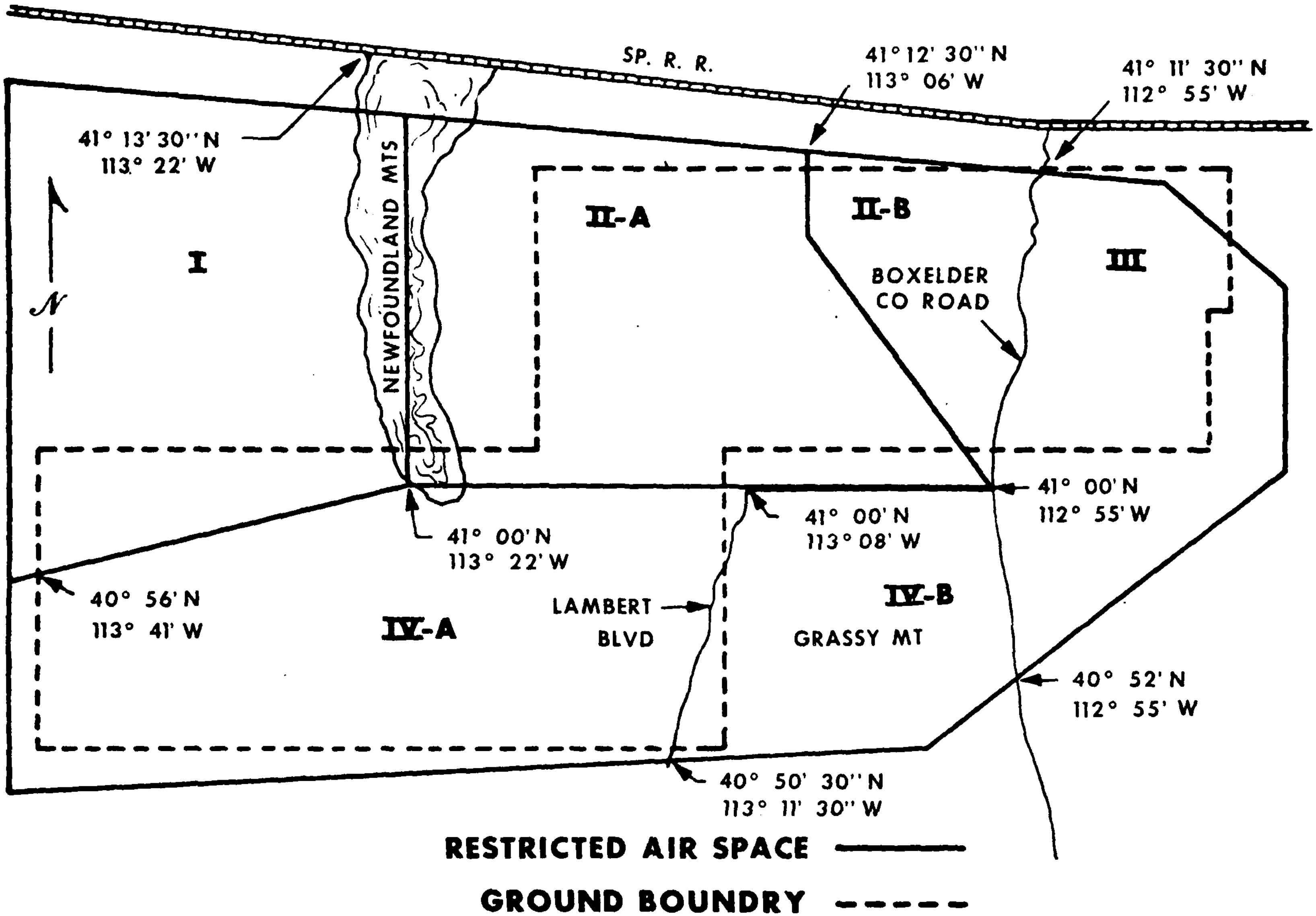
Summer afternoons are quite hot with maximum temperature averaging 94 F during August, the warmest and driest month. In the summer, precipitation consists of rain showers and thunderstorms, which usually occur in July and August. With high winds (50 mph or more), blowing dust and sand reduce visibility substantially and cause damage to exposed surfaces, such as paint and glass.

January is the coldest month with an average minumum temperature of 15 F and an average maximum of 38 F. The highest incidence of snowstorms occurs in January with snowfall averaging about four inches.

Storms have short duration and visibility exceeds ten miles during more than 95 percent of the year. Thus, field tests can be carried out about 350 days of each year.

f. Topography. The UTTR has a wide variety of terrain features from

NORTH RANGE WORKING AREAS



SOUTH RANGE WORKING AREAS

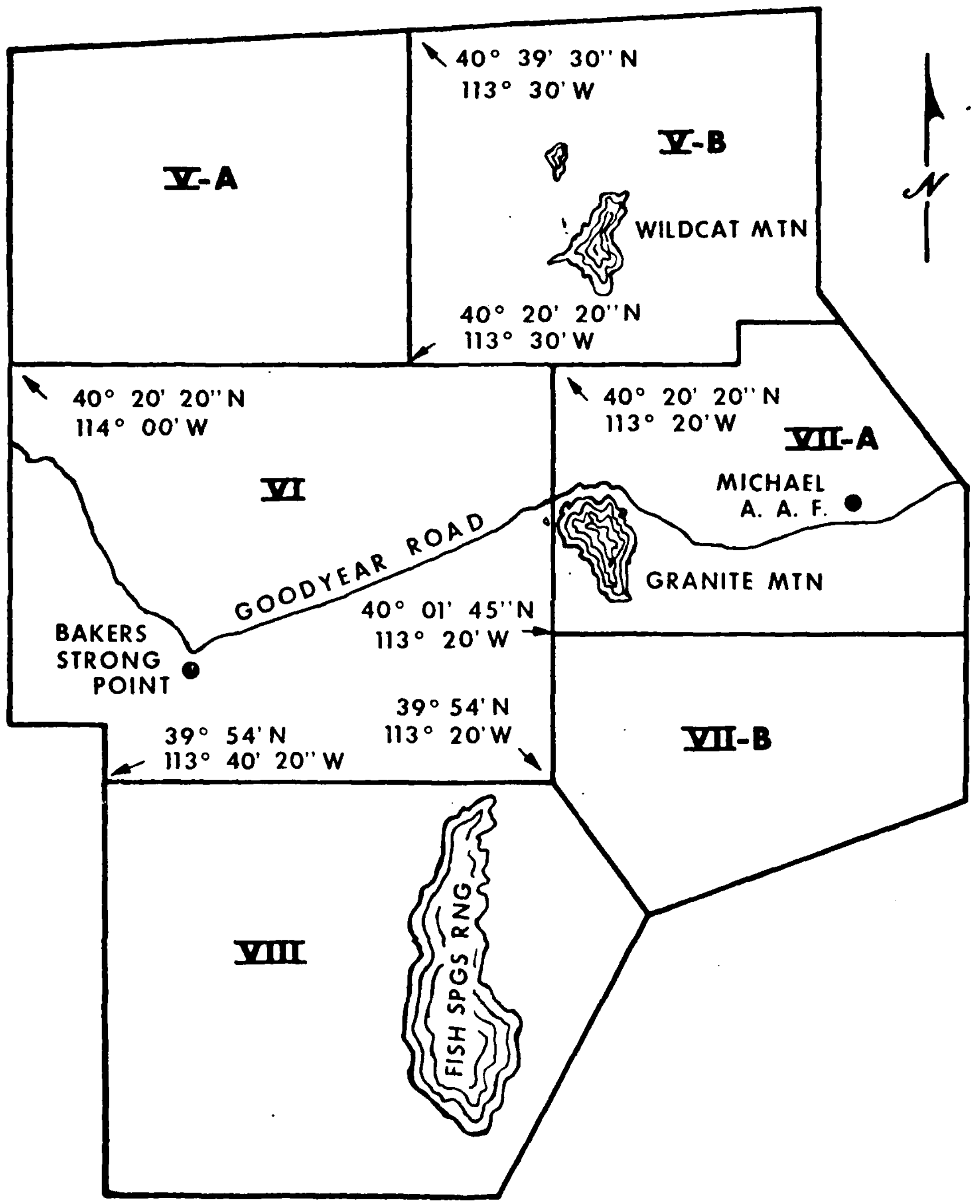


FIGURE S-3

expansive and level salt flats to rugged mountains. The Lakeside and Grassy Mountain Ranges are located on the east side of the North UTTR.

The Stansbury and Oquirrh Mountain Ranges are located on the east and Simpson and Dugway Ranges on the South UTTR. Deep Creek Range and Dutch Mountain are on the west. The Cedar Mountain Range, extending from English Village (DPG) (northwesterly), forms the northeast boundary of the Dugway installation. Little Granite Mountain, Camel Back Ridge, Wig Mountain, and Granite divide the installation into minor areas. Plateau elevations average about 4,300 feet above sea level with ridges and peaks generally rising between 1,000 and 3,000 feet above the plateau. The landspace that surrounds the UTTR is primarily owned by the Bureau of Land Management (BLM). It is very sparsely populated and has little or no value for grazing. This condition offers an excellent potential to support future DOD testing requirements.

g. Communications

(1) Microwave

(a) An RML-3 microwave link is presently being utilized to provide voice UHF, FM radio and radar video from the Francis Peak Site to the 299th Communications Squadron (Air National Guard) Air Traffic Control function in Salt Lake City, Utah. All the data being provided over the system support the UTTR.

(b) A leased microwave system provides telephone service between the North UTTR, R-6404, and Hill AFB, Utah. Capacity of the system is 12 channels. Eight of the 12 channels are presently being used. The system is capable of voice, data (narrowband), and video. The leased telephone system is an automatic 60-line exchange.

(2) Radio Communications

(a) Radio Communications are located on Francis Peak, under control of the Utah Air National Guard (299th Communications Squadron). FAA maintains facilities and equipment on the "Tenant" status at the site. This site is dedicated to full-time support of the ranges. The location affords radio and radar coverage of the entire range complex, with some limitations on low-level coverage. Present equipment includes 18 UHF air-to-ground radios and VHF FM radios. A complete artic dome tower is available for future communications expansion.

(3) Landline. Commercial telephone service, and government telephone service, is available for AUTOVON and local telephone. WATS lines through the HAFB switchboard are also available. Through these systems, worldwide voice communications are possible.

4. Instrumentation

a. Space Positioning Support

(1) The Instrumentation Radar System (IRS) is a tracking radar located at Wendover AFAF.

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(2) VATS-777 tracking radar for coverage of Ranges R-6402 and R-6407. The Vehicle Acquisition and Tracking System (VATS) 777 is a self-contained projectile tracking radar system which is used to position cinetheodolite cameras and to plot real-time position data.

(3) Francis Peak has an ARSR-1E radar that provides surveillance coverage throughout the entire range complex.

(4) Photo-optics is available at the UTTR; six mobile contraves cinetheodolites model "D" and six model "C" mobile cinesextant tracking cameras, two of which are equipped with shaft encoders.

(5) High accuracy multiple object tracking system (HAMOTS), a multi-lateration position location system, consisting of 28 unmanned interrogation stations to cover R-6405, R-6407, and R-6402, provides data for up to 40 separate targets from which accuracies in the order of four to five meters can be derived. The system is controlled in Mission Control Center Bldg. 1274 at Hill AFB.

(6) A narrow band microwave system for video/data channels, interlinks the Granite Peak, S-3 site, Wendover via Grassy Mountain and Francis Peak to building 1274 (Hill AFB). This system will also accept data inputs from the Francis Peak radar.

b. Timing. IRIG timing formats A, B, G, and H are available throughout the majority of the UTTR. The time code generator which converts the day, hour, minute, and second into binary coding for transmitter modulatin is maintained to an accuracy of one part in 108.

c. TV Equipment. The UTTR has the capability for closed circuit television (black and white) including mobile cameras with microwave transmission to the master recording and display facility at Mission Control Center, Bldg. 1274 at Hill AFB.

d. Photography

(1) Motion Picture Capabilities. These are numerous cameras used on the UTTR consisting of pin register and rotary prism framing types. Cameras are 16mm, 35mm, and 70mm and speeds vary from 1 to 44,000 frames per second. Turnaround time varies from two to five days depending on the number of frames per second and length or film to be processed.

(2) Airborne Photography. Hill AFB can provide aircraft-mounted cameras for aerial photography.

e. Instrumentaton Calibration Capabilities. The Precision Measurement Equipment Laboratory (PMEL) at hill AFB is responsible for the calibration reference standards assigned to the Ogden ALC. They perform field level repair, calibration, and certification of common precision measurement equipment for assigned, tenant, and support organizations.

f. Other General Instrumentation

(1) Telemetry

(a) The UTTR has a mobile telemetry system. This system provides 32 channels of pulse code modulated data (PCM) and 10 channels of frequency modulated data (FM). The telemetry system has a frequency response of DC to 2,000 Hz. The system has real-time and tape storage capability. It is used to support airborne, ground munitions, monitoring on-board aircraft instrumentation, and transporter evaluation. Operating in the S-band and over ranges of up to 20 miles, frequency response capability is DC to 2,000 Hz. The telemetry transmitter is used in stationary, ground mobile, or airborne applications. A tracking antenna is incorporated and utilized in the vicinity of a mobile ground station. The ground station has the capability to provide a real-time look at data of selected channels as well as tape storage of the total program. This telemetry system is designated to support airborne and ground munition function tests, transporter evaluations, wheel and brake studies, monitoring aircraft on-board parameters, and other engineering applications as required.

(b) A fixed telemetry system is located at Granite Peak.

(2) Meteorological. Standard weather information is available at Hill AFB Operations.

(3) Radio Frequency Interference/ Electromagnetic Compatibility. The 1881st Communications Squadron provides frequency management services to the UTTR. Additional resources are available, such as the Electromagnetic Compatibility Analysis Center (ECAC) used for spectrum environment studies.

(4) Visibility. No visibility instrumentation or equipment is available.

(5) Safety and Security. The Safety Office of the 6545th Test Group and the Ogden ALC provides for safety in all areas of the UTTR activities, to include flight, missile, explosive, and appropriate ground/industrial safety areas. The 6545th Test Group Safety Office will be the focal point for integrating of existing safety programs into the overall Commander's Accident Prevention Program and exercises complete safety surveillance during mission operations. The 299th COM SQ (UANG) provides full-period support in weapons and air-traffic control service to aircraft operating within the UTTR.

g. Special Purpose Instrumentation. In the northeast portion of the North UTTR, R-604B, special facilities are in place for testing solid rocket motors.

Horizontal and vertical test stands are available with capabilities for up to 1,000,000 pounds of thrust. Access and maintenance provisions include movable shelters and hoist capabilities up to 50 tons.

5. Data Acquisition and Processing

a. Data Acquisition (Cinetheodolite, Radar, Telemetry). The UTTR provides facilities for film processing and data readouts for telemetry and radar systems. The telemetry reduction equipment in building 1274 will accept and reduce the following data formats: PCM-NRZ, PCM-BIO, PCM-RZ, PDM-RZ, PDM-NRZ, PAM-RZ, and FM/FM.

b. Processing

(1) Data Reduction. Data reduction of telemetry, cinetheodolite, weather, radar, time plots, cross-plots, and multiplots can be provided. The data reduction techniques include numerous calibration, smoothing, conversion, and time reconstruction methods for telemetry data. These techniques can be employed on an "as needed" basis.

(2) Computers and Peripheral Equipment. The principal computer used to support the UTTR is the SEL 32/75 computers. Other available computers at Hill AF Base include CYBER 73.

6. Improvements/Modernization Planning. Technical equipment improvements and acquisitions are required for the enhancement of the present UTTR Mission Control Center (MCC) to accommodate a greater variety of the test and evaluation capabilities, range instrumentation management and control, first generation data processing and handling facilities, improved data display and mission control rooms; secure data, improved data transport to/from DPG and the Edwards FTMCC, electronic warfare threat systems, and enhanced metric radar and cinetheodolite TSPI capabilities.

The High Accuracy Multiple Object Tracking System (HAMOTS) is the heart of much of UTTR instrumentation capability and represents a large capital investment. Current AFGSC policy forbids improvement and modernization of this system except through project funding, thus there is no program to improve the basic capabilities of operational/maintainability features of the system for the purpose of time-space-position information as it is currently used. The system, however, has numerous potential capabilities that have not been explored for other applications; e.g., intercept of miss distance measurements, flight termination, command system, and multiple target formation control programs have been included for the basic development and demonstration of some of these potential capabilities, while it is left to individual projects to fund for implementation, and adaptation of the capabilities for their specific applications and requirements. This is hoped to overcome the long-time required to develop and improve these capabilities for programs whose requirements are seldom known more than six months in advance. There is no adverse impact envisioned with proposed Air Combat Maneuvering System, rather, an synergisitic effect is anticipated.

Other improvements in TSPI capabilities include improvements to existing radar and cinetheodolite systems. The RIR-777 radar system inherited from Dugway Proving Grounds requires either considerable improvement work or complete replacement by a modern system to get it up to a satisfactroy performance level. Cinetheodolite systems inherited from Dugway PG and OO-ALC have never hand any upgrade, and require considerable work to provide required performance and capability for reasonable data turn-around. New semi-automatic film readers are identified to enhance the data file reading turn-around time.

A Data Center in Bldg 1275 at Hill AFB will provide UTTR users a single location in which they can obtain and review post-mission processed data. Interactive capabilities by which users can further analyze their data are included. The Edwards CYBER or its replacement will be accessed from the Data Center, via the romote job entry terminal, for the second and third generation data processing.

The voice communications capabilities required for mission control and operational support are inadequate to the need to UTTR, and must be improved and expanded accordingly. A central electronic switching system, remote switching, and end instruments will be provided.

Microwave data communications systems are critical to the collection of range data and mission communications. The extension of the Microwave Data Communications System into the Dugway and southern Wendover range areas will provide for the Interfaces with the mobile instrumentation in those areas presently blocked from telemetry, UHF A/G radio, and/or radar tracking coverage. The upgrade of microwave systems inherited from Dugway PG and OO-ALC during HAVE CORONET implementation is essential to improve their operability and maintainability, as well as provide their integration into the UTTR.

The UTTR-AFFTC Interface provides those items required to permit UTTR and EFTR to operate as a single system in supporting inter-Range missions. Capabilities for EFTR and UTTR radar and telemetry system handoffs, the integrated use of the status and control system, timing correlation and synchronization, and radar synchronization are included within this program.

Improvements are needed to support scoring of ordnance in order to overcome wholly ineffectual or extremely manpower consuming techniques now used. Microprocessor technology will be applied to bomb drop scoring for near-real time determination of impact locations. Trajectories and attitudes of noncooperative missiles will be determined through use of video tracking systems and computer simulation comparisons.

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ANNEX T

OPERATIONAL TEST INSTRUMENTATION GUIDE

EASTERN TEST RANGE (ETR)

EASTERN SPACE AND MISSILE CENTER (ESMC)

PATRICK AIR FORCE BASE, FLORIDA

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ANNEX T

EASTERN TEST RANGE
EASTERN SPACE AND MISSILE CENTER (ESMC)
Patrick Air Force Base, Florida

1. Introduction

a. Overview. The Eastern Test Range (ETR) is a National Range managed by the Air Force's Eastern Space and Missile Center (ESMC) for the Department of Defense. It extends from the southeast coast of the United States eastwardly to 90° longitude in the Indian Ocean. The ETR (reference Figure T-1) is comprised of a launch head. Cape Canaveral Air Force Station (CCAFS), and a series of downrange stations at Grand Bahama Island (GBI), Grand Turk (GTK), Antigua (ANT), Ascension (ASC), and Pretoria, South Africa. These stations are augmented with instrumented ships (USNS Redstone, USNS Arnold and USNS Vandenberg) and aircraft for support of tests in the Broad Ocean Areas (BOA). In addition, ETR support is supplemented by NASA tracking stations at Bermuda (BDA) and Wallops Island.

Cape Canaveral Air Force Station (CCAFS) consists of 15,433 acres located on the east coast of Florida. CCAFS is isolated to the west by the Banana River, providing a secure buffer zone for the launching of ballistic missiles to the east. The launch facilities and assembly areas, in support of launching ballistic missiles and space launch systems, are located within the boundaries of CCAFS.

The administrative headquarters of the ETR are located at Patrick AFB, approximately 15 miles to the south of CCAFS. Also located at PAFB is a tracking site consisting of two tracking radars, an optical tracker, and a laser ranger system. PAFB further serves as the post-flight data reduction center with the data processing facilities located at the ETR Technical Laboratory.

b. Generic Systems Tested

- Submarine Launched Ballistic Missiles (SLBM)
- Army Tactical Ballistic Missiles
- Space Launches of Synchronous Orbiting Satellites
- Space Launches of Geophysical Satellites
- Space Launches of Deep Space Probes
- RPV's
- Anti-Tank Weapons
- Surface-to-Air Missiles
- Air-to-Surface Missiles

o Sensor Platforms

2. General

a. Major Tenant Units

(1) DoD Units

o Equal Opportunity Management Institute

o Defense Property Disposal Office

o Defense Investigative Service, CCAFS Field Office

o Det 4, Geodetic Survey Squadron

(2) Army Units

o US Army Field Office

o US Army Readiness Group

(3) Air Force Units

o AFSC Met Det 22

o HQ 1035th USAF Technical Operations Group (AFTAC)

o 2179th Communications Group (AFCC)

o 645th Radar Squadron (SAGE)

o Det 15, 38th Aerospace Rescue and Recovery Wing (MAC)

o 2nd Combat Communications Group

o 549th Tactical Air Support Training Group

o Det 11, 2nd Weather Squadron

o Det 6317, Air Force Audit Agency

(4) Navy Units

o Naval Ordnance Test Unit

o Military Sealift Command

(5) Other

o US Coast Guard, Port Canaveral

o NASA, Elements of John F. Kennedy Space Center & Goddard

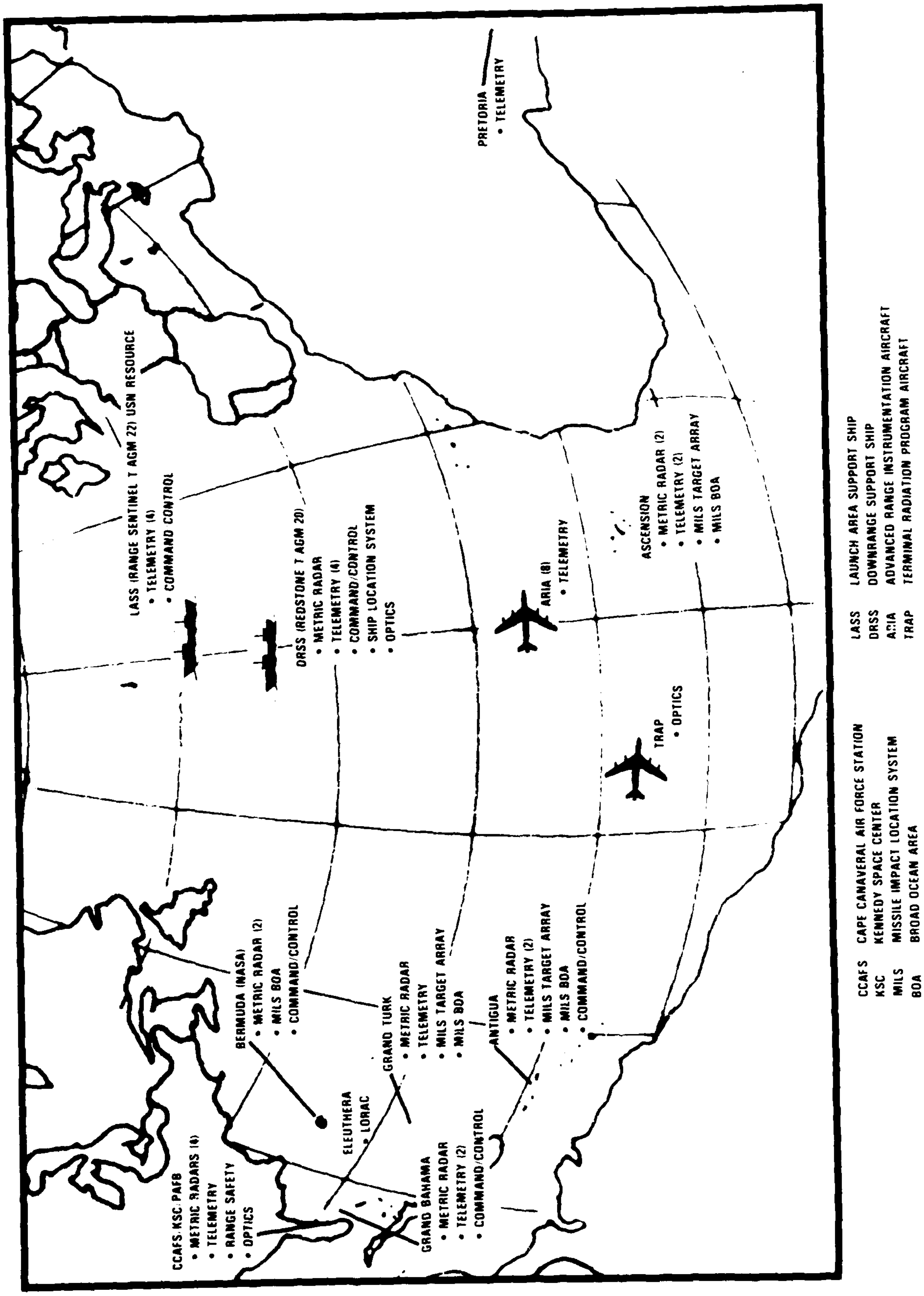

Figure T-1. Eastern Test Range Baseline Configuration

o GAO

o GSA

b. Maintenance Capability

(1) Limited vehicular maintenance is available.

(2) Transient aircraft maintenance is available

c. Access

(1) Air

o Patrick Airfield (9,000 foot runway) for Military Use

o Titusville, adjacent to Cape Canaveral (6,000 foot)

o McCoy/Orlando Airport (12,000 foot)

o Melbourne, Florida (9,500 foot)

o Cape Canaveral's "Skid Strip" (10,000 foot)

(2) Rail. A rail system, connecting the Integrated Transfer Launch (ITL) facility with the Florida East Coast Railroad network, exists at the north end of CCAFS.

(3) Road. Patrick AFB is located between the Atlantic Ocean and the Banana River. A major four-lane causeway provides direct access to US 1 and Interstate 95. CCAFS, line PAFB, is located between the ocean and the Banana River. Two major causeways provide direct access to US 1 and Interstate 95.

(4) Sea. Contiguous to Cape Canaveral is a man-made deep water port (45 feet). The eastern portion of the north side lies within the confines of CCAFS. This area is used to port submarines of the Polaris/Poseidon Class in relative isolation for off-loading of ordnance. At the port entrance, a new turning basin for the new large submarines of the Trident class has been constructed. This basin is completely isolated from the commercial ship traffic.

d. Logistic Support Capability. Patrick AFB operations are logistically supported by the 6550 Air Base Wing and a Base Supply Services Contractor.

e. Recurring commitments. Nothing impacting OT&E operations.

f. Special Operational Restrictions. The airspace over CCAFS and KSC is designated as FAA restricted area R-2902. This area, when activated in support of a launch or other hazardous operation to nonparticipating aircraft, is controlled by ETR Scheduling Division (ROS). During launch, the Range Control Officer controls the offshore and sea traffic within the continental limits of the US.

g. Environmental (Climate). Florida climate has mean temperature of 81° in the summer and 60° in the winter. VFR flying condition prevails 360 days out of the year. Annual precipitation averages approximately 47 inches. The climate is subtropical and during summer months, daily showers in the late afternoon are common. During the late summer and early fall, tropical disturbances occurring in the Caribbean Sea affect local weather conditions. The actual probability occurrence of hurricane conditions in the PAFB/CCAFS vicinity is no greater than that of any other east coast or gulf coast area.

h. Topography. The terrain of CCAFS and PAFB is flat. The soil is very sandy and provides excellent drainage characteristics. The elevation of Cape Canaveral is 12 feet and PAFB is 9 feet. The natural terrain consists of a low ground cover of small trees and bushes. Beaches are excellent and readily accessible with the coastal river providing natural intercoastal waterways for cargo barges and the passage of small coastal river providing natural intercoastal waterways for cargo barges and the passage of small coastal ships.

Patrick AFB covers approximately 10,000 acres and Cape Canaveral Air Force Station is approximately 15,000 acres.

i. Airspace Restrictions. See paragraph f above.

j. Power Availability. Commercial power is available to meet all foreseeable requirements. Two major power plants serving the central Florida area are located within ten miles of the CCAFS.

k. Communications. Extensive wire (landline and underwater cable) and radio, secure and nonsecure communications networks, including data links, have been developed and deployed for ETR operational use. HF radio connects remote sites of Antigua, Ascension, and Pretoria with the launch area. Downrange sites, including Grand Bahama Island, Grand Turk, and Antigua, are served by wideband submarine cable. VHF and UHF radio links serve local test areas.

Satellite communication terminals have been or are in the process of being established at remote sites and ships, including Ascension, the USNS Redstone, Arnold, and Vandenberg. The ETR communications system is discussed in more detail in reference 1 of the Bibliography.

3. Dimensions

a. Landspace

(1) Test Area Contiguity. Patrick AFB is approximately 15 miles south of Cape Canaveral Air Force Station. CCAGS and Merritt Island, the location of NASA's Kennedy Space Center, are separated by the Banana River, with a major causeway linking launch heads.

(2) Easements. None impacting OT&E operations.

(3) Impact/Live Firing Areas. There is no provision for the firing of live ordnance at CCAFS; however, inert firing of PERSHING, DRAGON,

STINGER, SAM-D, PENGUIN, and ROLAND have been, or may in the future be tested at CCAFS. Besides the seaward firings of inert rounds, short range firings can be performed under controlled conditions.

b. Airspace

(1) Landspace/Airspace Relationships. The space above and immediately around the CCAFS and Patrick AFB is controlled by the Directorate of Range Operational Scheduling Division in conjunction with the FAA during all launches.

(2) Manned Airborne Systems. PAFB and Cape Canaveral airstrips are used primarily by military aircraft and mission-related aircraft. The airfields are not open for commercial traffic except for extraordinary circumstances.

(3) Unmanned Airborne Systems. Remotely piloted vehicles (RPV's) have been tested at the CCAFS skid strip. An array of 20 large bay hangars, capable of housing aircraft or drone systems, is adjacent to the skid strip. In addition, special balloon tests are carried out at the CCAFS facilities.

(4) Area Surveillance. Air traffic surveillance for PAFB area is accomplished with the AN/FPS-6 and AN/FPS-66 radars. Air traffic control for the PAFB-Melbourne Airport uses the FPN-47 airport surveillance radar and FPN-16 precision approach radar. Air/sea surveillance for the immediate area of CCAFS is accomplished by a Raytheon Pathfinder Radar.

4. Instrumentation. Instrumentation characteristics are covered in detail in Reference 1 of the Bibliography.

a. Tracking

(1) Ground Elements

(a) Radar

o Radars for airborne element tracking include both ground and shipboard installations. Ground installations are located as shown in Table T-3.

o General performance characteristics of these radars are summarized in Table T-4. Complete accuracy data may be obtained from the ETR Quarterly Accuracy Bulletin.

o Tracking and target signature radars are also installed on two Advanced Range Instrumentation Ships (ARIS) and one Range Instrumentation Ship (RIS).

(b) Laser. Experimental laser illumination tests have been performed at ETR. A ruby laser range finder performs daily tracking of various satellites for NASA.

(c) Optical. Optical instrumentation for airborne element tracking includes:

- o BC-4 Ballistic Cameras
- o Askania KTH-53 cinetheodolites (three mobile and one tower-mounted)
- o Contraves mobile tracking cinetheodolites
- o Fixed metric (ribbon frame) cameras systems (CZ)
- o Intermediate Focal Length Optical Trackers (IFLOT)
- o Mobile Optical Tracking Systems (MOTS)
- o ITEK 48-inch Telescope, Computer Controlled on-Axis Tracking, which now belongs to the Space Divsion (SD) at Operating Location AJ
- o IGOR (Intercept Ground Optical Recorder) Tracking Units (two mobile, one fixed)
- o 16mm, 35mm, and 70mm motion picture cameras

(d) Relative (Miss-Distance). Not applicable.

(e) Airborne-to-Ground Target matching. Not applicable.

b. Timing

(1) Primary

o IRIG timing codes are used. Formats A, B, D, C, and H are available.

o The time signal generators produce 24 different time codes with frame rate ranging from 1 fph to 10 fphs and element rates ranging from 1 ppm to 1,000 pps. The time signal generators are synchronized to world standard Universal Time Corrected (UTC) with the aid of the cast coast Loran-C chain, which is controlled by the US Naval Observatory and radio station WWV, controlled by the National Bureau of Standards.

o The frequency sources are accurate to five parts in 10 billion at Grand Bahama Island, Grand Turk, and Antigua and Cape Canaveral Air Force Station. Ascension uses a free-running atomic standard, manually corrected to maintain specified synchronization.

o All downrange stations contain dual time signal generators and signal comparator.

(2) Secondary. Loran-C and WWV provide synchronization for all downrange stations. Backup synchronization is provided from CCAFS Central to GBI, Grand Turk, and Antigua via the ETR submarine cable.

c. TV. Closed-circuit television of the ETR is generally limited to Patrick AFB and Cape Canaveral, except for boresight TV cameras on precision radars downrange. Systems are used for management and test operations

TABLE T-3. TRACKING RADAR INSTALLATIONS

LOCATION	QUANTITY	TYPE
Cape Canaveral	1	Mod II
Cape Canaveral	1	Raytheon Pathfinder
Cape Canaveral	1	AN/FPS-16
Merritt Island	1	AN/FPQ-14
Patrick AFB	1	AN/FPQ-14
Patrick AFB	1	AN/FRQ-13
Grand Bahama Island	1	AN/FPQ-13
Grand Turk Island	1	AN/FPQ-14
Antigua Island	1	AN/FPQ-14
Ascension Island	1	AN/TPQ-18(M)
Ascension Island	1	AN/FPQ-15
USNS Redstone	1	AN/FPS-16V
USNS Arnold	1	IIR-L/U
USNS Arnold	1	IIR-C
USNS Vandenberg	1	IIR-L/U
USNS Vandenberg	1	IIR-C
Mobile C Band Radar	1	MCBR
Mobile Radar	1	MPS-36

TABLE T-4. RADAR PERFORMANCE CHARACTERISTICS

Type	Freq (GHz)	Range (nmi)	Tracking Rates Azimuth	M RAD/S Elevation
AN/FPQ-14	5.4-5.9	32,000	350	350
AN/FPQ-13	5.4-5.9	32,000	350	350
AN/FPS-16	5.48-5.825	1,000	733	392.6
AN/FPS-16V	5.40-5.9	32,000	733	392.6
Mod II	2,7-2.9	400	350	350
AN/FPQ-15	5.5-5.9	32,000	500	350
IIR-L	1,27-1,290	4,000	610	454
IIR-U	.439	--	610	454
IIR-C	5.4-5.9	32,335	610	454
AN/TPQ18	5.4-5.9	32,000	350	350
MCBR/MPS-36	5.4-5.9	32,000	350	350

support. The fixed Patrick Intercept Ground Optical Recorder (IGOR) tracking telescope includes a closed-circuit TV, whcih provides signals for range users and the TV newspool. Black and white coverge only is available. Equipment is standard commercial quality.

d. Photography

(1) Engineering Sequential and Documentary Photography. 16mm, 35mm, and 70mm motion picture cameras are used to support DoD and NASA launch and nonlaunch engineering and documentary photo requirements. They are capable of operation over a wide range of frame and shutter rates using internal and external magazine lads from 100 to 2,000 feet and varied combinations of lenses and accessories to meet a broad range or requirements.

(a) 16mm Cameras. The 16mm inventory is composed of over 100 Mitchell, Milliken, Fastex, Arriflex, Auricon, Cine Special, Filmo, and Hycam cameras capable of operation at frame rates from 12 fps to approximately 4,000 fps, using lenses with focal lenght to 180 inches.

(b) 35mm Cameras. There are over 50 flight research, Photosonics, Mitchell, Fastax, and Arriflex cameras in the 35mm inventory. These cameras are capable of operation at frame rates from below 10 fps to over 1,800 fps, using lenses with focal lengths to 500 inches.

(c) 70mm Cameras. The combined inventory consists of 44 Hulcher, Mitchell and Photosonics cameras, operable at frame rates of 10 to 60 fps, with lenses of nominal length/aperature ratios up to the 500-inch focal length lenses of the tracking telescopes. These cameras are used where a format larger than 35mm is required and most frequently are used on tracking mounts to record missile flight performance and intermediate staging events.

(2) Still Photography. There are over 160 still and 10 aerial cameras in the photo contractor's inventory. These cameras range in format size from 35mm to 8 x 10 inches. With a wide range of lenses and accessories, they are used in fixed remote positions or hand-held to support launch, nonlaunch, and aerial photo requirements.

Turnaround time - Range photography furnishes field photographic services and motion picture and still photo processing for range users and agencies. The Motion Picture Laboratory provides a 16mm, 35mm, and 70mm black and white and color capability and operates on a production line basis, but maintains a limited job shop ability for expending pictures. Picture needs are processed on a first-in, first-out basis and are normally delivered in three to five working days. The Still Photo section operates as a job shop with rush service for material requested within 24 hours. Routine still photography is usually furnished within five working days.

(3) Optics Maintenance Shop. The ETR Optics Shop consists of a camera repair shop, lens shop, and a high bay area to service our large mobile optical systems. The combined shops provide services for the repair and depot level maintenance of approximately 3,000 pieces of photo-optical equipment and accessories operated by the photo contractor and other authorized ETR/NASA-KSC elements. The capability includes the grinding,

polishing, and coating of optical elements and reflective mirrors, alignment and calibration of photographic lenses and sighting equipment. The high bay area has large double doors with a five-ton electric traveling hoist to move the heavy lens systems and mounts in and out of mobile optical instrumentation units such as the tracking telescopes, contraves, cinetheodolites, CZR Ribbon Frame Cameras, etc. Also included are large isolation pads for 168-inch and 240-inch collimators.

e. Instrumentation Calibration Capabilities. Calibration of range space positioning and velocity vector equipment is accomplished by optical star sights and tracking of calibration satellites.

On-site and central calibration labs handle equipment calibration.

f. Other Instrumentation

(1) Telemetry. Telemetry facilities include the central telemetry station located on Merritt Island and four downrange sites and a standby station at Pretoria, South Africa. USNS Redstone augments the telemetry capability at the land stations for BOA launches and BOA terminal areas.

(a) Telemetry Antenna System. Major telemetry antenna systems are primarily designed to receive 2200-2300 MHz. In special cases the antenna feeds have been modified for other frequencies.

Location	Type	Antenna Diameter
Merritt Island	TAA-3A	33 feet
GBI	TAA-2	85 feet
GBI	TAA-3B	33 feet
Grand Turk	TAA-8	80 feet
Antigua	TAA-8	80 feet
Antigua	TAA-3A	33 feet
Ascension	TAA-3B	33 feet
Ascension	TAA-3	30 feet
Pretoria	AT-36	60 feet
Redstone (T-AGM-20)	(4) Tel Ant	17 feet
ARIS (T-AGM-(9&10)	Tel Ant	30 feet

(b) Receiving and Recording. All major telemetry sites have receivers for the reception of frequency, phase, or amplitude modulated signals and demodulation of FM (frequency modulation), PDM (pulse duration modulation), PAM (pulse amplitude modulation), SSBAM (single side band amplitude modulation), PM (phase modulation), and PSK (phase shift keying) at frequencies from 105 MHz to 2300 MHz in descrete increments. The primary recording media is predetection with the use of AMR-FM-1400 recorders. These recorders are capable of recording dual channel modulated signals as high as 2 MHz.

(c) Decommutators. All types of IRIG 106-73 commutation from PAM, PCM, and PDM are possible at each range station. The decommutators using store program technology are capable of stripping data from all the standard IRIG formats.

(d) Real-Time Data. The telemetry system is capable of providing the data suitable for transmission in real-time via the available communication to the Telemetry Center from downrange stations. This capability includes a wide range of rates and formats consistent with the range user's requirements and available bandwidth.

(2) Meteorological. Meteorological instrumentation capable of obtaining surface and upper-air weather data at key range stations (CCAFS, Grand Turk, Antigua, Ascension, and Range Instrumented Ships) is in operation at ETR. The principal systems in operaton at ETR:

- o Launch Pad Lightning Warning System (LPLWS)
- o Weather Information Network Display System (WINDS)
- o Upper-Air Instrumentation (AN/GMD-4 Rawin Set)
- o Omega Navaid Sounding System
- o High Resolution Wind Measurement Balloon (Jimsphere)
- o LOKI Meteorological Rocket System
- o Satellite Imagery Reception and Processing

The data received is processed for range user application.

Located at CCAFS is a data receiving and display area for Satellite Imagery Acquisition and Processing of weather photos from NOAA weather satellites, and the Defense Meteorological Satellite Program (DMSP).

(3) Survey. All range facilities have a Class 1 survey. Surveying equipment and personnel are available via the Det 4, Geodetic Survey Squadron Office at Patrick AFB.

(4) Radio Frequency Interference/Electromagnetic Compatibility. The ETR has mobile ground monitoring EMC equipment. Surveillance of applicable portions of the frequency spectrum is maintained to preclude interference to frequencies used in support of missile/space operations.

Monitoring is also performed to detect, located, and alleviate interference, should it occur during an operation. EMC service/support is available to range users and can be obtained per regulation (Regulation RCEI 30-1).

EMC facilities consist of two mobile vans operating on the ETR and can perform the following functions:

- o Signal Analysis
- o Frequency Measurements
- o Field Measurements
- o Field Intensity Measurements
- o Power Density Measurements
- o Audio and Graphic Recording
- o Interference Evaluation
- o Direction Finding

Mobile van frequency coverage is as follows:

- o Monitoring 500 kHz to 16.0 GHz
- o Analysis 500 kHz to 16.0 GHz ($\pm$5%)
- o Direction finding 2 MHz to 16.0 GHz
- o Field Intensity Measurements 150 kHz to 16.0 GHz
- o Frequency Measurements 750 kHz to 16.0 GHz

A radar beacon checkout system is presently operational in each of the vans. These systems are used to check out all missile beacons during countdown and are available to range users on request. The systems can measure sensitivity, peak power, pulse width, countdown, recovery time, delay, and pulse jitter of missile-installed beacons for ranges 100 to 10,000 yards.

(5) Safety and Security. The ETR Range Safety System provides real-time missile position information from launch through burnout or attainment of orbit. The tracking information, from multiple sensors, is compared with nominal missile trajectory data to assure safety constraints are not exceeded.

g. Special Purpose Instrumentation

(1) Ballistic Data

(a) The Missile Impact Location System (MILS). MILS is an underwater sound detection and location system used to obtain the geographic position of the impact location of a nose cone or a data capsule dropped along a flight azimuth on the ETR. The target array provides high accuracy information within a 10 nmi radius. Arrays are located at Grand Turk, Antigua, and Ascension.

(b) The Sonobuoy Missile Impact Location system (SMILS). The SMILS is used to determine the impact location of missile reentry bodies and consists of four basic elements:

- o An ocean bottom acoustic transponder array.
- o Specially equipped P-3 ORION aircraft.
- o Modified Navy ASW sonobuoys.
- o An ocean surface duct.

High accuracy impact information can be gained out to a 20 nmi radius.

(2) LORAC. Positioning instrumentation at ETR includes two LORAC networks. LORAC is a long range, high accuracy navigation system for shipboard and surveying use. Network A includes stations at Jupiter (Florida), West End (Grand Bahama Island), Big and Litter Cart. - Cay and North Riding Point. All Network B stations are at big and Little Carter Cay, Great Stirrup Cay, Eleuthera, and Marsh Harbor (Abaco Island).

(3) Command/Control. The Command/Control System consists of a network of radio transmitters at CCAFS, GBI, Antigua, and USNS Redstone. NASA command facilities at Bermuda and Wallops Island are available for specific missions. The command sites are used to relay command destruct signals to the missile or space vehicle during a condition where the vehicle may endanger life or property. The command signals transmitted are typically designed to limit the flight of the vehicle by an engine cutoff, retrofire command or by a command to a destruct package incorporated in the space system. The commands are transmitted by a 406-450MHz carrier frequency. They consist of series of tones encoded to activate a command receiver/decoder on the missile or space vehicle. The ground transmitter at the key sites consists of dual transmitters and 10 kW power amplifiers which are remotely energized by the range safety officers through an encoding/verification system.

(4) Missile Tracking Instrumentation System (MTIS). The Missile Tracking Instrumentation System (MTIS) was developed by the US Navy to provide improved position and velocity data for evaluation of the Trident guidance system. Key use is made of the new NAVSTAR Global Positioning System (GPS). The MTIS processes real-time ranging and telemetry data for range safety impact prediction in addition to recording Satellite Missile tracking (Satrack) data for post-test trajectory analysis. The MTIS surface-based equipment, referred to as the Flight Test Support System (FTSS), includes two master ranging stations (MRS), one at GBI, and the other onboard the USNS Redstone; remote reaning station (RRS) at GBI, Grand Turk Island, Bermuda, Antigua, mobile RRS sites at Jupiter Inlet, FL, Folly Beach, SC, a local ranging station onboard the USNS Redstone, and pseudo-sat stations at GBI, Redstone, and Bermuda.

(5) Telemetry Doppler Metric Measurement System (TDMMS). The Telemetry Doppler Metric System (TDMMS) was designed to enhance the accuracy of the radar-only solution. The system uses available telemetry (2200-2300MHz) airborne and ground station equipment to the maximum extent feasible. Telemetry facilities at Merritt Island, Grand Bahama Island, Grand Turk Island, Bermuda, and Antigua are used in conjunction with the TDMMS. Off-the-shelf frequency standards, synthesizers and counters were procured to complete the system. Intersite doppler count synchronization is accomplished by using a missile telemetry link sync signal to start and stop the counters. Frequency differencing over common missile-referenced intervals cancels the vehicle transmitter errors and continuous counting is accomplished to avoid loss of cycle counts.

5. Data Handling/Processing. Three types of data are provided to real-time, quick-look and post-flight. The quick-look, or limited data analysis is presented as soon as possible (usually within six hours after a test), and the post-flight is a final report, in-luding complete data reduction.

(a) Data Storage and Retrieval Capabilities. Magnetic tape recorders are used to record data (in transmission modulated form; e.g., audio tones) of the electronic tracking instruments and range time at each tracking site of the ETR. Magnetic tape recorders are also used for permanent storage of telemetry data. The standard ETR recorder is the AMR-1400, a 7-track machine with recording speeds of 15, 60, and 120 in/s. Tape speed control and IRIG timing signals are available for recording simultaneously with the data.

Stripchart recorders are used to record analog data such as servo tracking error signals and AGC voltages.

Digital data used to compute impact predictions are recorded by real-time computer systems.

Extensive capabilities for the reduction of photographically recorded data exist at Patrick AFB, utilizing many types of equipment.

A wide variety of outputs is available from the Central Computer Complex Systems.

X-Y data measurements from photo and cinetheodolite film records of Askania units are performed with an Askania cinetheodolite film reader.

b. Quick-Look Capabilities. Quick-look trajectory data computations are made either by the Central Computer System at Cape Canaveral or by the Data Reduction Laboratory at Patrick AFB.

c. Processing

(1) Systems

(a) Central Computer Complex (CCC). The Central Computer Complex located at CCAFS is comprised of two CDC Cyber 74 CPUs that have 181K 60 bit works of memory each. Both use their own peripherals and share an extended-core storage of two million words. Two MODCOMP model II/4S/CP2 front end processors and their special interface equipment accumulate sensor data input to the Cybers and distribute the processed data to selected displays. The CCC's primary function is to support Range Safety impact requirements. In addition, it performs orbital determination, target acquisition, computation of toxic gas plume diffusion and debris fallout centers. Real-time weather computations are also performed, using data inputs from the AN/FPS-77 weather radar, the WINDS system and the Launch Pad Lightning Warning System (LPLWS).

During the launch phase of a missile test, the CCC processes incoming data from various sensors and dynamically computes position, altitude and velocity, instantaneous impact point and various other alphanumeric information in real-time and displays this information on cathode-ray tubes to the Range Safety Officer. Special parameters of interest to the range user, and which are derivable from position and velocity, may also be displayed. From this real-time information, the user can gain a preliminary knowledge or performance factors and pinpoint areas requiring further investigation.

Quick-look data usually consists of a printed trajectory defining position, velocity, and acceleration throughout the flight, impact location and miss-distance from the target or orbital elements in the case of space objects.

(b) Remote Job Entry (RJE) Terminal. The Remote Job Entry (RJE) Terminal located at the Tech Lab, Patrick AFB, utilizes a CDC 6500 with expanded memory. The RJE is connected to the Cyber 74s at the CCC by a 1.544 mbs data link which permits access to the CCC mass storage system and the Cybe's computational capability. The RJE accepts data in batch form, queries the inputs as required, formats and transmits the data to the CCC, accepts and outputs data back from the CCC and outputs it on magnetic tape, punched cards or printed copy as desired. The RJE also provides data compaction for Patrick interactive and noninteractive terminals.

(c) On-site Processing Systems. Each of the major AN/FPQ radars listed in Table T-3 incorporates a Sigma 5 Computer System, with the exception of radar 0.13 which uses a Sigma 7. The Sigma 5 operates as part of the tracking loop in the radar, enables the use of orbital constraints as part of the real-time tracking operation. The computer further provides for the conversion of the data generated in local geodetic coordinates to a common earth center system.

d. Range Improvement. The ETR improvement program is directed to provide increased operational capability commensurate with present support requirements. In addition, the program includes new instrumentation and instrumentation modifications to be funded directly by the Range User to meet specific Class I program requirements. Major ETR proposed improvements include:

(1) Modernize Range Safety command/control system which has b en in operation since the 1950's.

(2) Upgrade range telemetry system installed in the early 1960's to achieve compatibility with current user requirements.

(3) Provide new mobile radar, optics, and telemetry tracking capability in support of missile defense systems.

(4) Automation of the communication control by the addition of a central communication processor.

(5) Addition of communications satellite terminals at CCAFS.

(6) Modernization of radar components (receivers, range machines, and angle servos).

(7) Upgrade of timing, navigation, optics, and meteorological systems.

(8) Major marine modifications.

(9) Installation of a third radar, TPQ-18, at Ascension for increased coverage or reentry bodies.

ANNEX T - BIBLIOGRAPHY

Reference Document

1. ETR Instrumentation Handbook, Directorate of Plans, Programs and Requirements, Eastern Space and Missile Center, Air Force Systems Command, Patrick Air force base, FL, dated 1 Apr 80.

ANNEX U

OPERATIONAL TEST INSTRUMENTATION GUIDE

WESTERN SPACE AND MISSILE CENTER (WSMC)
Vandenberg Air Force Base, California

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ANNEX U

WESTERN SPACE AND MISSILE CENTER (WSMC)
Vandenberg Air Force Base, California

1. INTRODUCTION.

a. Overview.

The WSMC, designated by the Secretary of Defense as a National Range, is configured to support research, development, test, and evaluation of ballistic, space, and aeronautical systems.

WSMC is an operational component of the Air Force Systems Command (AFSC) and is headquartered at Vandenberg Air Force Base (VAFB), California. WSMC is directly responsible to Space Division (SD) (formerly Space and Missile Test Organization (SAMTO)) for mission accomplishment. One of WSMC's primary mission responsibilities is to manage and operate the Western Test Range (WTR). (See figure U-1).

The WTR has been designated a National Range by the DOD for the purpose of providing support to aerospace and related test programs. The facilities and services of the WTR are equally available to all DOD departments and other Government agencies and to foreign governments and United States commercial enterprises when their sponsorship is in the national interest. The WTR embraces an area extending from the west coast of the United States to 90 degrees east longitude in the Indian Ocean (figure U-2).

b. Generic Systems Tested.

The WSMC range instrumentation includes metric, telemetry, optical, data processing, data transmission, meteorological, timing, safety, and communications equipment associated with Test Center Operations.

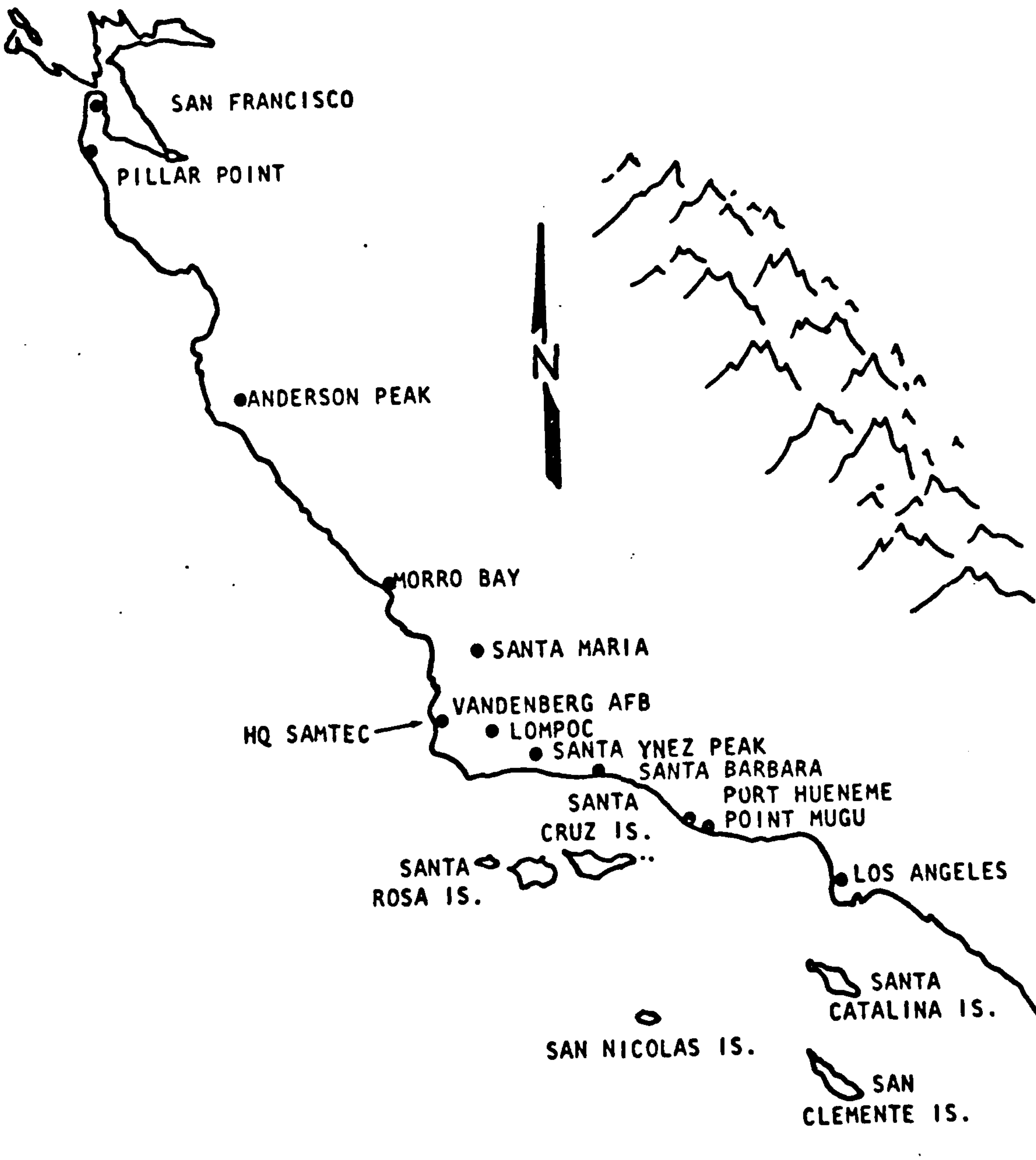


Figure U-1. VAFB, Uprange Facilities

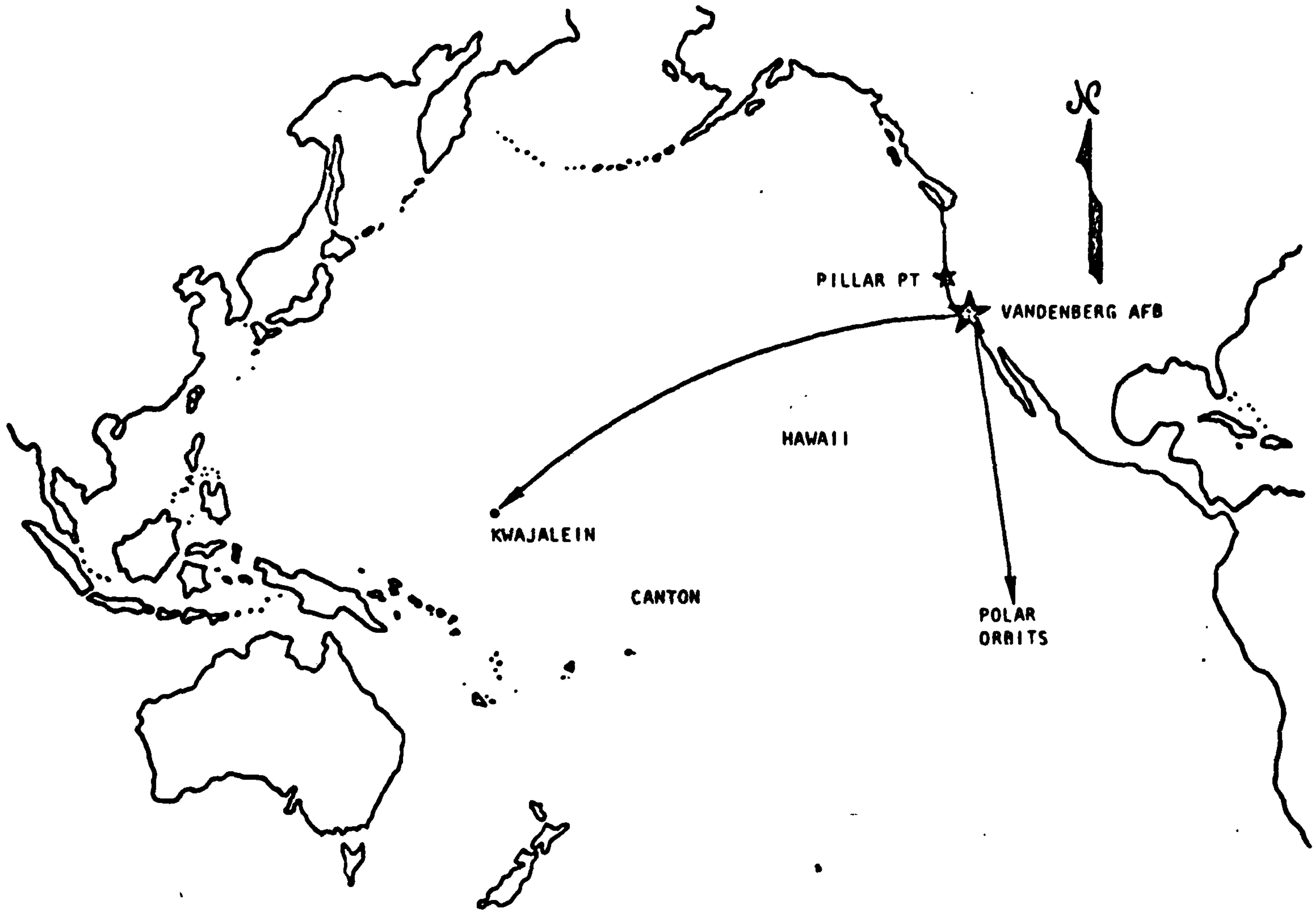


Figure U-2. Western Test Range

Individual uprange services performed include electronic and optical data acquisition and reduction, satellite tracking, missile flight safety, radio frequency monitoring and control, communications, scheduling, weather forecasting, and area clearance. The Pacific Missile Test Center (PMTC) and the Air Force Satellite Control Facility (AFSCF) provide major contributions to the uprange complex capability from Point Mugu and Vandenberg AFB, respectively. In addition, landbased instrumentation is augmented by mobile metric, telemetry, and optical sensors, when required.

2. GENERAL.

a. Units Represented at Vandenberg AFB.

(1) Air Force Units.

- 1st Strategic Missile Wing (Host)
- Western Missile and Space Center (WSMC)
- Space and Missile Test Organization (SAMTO)
- Air Force Logistics Command Office
- Air Defense Command Office
- Military Airlift Command Office
- Aerospace Training Command Office
- Air Force Communication Squadron

(2) Army Units.

- Army Field Office
- Army Corps of Engineers

(3) Navy Units.

- Naval Missile Center Detachment
- Office of Naval Research
- Applied Physics Laboratory

(4) Other Military and Civilian Units.

(a) DOD.

- Defense Investigation Service
- Defense Contract Audit Agency
- Det 1, Geodetic Survey Squadron

(b) NASA.

- JFK Space Center
- Langley Research Center

(c) Department of Transportation.

- Coast Guard, Loran Transmitter Station

(d) General Services Administration (GSA).

- Interagency Motor Pool

b. Maintenance Capability.

Vandenberg AFB maintains the approximately 1,700 nontracked vehicles assigned to it. Presently, no extensive capability to perform maintenance on a significant amount of user vehicles exists. Helicopter maintenance is limited to the servicing of the three helicopters assigned to Vandenberg AFB for area surveillance. Transient aircraft maintenance is available.

c. Access.

(1) Air.

Commercial passenger/freight service is available through Los

Angeles International Airport with smaller airfields located in Santa Barbara and Santa Maria. Aircraft operation directly into Vandenberg AFB is available per AFR's 55-20 and 55-21.

(2) Rail.

The Southern Pacific Railraod provides service.

(3) Road.

U.S. Highway 101 and California State Road 1 allow easy access to Vandenberg AFB.

(4) Sea.

Commercial shipping is available in ports at Los Angeles and San Francisco. Military Sealift Command Service is available to downrange sites via the Military Ocean Terminal Bay Area, Oakland, California.

d. Logistic Support Capability.

Normal supply and equipment services are available dependent on requirements stated in the range users' contract. Approval of requests for equipment and supplies from Vandenberg AFB supply agencies is based on individual determination.

Ordnance support at Vandenberg AFB will be provided by the 51st Munitions Maintenance Squadron.

e. Special Operational Restrictions.

The number of launch sites, instrumentation sites, buried cables, etc., will restrict any user project which would require an extensive use of land area (for example, four square miles).

f. Environment (Climate).

The climate of Vandenberg AFB is typical of the mid-California coast, with year-round mild temperatures that shift through gradual transitions without clearly defined seasons. In general terms, there are two seasons based mainly on rainfall amounts. The wet season (winter) extends from November through April. This season consists of generally fair weather interspersed with short periods of cloudiness and rain shower activity. The dry season (summer) extends from June through September. This is also referred to as the fog season. This season is characterized by low cloudiness and fog during the night with sunny afternoons and very little rainfall. The months of April and October are considered transition periods between these seasons.

g. Topography.

The northern portion of the land area of Vandenberg AFB is rolling hills covered with grass, shrubs, and a few trees. The southern portion consists of rugged mountains and deep valleys.

h. Airspace Restrictions.

The airspace over Vandenberg AFB includes restricted areas R2516, R2517, R2534A, and R2534B.

i. Power Availability.

Vandenberg AFB obtains commercial power from Pacific Gas and Electric. Vandenberg AFB also has six CE power plants.

j. Communication.

The WSMC has communications responsibilities extending from the west coast of the United States to the mid-Indian Ocean area.

The information transmitted is voice, video, data, facsimile, and teletype communications. The transmission medias used are microwave, radio (HF, VHF, UHF), submarine cable, carrier, and coaxial cable.

3. DIMENSIONS.

a. Landspace.

(1) Test Area Contiguity.

Vandenberg AFB forms a contiguous test area except for the land area of the Surf Recreational Area and the road (highway 246) between Surf and Lompoc.

(2) Easements.

Highway 246 between Surf and Lompoc, California forms an easement dividing VAFB into two noncontiguous areas: South Vandenberg AFB and North Vandenberg AFB. Cattle grazing, by a lease agreement, is allowed.

(3) Impact/Live Fire Areas.

There are no designated impact or live fire areas on Vandenberg AFB other than the Air Police Firing Range.

b. Airspace.

(1) Landspace/Airspace Relationship.

See the following paragraphs.

(2) Easements.

Restricted areas R-2516 and R-2517 extend from ground to unlimited altitude. R-2534A and R-2534B extend from 500 feet to unlimited altitude. Note that the restricted areas extend to the three-mile coastal limit. (Additional information in contained in "Flight Information Planning Guide-Flip, Section AP/IA, Special Use Air Space.")

(3) Unmanned and Manned Airborne Systems.

The airspace off the California coast is available for a wide variety of manned and unmanned tests. This area is presently being used for Development, Test, and Evaluation (DT&E) flights of the B-1 bomber between the Mexican border and northern California.

(4) Area Surveillance.

Instrumentation coverage of the OTA is available at various altitudes from the Mexican border to Ukiah, California.

4. INSTRUMENTATION.

a. Space Positioning and Velocity Vector.

(1) Ground Elements

Vandenberg AFB has no range instrumentation specifically intended for tracking of ground elements.

(2) Airborne Elements.

(a) Radar.

1. AN/FPS-16 Radar.

WSMC has three land-based AN/FPS-16 Radars, two at Vandenberg one at Pillar Point. In addition, any of seven Pacific Missile

Range AN/FPS-16's at Point Mugu and San Nicolas Island are available as necessary to provide simultaneous track with the WSMC radars, with data transmitted for display at Vandenberg by the Instrumentation Data Transmission Systems (IDTS) and the Real-Time Data Handling System (RTDHS). Realtime radar data are transmitted to the Range Safety Center plotboards for use by the Missile Flight Control Officer in making command control decisions. Data are also transmitted to other sites for sntenna slaving and to recorders for later data reduction.

2. AN/FPQ-6 Radar.

The AN/FPQ-6 is a high-accuracy, long range amplitude comparison, C-band, monopulse radar capable of manual or automatic acquisition and tracking of objects in flight or in orbit. The system provides three-coordinate data in digital format which are processed by their own RCA Data Processor. The WSMC AN/FPQ-6 is a fixed station installation using a one-story building to house all electronic equipment. The antenna pedestal is mounted atop a concrete tower adjacent to the main building at Pillar Point. An integrated Circuit Digital Ranging Subsystem (IDRAN) gives the AN/FPQ-6 an unambiguous range of 32,000 nmi with a range granularity of ±2 yards (using an airborne beacon).

3. AN/FPQ-14 Radar.

The AN/FPQ-14 is used to obtain high accuracy, long range radar trajectory data from vehicles in flight or in orbit. In its Kaena Point Location, it will be used primarily to obtain mid-range trajectory data for MINUTEMAN III launches, although utilization in satellite tracking operations is also expected.

4. AN/TPQ-18 Radar.

The AN/TPQ-18 is used to obtain high accuracy, long range trajectory data from vehicles in flight or in orbit from south Vandenberg AFB.

5. AN/M-33 Radar.

The AN/M-33 is used for weather balloon tracking. The AN/M-33 radar set is a modified, van-mounted fire control radar. WSMC presently has one AN/M-33 radar at Vandenberg AFB.

6. General Electric Radio Tracking System (GERTS AN/VRW-12).

The GERTS functions as a highly accurate missile tracking and trajectory measuring system with command guidance capabilities. The GERTS is a guidance system which was designed for ground guidance of the ATLAS D Series Weapons System. It is currently being used simultaneously as a Missile Guidance System and a Range Flight Control Instrumentation System. The GERTS operates with a missileborne system comprised of a pulse beacon, pulse decoder, rate beacon, power supply, and associated hardware.

7. AN/MPS-36 Radar.

The two MPS-36 radars were developed to provide medium range tracking capability for range safety. The MPS-36's are presently being used as mobile metric radars.

(b) Laser.

No laser instrumentation for tracking is available.

(c) Optical.

1. LA-24 Optical Tracking Telescope.

The LA-24, located at South Vandenberg AFB, is a telescope used to optically track airborne targets at long ranges and to provide a photographic record made at high film rates. It can be equipped with a high speed 35mm or 70mm camera using color film during daylight operations. Timing is recorded on film along with the target image.

2. Recording Optical Tracking Instrument (ROTI).

ROTI is a large aperture tracking telescope system used to obtain time-correlated, high resolution, long range photographs of objects in space.

The ROTI, located at Santa Ynez Peak (4,100 feet) in the Los Pafdres National Forest above Santa Barbara, has a 24-inch aperture, 100-inch focal length Newtonian optical system. Focal length increases are provided by BIOTAR relay lenses in increments of 100 inches, to a maximum of 500 inches. Four tracking modes are possible:

- Slaved to the target acquisition bus.
- Slaved operation with operator override.
- Programmed automatic tracking.
- Operator tracking by joystick which permits control of position, velocity, and acceleration motions of the instrument in both axes.

The insertion of a channel plate image intensifier between the lens and camera permits the recording of extremely low energy targets (equivalent to 14th magnitude stars) during night operations with the use of special black and white motion picture film. Daylight operations are recorded without the image intensifier using conventional color or black and white film. Parallax corrected target acquisition data are provided by refined radar data from VAFB.

3. Cine-Sextant Tracking Mount (Temporary).

The Cine-Sextant Tracking Mount is used to obtain long distance photographic or electrooptical recordings, including post-boost-flight coverage of westerly launches.

The Cine-Sextant Track is capable of supporting several sensors. These may be a combination of conventional film cameras or low light level sensors. Night operations are usually recorded with electrooptical low light level systems and recorded on video tape and film. Daytime operations are recorded conventionally with film cameras.

4. Deployment Mapping Instrument.

The deployment positioning instrumentation will be used to obtain extremely long range electrooptical and conventional film recordings from Anderson Peak. The maximum focal length is estimated to approach 1,400 inches and will provide coverage for the post boost deployment sequences of westerly launches.

b. Timing.

WSMC time is synchronized to Universal Time Coordinated (UTC). The time code generators are controlled by primary atomic frequency standards and are synchronized to better than ±10 microseconds relative to UTC.

c. Television.

The Closed Circuit Television (CCTV) System provides real-time viewing of various missile functions during prelaunch, launch, and early missile flight. It also provides visual display of weather and selected strip chart information.

d. Photography.

Engineering sequential and documentary photography can be provided for all activities conducted at SAMTEC.

e. Instrumentation Calibration Capabilities.

The Precision Measurement Equipment Laboratory (PMEL) provides repair, overhaul, calibration, and certification of precision measurement equipment (PME) for WSMC, range users, military organizations, and other Government agencies in central California.

f. Other General Purpose Instrumentation.

(1) Telemetry.

The Pacific area range telemetry installations are shown in figure U-3. The installations operated by WSMC are briefly described as follows:

(a) Telemetry Receiving Station (TRS)-Oak Mountain, SVAFB.

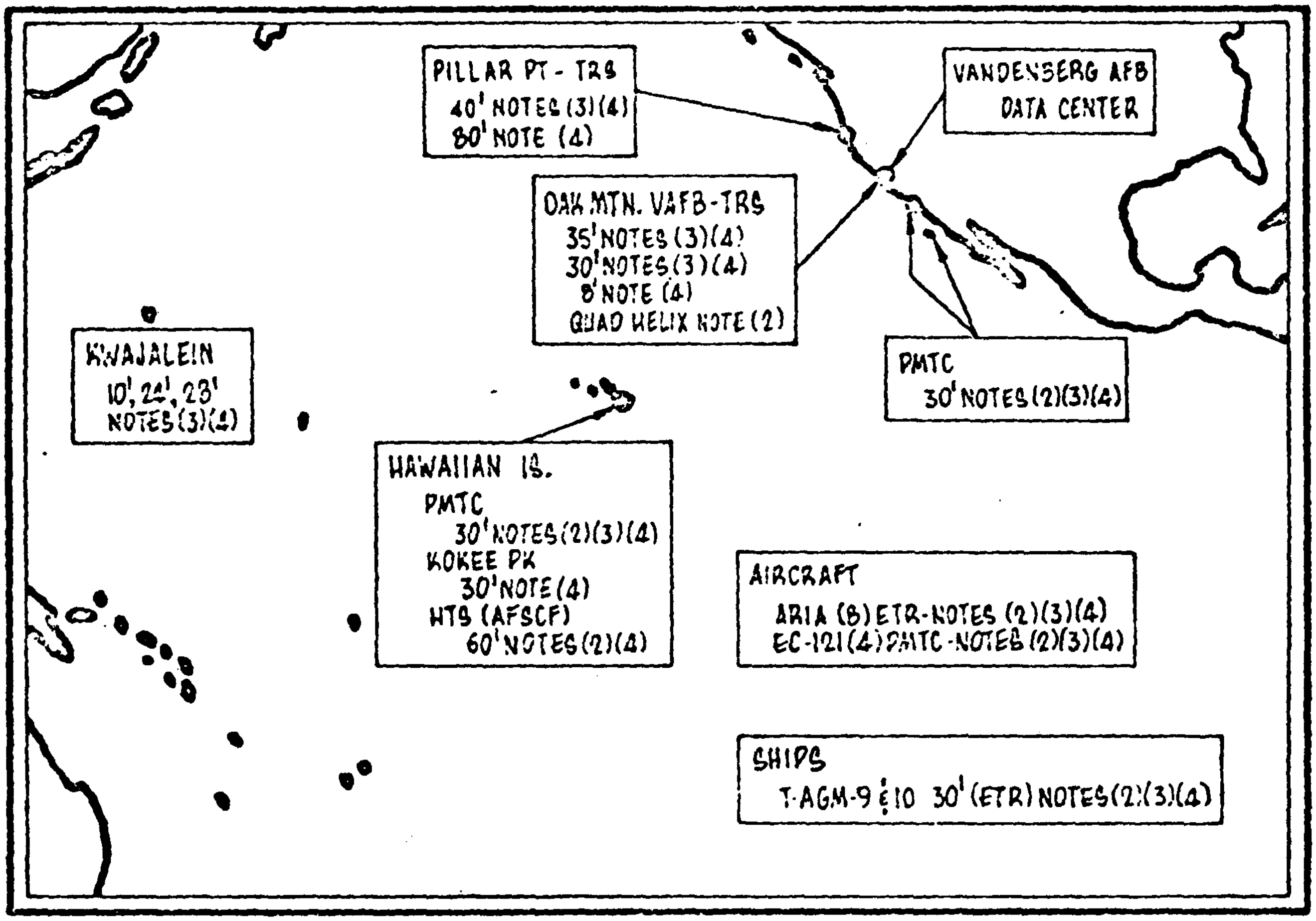
The Oak Mountain TRS has three Pre/Post-D diversity receive/record stations and a Space Ground Link Subsystem (SGLS) downlink station, in addition to the antennas shown in figure U-3.

(b) Telemetry Facilities-Pillar Point AFS (PPAFS).

The PPAFS Telemetry System consists of a general purpose Pre/Post-D diversity receive/record station, one specialized high sensitivity SGLS downlink station, and one general purpose polarization diversity SGLS downlink station in addition to the antennas shown in figure U-3.

(c) Data Centers (DCs).

The DCs in Bldg 7000, VAFB, form the central telemetry data processing facility. The DCs are coupled to various launch complexes, assembly and checkout facilities, the Oak Mountain and Pillar Pt, and PMTC via microwave link. In addition, the DCs are microwave



NOTES:

(2) 215-265 MHz
(3) 1435-1540 MHz
(4) 2200-2300 MHz

Figure U-3. Pacific Area Telemetry Capability linked to the Air Force Flight Test Center (AFFTC), Edwards AFB, CA, for real time transmission of aircraft test data. The present capability of the DCs include seven computerized systems and three manually patchable systems. The computerized systems are capable of providing real time record, computation and display (line printer, CRT, and strip charts) while the patchable systems are capable of only decommutation and display on strip charts in real time with formatting post operation.

(2) Meteorological.

(a) Weather Surveillance Radar Set (AN/FPS-77).

The AN/FPS-77 Radar Meteorological Set is a C-band search radar that detects precipitation within a 200-mile radius.

(b) Weather Satellite Readout Station AN/GKR-4.

The AN/GKR-4 telemetered meteorological daa receiving set located at the environment support center provides facsimile reproductions of pictures transmitted from orbiting meteorological satellites when the satellite is at least 10 degrees above the horizon.

(c) Weather Information Network and Display System (WINDS).

The WIND system consists of 21 weather information gathering substations with 110 sensors, an XDS 930 computer, and three display subsystems.

(d) Ionospheric Sounder.

The equipment determines, as a function of frequency, the virtual heights and the electron densities of reflecting layers in the ionosphere up to and including the maximum electron density (F2 layer).

The information is used to predict the best HF frequencies for long distance communications.

(e) Atmospheric Sounding System Rawinsonde.

An AN/GMD-1, or 2A, is used to track a balloon borne J006 Radiosonde in order to measure meteorological parameters in the upper atmosphere.

(f) High Resolution Wind Sounding Systems.

A specifically designed radar reflective balloon is tracked by an AN/FPS-16 radar from the surface to 60,000 feet altitude. A high resolution wind profile (readouts at 100-foot intervals) is computer processed from the tracking data.

(g) Shipboard Meteorological System.

The ships USS General Arnold and USS General Vandenberg are outfitted with meteorological instruments which permit both surface and upper air observations.

Surface observations include wind velocity and direction, temperature, dewpoint, pressure, and cloud cover. Upper air data taken are wind velocity and direction, temperature, dewpoint, and pressure.

(3) Survey.

None.

(4) Radio Frequency Interference/Electromagnetic Compatibility.

(a) Frequency Control and Analysis Center (FCAC).

The FACA is the operational coordination facility for the WSMC Frequency Control and Analysis (FCA) System and is the single point of contact for all other WSMC elements and range users for all operational frequency matters. The FCAC supports range scheduling by ensuring (through FCA resources) that all requests for scheduling radio frequency operations are compatible in the Vandenberg AFB and southern California environment. The FCAC also coordinates the investigation and resolution of frequency compatibility and interference problems.

(b) Radio Frequency Measurements Laboratory (RFML).

The RFML provides radio frequency engineering services to help minimize or eliminate electromagnetic compatibility problems that cannot be controlled by frequency assignment, scheduling, or coordination.

(5) Visibility.

No visibility measuring equipment is available.

(6) Sound Measurement and Analysis.

No special measurement and analysis equipment is available.

(7) Safety and Security.

(a) Command Control Transmitter (CCT).

The CCT System is used to terminate the flight of a launch vehicle that is determined by the Missile Flight Control Officer (MFCO) to be performing abnormally or is outside the predetermined safe flight path. There are two CT sites a Vandenberg AFB and one at Pillar Point.

(b) Technical Operations Control Center (TOCC).

The TOCC serves as the technical and management control facility for all of the WSMC's Western Test Range (WTR) resources. It is composed of the Range Control, Missile Flight Control, Area Control, Operations Control, and Launch Operations Control Centers. It maintains communications with the launch pad, Range Operations, Command Center, and other required support agencies.

(8) Soil Conditions.

No soil measurement equipment is available.

g. Special Purpose Instrumentation.

This is an ESMC responsibility (ETR).

(1) Ballistic Data.

See section on radars and telemetry.

(2) Other.

(a) AFETR Advanced Range Instrumentation Ships USNS Gen. H.H. Arnold (T-AGM9) and USNS Gen. H.S. Vandenberg (T-AGM10).

The primary purpose of these ships is to gather radar, telemetry, and optical/optiradiometric data.

To permit autonomous operation in remote areas, the ships have supporting subsystems for timing, communications, operations control, and data handling. The data can be stored for later processing and evaluation. During a tracking periods, collected data include:

1) Primary target azimuth and elevation within 0.5 mrad and range within 100 feet, relative to ships position, heading, and indicated vertical.
2) Radar cross-section within 2 db and C- and L-band frequencies for all primary targets with a signal-to-noise ratio of at least 12 db.

3) Ship location, using the MK-IV SINS and a star tracker in conjunction with a sonar beacon field, to better than 1,500 feet (vector RMS) geodetic accuracy.
4) Telemetry data in selected bands between 60 and 4,000 MHz.
5) Optical data, including radiometry, spectroscopy, and imagery in the ultraviolet, visible, and infrared bands.
6) Surface and upper atmospheric meteorological data.

Additionally, a PMR range instrumented ship (USNS Wheeling) is also available for support.

(b) Aircraft.

1. Advanced APOLLO Range Instrumentation Aircraft (EC-135N).

At present, there are eight Boeing C-135A aircraft designated as EC-135N aircraft APOLLO Range Instrumented Aircraft (ARIA) available to support NASA and DOD programs. The aircraft are stationed at the Air Force Eastern Test Range (AFETR) and support is secured by request through the Joint Area Scheduling Office.

2. Terminal Radiation Program Aircraft (TRAP) (KC-135A).

The Terminal Radiation Program (TRAP) is a part of the Advanced Ballistic Reentry Systems (ABRES) Program conducted by the Duputy for Reentry Systems, SD (RS). The primary purpose of TRAP is the acquisition, reduction, and analysis of optical data in the ultraviolet, visible, and infrared portions of the spectrum for the evaluation of R&D reentry experiments.

3. PMR TM Aircraft (EC-121K).

The PMR EC-121 aircraft are primarily used at the Pacific

Missile Test Center (PMTC) for telemetry reception and recording in support of missile and space programs. In addition, the aircraft are equipped for command control monitoring, recovery support, and range area clearance.

5. THREATS/TARGETS.

a. Ground.

Vandenberg AFB has sufficient landspace to accommodate live firing operations, but these operations would be constrained to a small area of land. WSMC, however, has no particular capability to provide targets or threat simulations for ground exercises.

b. Airborne.

Vandenberg AFB cannot provide drones for testing, but does have facilities to accommodate the ground instrumentation required for drone support. If the user will provide the drones and support equipment, Vandenberg AFB can provide landspace from which to fire user weapons (missiles, artillery, etc.). The firing would have to be done over the ocean.

6. DATA HANDLING/PROCESSING.

a. Major Computer Systems.

WSMC's major computer systems provide support in two general areas, scientific studies/analysis and launch support. (Refer to figure U-4.)

(1) IBM 7094 Data Processing System.

The IBM 7094 Data Processing System (Building 488) is used principally for preoperation, postoperation data reduction, real-time guidance, program development and maintenance, and housekeeping reporting, with the formatted file system.

(2) IBM 360/30 Data Processing System.

The IBM 360/30 Data Processing System is used as an input/ output peripheral processor for the IBM 7094 Data Processing System.

The IBM 360/30 software inclues the 1401/1440/1400 compatibility support feature and the "Basic Telecommunications Access Methods" as well as 7094 utility support programs.

(3) IBM 360/65 Data Processing System.

The IBM 360/65 is the central computer system for the WSMC TOCC. The 360/65 is the heart of the Real-Time Data Handling System (RTDHS) which acquires data from the various tracking sensors for the purpose of data display, range safety control, and permanent data recording. The subsystems connect the 7044 to range radars, GERTS, plotting boards, control consoles, teletype circuits, and 1/0 data devices during a real-time operation.

(4) Data Center 10 (XDS sigma 2 Processing System).

The four Sigma 2 computers are an integral part of the Telemetry Decommutation and Display System (TDDS) which provides four independent subsystems for the efficient, high-speed computer processing and display of PCM telemetry data.

(5) Data Center 20 (CDC 1700/3300 Processing System).

The CDC 3300 Data Processing System is comprised of two 3300 computers, one CDC 1700 computer and various peripherals and telemetry equipment. The primary applications of DC-20 are the unique functions of Telemetry Decommutation Validation System and Backup Information Display System.

DESCRIPTION	STORAGE	DATA CHANNELS	DISC	MAGNETIC TAPE	CARD READER/ PUNCH	PRINTER	OPERATING SYSTEM	FEATURES
IBM 7094	32 K	4	1	16	1	1	IBSYS, DRCP, LAIRS	Floating point arithmetic, double precision storage control, interval times
IBM 7094	32 K	2	1	6	1	1	IBSYS	Floating point arithmetic, single precision extended performance set, memory protect storage control, interval times
IBM 360/30	24 K	2	1	4	1	1	DOS	Floating point and decimal arithmetic, 1400 series capability
IBM 360/65	768 K/ * 2,000 K	4	3	12	1	2	OS/MVT	
XDS Sigma 2	24 K		4	10	2	4	RTBM	Real-time clock, memory protect
XDS Sigma 7	98 K		5	4	1	2	RTBM, BPM, CPS	Real-time clock, memory protect
CDC 1700	12 K	3	0	0	0	0		Front-end processor for CDC 3300
CDC 3300	32 K		6	4	1	1	MSOS	Floating point arithmetic

*2,000K storage was added on to the original 768K.

Figure U-4. Major Computer Summary

(6) Data Center 40 (XDS Sigma 7 Processing System).

The XEROX SIGMA 7 computer systems are also used to provide real-time processing and display of analog and PCM telemetry data. In addition, the systems support off-line analysis for various projects.

b. Other Computer Systems.

Other computers are used at the Western Test Range in support of instrumentation and communication systems. These computers are listed, along with their stated primary purpose, in table U-1.

c. Data Control.

(1) Data Control Center.

The Data Control Center is operated jointly by the WSMC and the Range Technical Services Contractor and is responsible for the positive control of all range data from acquisition to delivery.

(2) Data Handling Center.

The Data Handling Center has responsiblity for distributing all data to range users or other ranges.

d. Software.

The WSMC software consists of over 850 active computer programs.

e. Other.

(1) Microfilm Digital Printer/Plotter System.

Table U-1. Other Computers Used at Western Test Range

SYSTEM	LOCATION	PRIMARY PURPOSE
Remote Sites		
UNIVAC 1218	Pillar Point	Radar Tracking System for FPS-16
UNIVAC 1218	Tranquillon Peak	Radar Tracking System for FPS-16
RCA 4101	SVAFB	Radar Tracing System for TPQ-18
RCA 4101C	Pillar Point	Radar Tracking System for FPQ-6
MH DDP 124	VAFB	Radar Tracking System for MPS-36
Support Systems		
XDS 910	SVAFB	Interface Testing
XDS 930	NVAFB	Weather Data Processing
MH DDP 516	NVAFB	Communications
MH DDP 516	NVAFB	Microfilm Printer/ Plotter System
Pacific Area		
XDS SIGMA 5	Karena Point	Radar Tracking System for FPQ-4
MH DDP 124	Wheeler AFB	Communications

The WSMC Microfilm Digital Printer/Plotter System (MDPPS) is a device with peripheral equipment that converts standard digital magnetic tape into eye-reader letters, numbers and graphics, and records these data on microfilm at extremely high speeds.

7. IMPROVEMENTS/MODERNIZATION PLANNING.

The following range improvements and modernizations will increase WSMC's ability to support present and future programs.

In the next few years, more and more programs will require low altitude subsonic and supersonic flights and WSMC will be conducting more aeronautical tests in its offshore test area. Placing portable radar and telemetry instrumentation in the Big Sur area will fill a gap in the low altitude coverage and create 275 miles of continuous coverage at 200 feet.

The development of a broad ocean area scoring capability will permit extremely long range variable azimuth ballistic missile tests for advanced ICBM's.

In the mid-1980's, Vandenberg will have an operational space shuttle which will launch from Space Launch Complex 6 and land on an extended runway. This is a highly cost-effective way of placing payloads in orbit and will eventually replace all presently used space boosters except Scout.

WSMC is installing a new Telemetry Integrated Processing System (TIPS) which will perform the work currently done by ten older systems. TIPS will meet future data processing workload requirements while reducing the cost of computer operations and maintenance.

During missile flights, reliable Command Control Transmitters (CCT's) are essential to protect lives and property. Older CCT equipment is being replaced to decrease maintenance costs and increase reliability.

A new display system is being developed so the Missile Flight Control Officer can more quickly and accurately determine if a missile needs to be destroyed. The new system will consider atmospheric drag and wind velocity to project a footprint pattern for debris from the destroyed vehicle.

ANNEX U - BIBLIOGRAPHY

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ANNEX V

OPERATIONAL TEST INSTRUMENTATION GUIDE

Nellis Air Force Base, Nevada

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CONTENTS - ANNEX V (CONTINUED)

ANNEX V
UNITED STATES AIR FORCE
TACTICAL FIGHTER WEAPONS CENTER
NELLIS AFB, NEVADA

I. INTRODUCTION

A. Overview. Nellis Air Force Base is located eight miles northeast of Las Vegas. It is the home of the Air Force Tactical Fighter Weapons Center Headquarters (TFWC), the 57th Tactical Training Wing, the 474th Tactical Fighter Wing, the 440th Tactical Fighter Training Group (Red Flag), the 4513th Tactical Training Group, and the 554th Range Group. The 554th Range consists of a North Range, South Range, six (6) airspace training areas, and two (2) restricted electronic warfare ranges.

The primary purpose of the 554th Range is to develop, maintain and operate an operational test training facility for the use of all DOD components. The specific mission of the 554th Range is to provide an operationally oriented, combat-like facility whereon multiple air and ground participants can accomplish integrated air-to-air and air-to-ground training, test and evaluation missions.

The 554th Range Complex covers approximately 6,000 square miles and extends roughly from Nellis AFB northwest to Tonopah (140 miles), then east to approximately 30 miles northeast of Caliente (140 miles), and back to Nellis AFB (110 miles). Elevations of the area vary from 2,500 feet to 10,000 feet mean sea level (MSL).

554th South Range (R4806) consists of 1,600 square miles and provides for air-to-air and air-to-ground munitions delivery, air-to-air combat maneuvering and Air Combat Maneuvering Instrumentation (ACMI) arena.

NOTE: The majority of R-4806 is part of the Desert National Wildlife Range (DNWR) and is administered by the Fish & Wildlife Service (FWS). A Memorandum of Understanding between Department of Interior and the USAF outlines the procedures for joint use of the land.

554th North Range (R-4807) is approximately 2,300 square miles, it is used for realistic ground target simulation, munitions delivery on existing targets, and EW exercises.

The overall range is desert terrain with north-south mountain ranges separated by valleys and dry lake beds.

B. Generic Systems Tested. The 554th Range provides a realistic training arena for all DOD forces. Training ranges from single sorties to joint exercises of up to several hundred aircraft. Units deploy to Nellis AFB and operate out of their main operating bases as well as take part in Nellis training.

II. GENERAL

A. Military Units.

(1) Air Force Units.

a. 57th TTW

b. 474th TFW

c. 4440TFTG (Red Flage)

d. 4513th TTG

e. Fighter Weapons School

f. USAF Thunderbirds

(2) Army Units. Army Liaison Team assigned by charter to United States Air Force Tactical Fighter Weapons Center.

(3) Nearby Government Installations.

a. Ft Irwin (160 miles)

b. Fallon NAS (290 miles)

c. George AFB (200 miles)

d. Indian Springs AAF (42 miles)

e. Luke AFB (260 miles)

f. China Lake (150 miles)

g. Edwards AFB (180 miles)

B. Maintenance Capability. The maintenance capabilities are adequate for present and near term requirements. Maintenance base includes F-15, F-5, A-10, F-4, T-38, and A-7 aircraft capability.

C. Access.

(1) Air. Commercial air transportation is available at North Las Vegas Municipal Airport (longest runway: 5,000 feet) and McCarran International Airport (longest runway: 12,500 feet) and Indian Springs AAF (longest runway: 7,650 feet).

(2) Water. There are no waterways to or around Nellis.

(3) Road. Nellis can be reached via Interstate 15. The Nellis ranges can be reached via Highway 95.

(4) Rail. The Southern Pacific Railway has a terminal at Las Vegas. This is the closest rail terminal to Nellis.

D. Logistic Support Capability. Nellis has a TAC supply system adequate for a large of number of fighter aircraft.

E. Recurring Commitments. Red Flag is the major recurring commitment Nellis has. Also, the ranges are used extensively by the Fighter Weapons School for training purposes. Joint Force operations are also performed on the ranges throughout the year.

F. Special Operational Restrictions. Permission must be obtained from DOE to penetrate R-4808 and R-4809 restricted airspaces. Military users schedule through 554th Range Group on a reimbursement, non-interference basis to all units that require a facility for practice or training operations.

G. Environment. The weather is typical for the high desert, warm and dry in the summer and moderately cool in the winter, with frequent nighttime frosts. The dry climate results in excellent flight conditions year-round.

H. Topography. Nellis AFB and its associated ranges lie in a semi-arid desert with occasional mountain peaks.

I. Airspace Restrictions. Nellis AFB has a letter of agreement with Los Angeles Center that permits Nellis aircraft to operate in five airspace training areas which are each made up of two vertical parcels of airspace, the Milirary Operations Area (MOA) and the ATC Assigned Airspace (ATCAA).

Two electronic warfare training areas are utilized to provide realistic enemy radar environment for aircrew training, (Tolicha Peak EW), (Tonopah EW), See figure V-1.

The 554th Range Complex is composed of six training areas and two restricted areas. Five of the training areas are each made up of two verticle parcels of airspace, the Military Operations Area (MOA) from 100 feet AGL up to but not including FL 180 and the ATC Assigned Airspace (ATCAA) from FL 180 to FL 500 or the highest altitude assigned. The Cedar ATCAA, which overlies the northeastern portion of Caliente is from FL 290 to FL 500. Restricted Areas R-4806 and R-4807 are assigned to 554th Range Group, airspace from the surface to unlimited. Two additional restricted areas, R-4808 and R-4807 are assigned to 554th Range Group, airspace from the surface to unlimited. Two additional restricted areas, R-4808 and R-4809 assigned to the Department of Energy (DOE), are available to 554th Range Group with special use of portions of the restricted areas through Letters of Agreement. No airspace within the Range Complex will be overflown unless scheduled through the Range Group Scheduling Branch (554RG/RCS autovon 682-5143/5144). Individual detailed Range/Training Area airspace restrictions are contained in AFR 50-46/NAFB Supplement 1.

Nellis Area II is a special activities base located 3NM northeast of Nellis AFB and is prohibited to overflight.

The Nellis AFB VFR training areas are used for transition, aerobatics, functional check flights, air combat, and other air work associated with training activities (see figure V-1).

- Coyote, Caliente, Almamo, and Elgin extend from the surface to 17,500 feet.

- Nellis - flight level 240 through flight level 580.

Two electronic warfare training areas are utilized to provide realistic enemy radar environment for aircrew training (see figure V-1).

- Tolicha Peak (R-76) - surface to unlimited.

- Tonopah (R-4809) - surface to unlimited.

J. Power Availability. The remote range areas are serviced by portable generators. The power available at Nellis AFB is adequate for present operations.

K. Communications. Air-to-ground UHF communications area available to both EW ranges, the OT&E range, and the bombing and gunnery scoring range.

III. DIMENSIONS

A. Landspace.

(1) Test Area Contiguity. The Nellis South Range is located 33 miles northwest and the Nellis North Range is located approximately 90 miles northwest of Nellis AFB. The Caliente Range is located 90 nautical miles northeast of Nellis AFB. The boundary of the range is a 20-nautical mile radius circle centered on the Lincoln Country Airport, Panaca, Nevada. Figure V-1 shows the location of the Nellis ranges.

(2) Easements. There are no easements in effect on any of the Nellis ranges; however, some of the land area adjacent to the ranges is outgranted to DOE. A whild horse range and Desert National Wildlife Range coincide with portions of the North and South Ranges, respectively.

(3) Area Surveillance. Inputs from FAA Air Route Surveillance Radars (ARSR) at Cedar City, Tonopah, and Angel Peak are utilized for display of the restricted and assigned airspace above the Nellis Range Complex onto the large screen color display located in the Range Control Center.

IV. INSTRUMENTATION.

A. Ground Elements. The South Range uses a TV Ordance Scoring System (TOSS) to determine impact and miss-distance for bomb drops on Range 63.

B. Airborne Elements.

(1) Radar. The Tonopah EW Range uses AN/MSQ-T7, MSQ-T8, MPS-T1 radar set and an AMV, AMS SIF/IFF set. MSQ-T7, T8 provides target acquistion.

(2) Laser. The operationsl laser systems approved for routine employment on the 554th Range Complex are the JAGUAR LRMTS (RAF) Laser

Target Designator, Pave Spike (USAF) Laser Target Designator, Laser Augmented Air Rescue System (LAARS), Laser Target Designator Scoring System (LTDSS).

(3) Optical.

a. Nellis Ranges. The mainstay of the South range photography is the Askania cinethodolite. These trackin mounts are fixed on surveyed camera sites and provide time-space-position information (TSPI), velocity, acceleration and altitude. By utilizing any three of the five Askanias, the exact location of aircraft ordnance can be accurately determined to ± 10 feet. The Mobile Optical Tracking System (MOTS) is camera mounts fashioned out of M-45 machine gun mounts. These mounts can be fitted with several different cameras to provide a variety of data results. The MOTS systems provide time space-position information (TSPI) like the Askanias accurate to ±.2 milliseconds. The Cine-Sextants are a new mobile system that is replacing the older MOTS. Three of these systems are on hand and two more are due in during the second quarter of FY80. The Cine-Sextants are a versatile tracking mount capablie of simultaneously running four cameras and has the capability to mount TV cameras for video coverage for video coverage.

b. Tonopah Test Range (DOE)

(1) Swiss Data (Contraves) Tracking Camera with 60-inch Focal Length Catadioptric Lenses. At the present time, there are eight of these camera stations, 7 MS models and 1 CS model. All are mobile and are used at various different sites on the range.

(2) Model ME-16 Tracking Telescope with Nentonion Photographic Objectives, for Event Surveillance Slow-motion Picture Record on 35mm Color Film. At the present time, there are four mobile ME-16, three fixed ME-16 and one LA 24 telescope.

(3) Target Instrumentation. There are two pedestal mounted tracking cameras and eight fixed cameras. The two pedestal cameras comprise:

1 Mitchell camera

1 Photosonic camera

To gather raw data on target operations, two pedestal-mounted tracking cameras and eight fixed cameras have been installed. The stations have been located to give optimum coverage on a 347 degree course line. As the stations are located in close proximity to the course line and to the hard target, operations are restricted to a maximum of 2,000 feet absolute altitude.

The two pedestal cameras comprise:

- One Mitchell camera that can operate at either 96 or 48 frames per second and can be equipped with either 40-inch or 24-inch focal length lenses. IRIG time code is recorded on the film.

- One Photosonic 35mm camera which can be operated at speeds from

300 to 1,000 frames per second, running time varying from 53 seconds to 16 seconds. Cameras can be equipped with either 12-inch or 24-inch focal lenght lenses. IRIG time code is recorded on the film.

The fixed cameras are so placed around the hard target that fields of view overlap and give complete coverage of impact on the surface of the target. The cameras normally operate at 90 frames per second (although various frame rates are available), have a frame size of 3/8 x 5 inches, and use black and white film. Each camera has a 10-inch length lens, and has a running time of 18 seconds with 50-foot film load. IRIG time codes is recorded on the film.

(4) Bomb Scoring. Impact points are computed by triangulation (three visual spotting stations) at the range. The aircraft personnel may request that impact information be radioed to them or, for the purposes of bomb scoring, aerial photographs may be taken. Upon request, report sheets providing bomb scoring information will be mailed to organizations using the range. These report sheets will list the CE, aircraft groung track to the nearest 0.5 degree, and ground speed to the nearest foot per second.

For those operations or training missions where no unit is released, scoring can be provided.

C. Timing.

(1) Primary. The South Range master timing center provides a common time basis to all range instruments. The output of the MTC is IRIG B.

(2) Secondary. Portable time code generators are used in remote areas. The aircraft pod has as internally mounted Geosace 8156 time code generator for local reference.

D. Photography.

(1) Motion Picture Capabilities. The Nellis AFB photo lab has color motion picture, 16mm and 35mm, Ektachrome (ME-4), and black and white negative film, 16mm, 35mm, 70mm to 9 1/2 inches wide photo capabilities.

(2) Still Photography. The cameras available for still photographs are 35mm, 70mm, 120mm, and 4x5" Polaroid. The processing capabilities include black and white and color prints for most types of 35mm, 70mm, 120mm, and 4x5" film.

3. Airborne Capabilities. Aircraft Pod - Range 63 is the owner and operator of the Nellis Camera Pods. This pod can be mounted on F-4, A-7, A-10, F-104, F-16. The pod coverage provides the capability to collect data from the aircraft concerning accuracy or ordnance separation. The cameras may be fixed to look forward, side or aft and record events referenced to a common time base.

E. Instrumentation Calibration Capabilities. The calibration facilities are limited and are not designed to support heavily instrumented tests.

F. Other General Instrumentation. For telemetry recording at Tonopah, there are five fixed stations and one mobile station. Associated with telemetry, five Midot stations have been established to obtain trajectory data.

(1) Meterorlogical. Standard meteorological equipment is available at Nellis AFB.

(2) Survey. Lower order surveying is accomplished by the Nellis facility. Higher order surveying is accomplished by the 1st Geodetic Squadron, F.E. Warren AFB.

(3) RFI/Electromagnetic Compatibility. No RFI or electronmagnetic compatibility equipment is available.

(4) Nellis South Range. Table V-1 lists the basic test parameters and the South Range instrument source from which they are derived. Tonopah also provides the following data for post-mission analysis.

a. List of equipment radiating verus time (manual log).

b. TSPI of target aircraft in the form of pen plot of aircraft track versus threat locations (up to 20 aircarft per plot).

c. Effectiveness of ECM in the form of computer printout, linear recordings, and video recording or radar scopes, when requested.

5. South Measurement and Analysis. No sound measurement and analysis equipment is available.

6. Safety and Security. Nellis uses no special safety or security instrumentation. Armed military guards patrol restricted areas and man roadlocks where necessary.

7. Soil Conditions. No soil condition measurement equipment is available.

G. Special Purpose Instrumentation. No special purpose instrumentation equipment is available.

V. RANGE/TARGET CAPABILITIES.

A. Nellis.

(1) Ground.

a. Range 63. Listed below are the equipment items available to provide a threat environment on Range 63.

Number	Classification
7	Cinetheodolites Optical Tracking System (COTS)
5	Mobile Optical Tracking System (MOTS)

Number	Classification
1	TV Ordnance Scoring System (TOSS)

b. Nellis Range Targets. Ground targets and scoring systems available at Nellis are as Follows:

- Two bomb circle targets are provided for bomb scoring (South Range).

- Two CBU grids are provided for bomb scoring (South Range).

- 3-H-18C acoustiscore system for scoring strafing missions with nixie tube readout of numbers of hits are also available.

- Static targets include pylons, ground cloths, trucks, tanks, and bunkers.

- Two strike targets are available at the North Range.

The Nellis target areas include numerous tactical targets with varying capabilities for using up to and including heavy ordnance.

(2) Airborne. Air-to-air (three air-to-air ranges)

a. Red and Blue Range.

- 35NM NW of Nellis

- 27NM long and 9NM wide on South Range (east of Green and White Range)

- Tow targets

b. Green and White Range.

- 45NM NW of Nellis

- 20 NM long and 11NM wide on South Range (west of Red and Blue Range)

c. AIM Missile Range.

- Airspace above ranges 71 and 76 (North Range) over Tolicha Peak, Black Mountain, and Mountain Helen on North Range.

- 19NM x 13NM on North Range

- For AIM firing

B. Tonopah EW Range.

(1) Tonopah EW Range Threat Capabilities. Listed below are the equipment items available to provide a threat enviroment on the Tonopah EW Range:

Number	Classification
5	MPS-TI Control Van
2	MPS-T1EF R/T Unit
2	MPS-TIG R/T Unit
2	MPS-T1I R/T Unit
1	MSQ-T7
1	MSQ-T2
2	MPS-9
1	MSQ-T8
1	AMS
1	TRTG
1	M-331
1	MM-33H

NOTE: I takes one control van and a R/T Unit to make an operational MPS-T1 system. A control van only operates with one R/T Unit at a time and provides a radar signal and collect data.

(2) Tonopah Test Range Targets (DOE).

a. Main Target. The main target is located on the northern-most lake in the chain of dry lakes. The coordinates are:

37 degress	50 minutes	36.7 seconds	North
116 degrees	43 minutes	44 seconds	West

at an elevation of 5,331 feet MSL. The normal course for the main target is 347 degrees true (331 degrees magnetic). The IF for the course is four miles east of Black Mountain (elevation 7,180 feet). This point is approximately 40 miles south of the target, 63 1/2 miles from Tonopah Radio (11/.2 mc), and is on a bearing of 153 degrees 30 minutes.

b. Hard Target. The hard target is located 3,696 feet from the main target at 167 degrees true. The coordinates are:

37 degrees	50 minutes	0? seconds	North
116 degrees	43 minutes	33.9 seconds	West

Operation on this target are limited to a maximum altitude of 2,000 feet absolute, and special permission must be obtained to use this target for practice drops.

c. Pedro Target. The Pedro target was established primarily for use on operations/tests with speeds in excess of 1.5 mach. The target coordinates are:

37	degrees	42 minutes	58.1 seconds	North
116	degrees	41 minutes	12.5 seconds	West

Target elevation is 5,371 feet MSL. Three different course lines are available for using this target: 167 degrees, 180 degrees, and 195 degrees (all true headings).

d. Antelope Lake Target: Antelope Lake is the southern-most and largest lake in the chain of dry lakes. A target was established here for operations in excess of 50,000 feet MSL and speeds in excess of 1.65 mach; it is also used for operations/tests of a hazardous nature and for those having stringent recovery requirements. In addition, this target is used for practice missions, impacts being scored by triangulation. The coordinates for the target are:

37 degrees	41 minutes	13.1 seconds	North
116 degrees	40 minutes	24.2 seconds	West

The elevation is 5,360 feet MSL. The normal course line for this target is 167 degrees true; 180 degrees and 195 degrees can be used on special request.

C. Tolicha Peak. Tolicha Peak Site Threat Capabilities: Listed below are the equipment items available to provide a threat environment in Range 76 target area:

Number	Classification
1	MPS-T1 Control Van
1	MPS-T1I R/T Unit
1	AMS
1	MSQ-T12
1	VITRO
1	MSQ-T11
1	TOSS
2	MSQ-T6
1	MSQ-T4
2	M-33I

NOTE: It takes one control van and a R/T Unit to make an operational MPS-T1 system. A control van can only operate with one R/T Unit at a time and provide a radar signal and collect data.

VI. DATA MANAGEMENT.

A. Range Control Center (RCC). The RCC is the central collection point for range test data. Sources of these data are defensive (threat) systems instrumentation equipment and several aircraft position reporting systems. Real-time display is provided on a large screen (6' x 8') color display system. Also provided at the RCC are real-time test control, air traffic management, and range data management.

B. Computer Systems.

(1) Varian V76 computers support the 554th Range real time requirements. These are mini computers designed and configured to handle real-time data processing.

(2) A CDC Cyber 74-18 large-scale computer is also used to support the data management requirements. It is currently used primarily for batch processing of data collected in real-time, scheduling the range use, and for studies and analysis gaining models.

(3) There are over 60 different instrumentation sources to drive 13 display systems, format and record all data, and provide a summary of the test results.

C. Computer Programs.

(1) The real-time programs process data from over 20 different instrumentation sources to drive 13 display systems, format and record all data, and provide a summary of the test results.

(2) The data reduction programs merge all data inputs including real-time data, instrumentation tapes, and manual data. Using this information, a data base is built which is available for specific uses by the user.

(3) Application programs are produced to satisfy the range user requirement. These include time-space-position information, plots, data listings, events, mission flow, etc.

VII. 554TH RANGE REQUIREMENTS.

A. Overall Range Group Combat Arena. The 554th Range has the largest continuous air and ground space available for peacetime military operations in the world. On this Range, Range Group is developing the best simulated combat arena that can be used to support aircrew training, tactics development, and testing. Range Group's long-range goal is to develope a combat arena on the North Range that can be divided into three complementary electronic warfare areas, and an Alternate Operating Area at Ft Irwin. On the North Range, there will be an area simulating the Forward Edge of the Battle Area (FEBA) located in Kawich Valley and Southern Tonopah, and two point defense areas located in the Tonopah and Tolicha Peak Electronic Warfare Ranges. The Alternate Operating Area at Ft Irwin will consist of a mini-FEBA and mini-point defense area. Until Kawich Valley and Ft Irwin are activated, all threats will be deployed at either Tonopah or Tolicha Peak in the optimum manner required to support aircrew training and various tests.

B. FEBA.

(1) Range Group is building in the R-4807 Bombing Area a target array which simulates a motorized rifle division. Range Group is acquiring a representative number of simulators for the SAM and AAA air defense assets that would be associated with a motorized rifle division. These simulators will be deployed in Ranges 72, 73, and Southern Tonopah as close to the targets as safety and other practical considerations will allow.

(2) Range Group will acquire the number of simulators required to realistically simulated the numbers of threats that would be encountered in a division sized area. This density will be made up of a various mix of sophistication of simulators. There will be a few relatively expensive simulators for each threat that will be emitter/receiver/processors (ERPs) which will realistically simulate how the threat operates. These ERPs will be able to support testing which requires extremely realistic simulators. There will be a larger number of less expensive emitter/receivers (ERs) which emit a realistic signal but do not necessarily operate the same way threats do. These less expensive systems will be used to provide the number of signals required to simulate signal density.

(3) The threats that will be simulated in the FEBA will be the SA-4, SA-6, SA-11, GUN DISH, FLAP WHEEL, IR SAMS, communications and radar jammers, and the height finding radars which are associated with these threats.

C. Tonopah and Tolicha Peak Point Defenses.

(1) The Tonopah and Tolicha Peak Electronic Warfare Ranges will simulate two point defense areas. These will be located behind FEBA and will provide overlapping defensive coverage of the interdiction type targets in the central portion of R-4807, such as airfields, railyards, and industrial complexes. There is no "standard" deployment pattern for point defenses, but they do involve such systems as SA-2s, SA-3s, SA-4s and different AAA systems.

(2) The Tonopah Electronic Warfare Range in R-4809 is the larger of the two ranges and is located just north of the interdiction targets in R-4807. It has simulators programmed for such point defense systems as SA-2s, SA-3s, SA-4s, Advanced Strategic SAMs, multiple AAAs, and acquisition radars. There are also communication and radar jammers programmed for this area. Some of these systems can be used to simulate those threats which would be located just behind the FEBA. Special systems coming to TFWC for AFTEC testing, such as communication data link jammers and laser weapons systems, will also be deployed at Tonopah.

3. The Tolicha Peak Electronic Warfare Range is on the south side of the interdiction targets located in the central portion of R-4807. It

has simulators programmed for such point defense systems as SA-2s, SA-3s, Advanced Strategic SAMs, radar jammers, multiple AAAs, and the SPOON REST. In addition, a BAR LOCK and SIDE NET simulator will be deployed.

D. Integrated Air Defense System. These two electronic warfare areas will be tied into one Integrated Air Defense System (IADS). Target information from the acquisition radar net will be fed into the Combined Operations Center at Nellis AFB. From there, battle management instructions will be forwarded to the various threat simulators.

E. Alternate Operating Area. The Army is developing a National Training Center at Ft Irwin which Range Group will be able to use as an alternate operating area. Ft Irwin will be used to support Wild Weasel training of the 35TFW and to handle overflow from the 554th North Range. Currently the 35TFW uses the 554th North Range which stretch the "legs" of their aircraft. They also have problems in scheduling time for their upgrade training program since they must compete for the limited range time available with Red Flag and the 57TTW training. Establishing an alternate operating area at Ft Irwin, consisting of a mini-FEBA and mini-point defense area, will solve the 35TFW range and scheduling problems. The 35TFW training requirements can usually be satisfied by providing one or two simulators for each kind of threat, and for those times when a realistic density is required, the 35TFW can schedule the 554th Range.

F. Overall Instrumentation Requirements. The 554th Range, with its large continuous air and ground space and extensive threat procurement program, is being developed into the best simulated combat arena in the world. However, for these assets to be properly utilized, the 554th Range must be adequately instrumented. To operate an effective range, Range Group needs to manage and control the range, collect data on what is happening on the range, and provide timely feedback to the various users of the range.

G. Range Control and Management. Range Group must effectively manage and control the range due to the limited amount of range time available to support all of the various users such as: the 4440th Tactical Fighter Training Group (Red Flag); the 57th Tactical Training Wing (TTW); the 474th Tactical Fighter Wing TFW); the 35th Tactical Fighter Wing (TFW); and the various testers. Most of the range control and management functions are conducted in the Range Control Center (RCC) at Nellis AFB. The two major instrumentation systems in the RCC are the Range information System (RIS) and the Enroute Automated Radar Tracking System (EARTS). The RIS is used to monitor and record what is happening on the range. It takes inputs from the threats, command, reference systems and scoring and collects, records and displays it in the RCC. The EARTS program is a Federal Aviation Administration multi-processing system that accepts input data from multiple air traffic control (ATC) radars and displays this data to give aircraft location and identification. It will provide for positive air traffic control on the range. EARTS currently uses radar inputs from FAA radars at Angels Peak, Tonopah and Cedar Peak. In the future, both EARTS and RIS will accept input from the gap filler radars and the programmed ATC radar replacement for Angels Peak. Both the RIS and the EARTS systems have enhancements programmed.

H. Data Collection.

(1) In order for training, testing, or tactics development to be effective, the appropriate data on what is happening on the range must be collected and recorded. This data includes such things as event data from threats and aircraft, video, time-space-position information (TSPI) data on all participants, and data on ordnance scoring. In addition, a communications network is required to get information to the ranges and data back from the range to Nellis AFB.

(2) On the North Range, each threat will be equipped with a Modular Instrumentation Package (MIP) microprocessor which will format, time tag, record, and transmit, via the Range Microwave System, all the event data from the threat. Accurate TSPI data is required to support ground-to-air, air-to-air, and air-to-ground scoring. Currently, this data is acquired using an IFF system that has accuracies such that only limited target pairing and envelope scoring can be used. As an interim solution, Range Group has a RMS II TSPI system programmed. This will supply reliable data which can be used for target pairing and envelope scoring. The Advance TSPI System programmed for Range Group will have accuracies which are required to support miss-distance scoring and AFTEC testing requirements. Currently, ordnance scoring is done by a remotely operated TV Ordnance Scoring System (TOSS). A total of nine TOSS systems have been programmed for Range Group and an enhancement effort for the TOSSes is programmed in FY82. Other enhancements programmed for Range Group are an air-to-air and air-to-ground scoring system which will work with the Advanced TSPI and an attrition network which will support tactics development.

(3) The basic function of the South range is to support operational test and evaluations (OT&E) and air-to-air combat training on the ACMI System. The ACMI System is installed and any further improvements are not defined past FY80. OT&E is usually conducted on the small, instrumented Range 63 by using old Askania Cinetheodolites and Cinesextant optical trackers. In order to provide more reliable TSPI data, better coverage, and the ability to track multiple targets, the following systems are being procured: a Precision Tracking Radar, a Sensor Acquisition Processing System, three Laser Rangers, Videotheodolites, and a Contraves Cinetheodolite.

(4) A Digital Microwave Communications Network is programmed for the 554th Range. Currently, communications are being conducted with a limited analog microwave system. The digital microwave system will provide an encryptable link between the threats. Tonopah and Tolicha Peak Electronic Warfare Ranges, and Nellis AFB. This microwave system is required to get all the necessary data and information to and from the threats, the ranges, and the RCC. Also programmed for the Range Group is a new Key System for the RCC and RCC. Also programmed for the Range Group is a new Key System for the RCC and a microwave link between Tolicha Peak Electronic Warfare Range and Nellis to remote radar data from a GCI radar site to the Combined Operations Center in the RCC.

I. Feedback and Debriefing Products.

(1) The data collected on the range must be processed, appropriately formatted, and packaged to provide feedback to the users in a timely manner. For aircrew training the debriefing product must be timely

(available to the diverse backgrounds), and presented in a manner to get aircrew attention. To satisfy these requirements, a debriefing system has been added to the range improvement program. The aircrew debriefing system will consist of necessary computer consoles, visual displays, communication and audio equipment to provide a debriefing capability in several areas as well as the necessary software to chronologically sequence and call up audiovisual and technical information. The audiovisual information will include RIS large screen color display, ingress and egress data and range threat boresight and scope video. Additionally, a selectable multiple channel audio capability for accessing recorded ground, airborne, air-to-air, ground-to-air, and other communications will be included. Range users have indicated that threat video products are a valuable debriefing tool. Video products can be used to indicate the threat's ability to track an aircraft, aircraft evasive maneuvers, tactics such as terrain masking, and the effect(s) of electronic countermeasures (scope video). Four video edit facilities are programmed to collect video from the threats and to edit them to determine which video should be sent down in real-time. Audio recordings will provide valuable mission reconstruction and communication jamming information. The technical information displayed will include time-correlated ground-to-air, and air-to-ground event data, as well as scoring and graphic information. The system will have a stop action/pause capability to aid in debriefing.

(2) Test users require data from the same sources. However, it is normally required in a more detailed and less timely manner.

J. Improvements/Modernization Planning. The following range improvements and modernization plans were obtained from material contained in Reference 2. Since the nature of Reference 2 is a planning document, the information provided in the paragraphs to follow may be subject to change and should be considered generally as a guide to the direction of the proposed range improvements efforts.

K. General Trends.

(1) Planned improvements to the 554th Ranges include upgrading of range threat systems and targets, the addition of a wide varity of support instrumentation, improved data management capabilities, and expansion of existing communications equipment. A major emphasis will be on increased realism in the threat environment. This will include not only increase density through additional new systems, but also the establishment of three Forward Edge of the Battle Areas (FEBA) in the North Range.

(2) Extensive target improvement is anticipated, including EW fixed expendable targets and remote control systems, dynamic ground targets and their remote control systems, airborne targets, and scoring devices for a scorable range within R-4807.

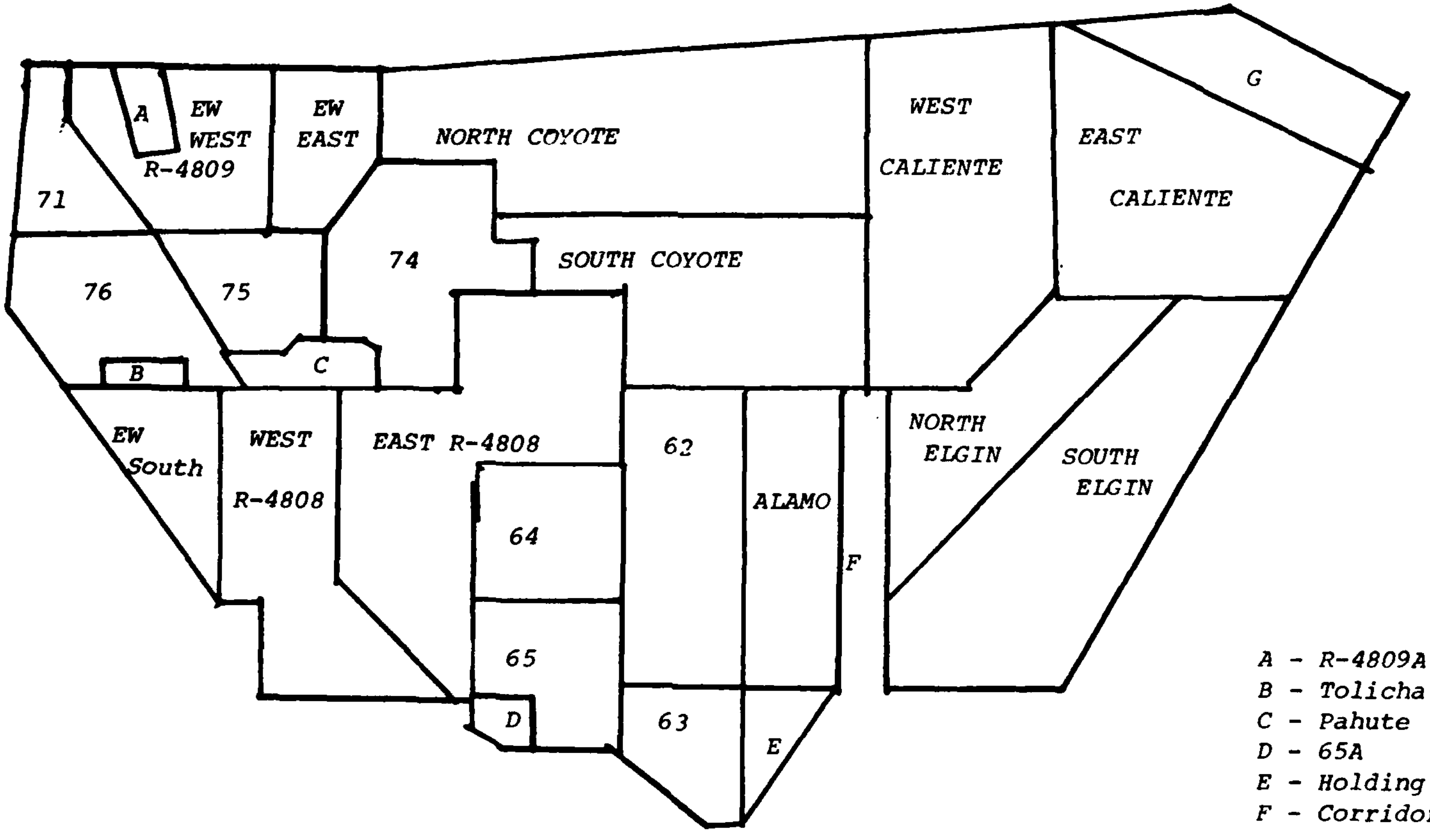
(3) Instrumentation improvements are planned throughout the 554th Ranges. For the South Range, additions include a precision tracking radar, laser tracker, new Contraves C-F cinetheodolite and film readers, high-speed cameras, a telemetry system van and a new airborne camera pod. Improvements to the Caliente EW Range include additional radar units and AN/MPS-T1 control vans. The North Range is programmed for additional radar

installations. In addition, much equipment intended for common range usage is planned, including ATC radars, digitizers, video and instrumentation recorders, frequency control/analysis vans, and improvements to the existing timing systems.

(4) The Range Control Center (RCC) located at Nellis AFB is scheduled for expanded ATC facilities with the installation of an Enroute Automated Radar Tracking System (EARTS). This will be interfaced with the national aerospace system (FAA) and will provide for control of all aircraft, both civil and military, in and around the Nellis complex. Increased data management will be provided through a new computer installation.

(5) Communication links throughout the range complex are scheduled for upgrading. New microwave (MW) systems should be installed in the Caliente, South and North ranges. Gap filler radar MW links are scheduled. In addition, a voice documentation recorder is planned for the range communication upgrading.

L. Specific Improvements/Modernizations. Table V-1 shows a list of planned Range Group additions, improvements, or modernizations to the existing facilities. The table is based on year of funding; therefore, the new capabiliy will be operationsl about 1 1/2 to 2 years later.



A - R-4809A
B - Tolicha Peak EW Range
C - Pahute
D - 65A
E - Holding
F - Corridor
G - Cedar

Figure V-1

INSTRUMENTATION PE 27429

PROGRAMMED FISCAL YEARS

RANGE 63 INSTRUMENTATION

TOTAL	SYSTEM	ON HAND	PROG	80	81	82	83	84	85	86
1	PRECISION TRACKING RADAR		1							
2	STRAFE SCORING	2								
1	LASER INSTRUMENTATION	1								
1	MASTER TIMING	1		+						
5	ASKANIA CINE T	5					-5			
3	MOTS	3		-3						
5	CINESEXTANTS	3	2							
4	CONTRAVE MODEL F	3				1				
1	SAPS					1				
3	LASER RANGERS					3				
4	VIDEOTHEODOLITE					4				
1	A/G TELEMETRY						1			

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INSTRUMENTATION PE 27429

PROGRAMMED FISCAL YEARS

OTHER INSTRUMENTATION

TOTAL	SYSTEM	ON HAND	PROG	80	81	82	83	84	85	86
8	GEIS	8								
8	PBS	8								
157	MIP		14	32		50		61		
1	ACMI	1		+						
1	RMS-2		+							
1	ADVANCED TSPI						+	+	+	
1	EARTS	1	+	+		+				
2	GAP FILLERS		2							
1	AIR TRAFFIC CONTROL RADAR									1
1	RIS	1	+		+					
1	VIDEODIT FACILITY				1	2		1		
1	AIRCREW DEBRIEFING				1	+	+	+		

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INSTRUMENTATION PE 27429

PROGRAMMED FISCAL YEARS

OTHER INSTRUMENTATION

TOTAL	SYSTEM	ON HAND	PROG	80	81	82	83	84	85	86
9	TOSS	5		2		2				
+	TOSS ENHANCEMENT					+		+		
1	ATTRITION NET									1
1	A to A/A to G SCORING									1
+	STATE-OF-THE-ART INSTRUMENTATION									+
+	COMMUNICATIONS	+	+	+				+		+

SURFACE-TO-AIR MISSILES (PROGRAMMED FISCAL YEARS)

TOTAL	SIMULATOR	ON HAND	PROG	80	81	82	83	84	85	86
3	MPS-T1 (E/F)	2	1							
4	MPS-T1 (G)	3	1							
4	MPS-T1 (I)	3	1							
8	MPS-T1 CONTROL VAN	7	1							
1	MSQ-T4	1								
3	M.T.E.-3						3			
2	MSQ-T6	2								
3	MPS-T10	2				1				
2	M.T.E.-4						2			
1	SQUARE PAIR					+	+	+	+	
2	MSQ-T13	2								
4	M.T.E.-6				3			1		
10	PAQ-T1	4	6							
4	MPS-TYY					1	1	1	1	
6	M.T.E.-8					5	1			
10	*TRTG		10 MOD							
4	ADV STRATEGIC SAM					+	+	+	+	3
9	M.T.E.-11							3	6	

* AAA, LIMITED SAM CAPABILITY

+ INDICATES PROTOTYPE DEVELOPMENT PE 64735

ANTI AIRCRAFT ARTILLERY (PROGRAMMED FISCAL YEARS)

TOTAL	SIMULATOR	ON HAND	PROG	80	81	82	83	84	85	86
1	MSQ-T12	1								
12	*TRTG	2	6	4						
11	MPQ-T3		6	1		2	2			
3	MPS-9	3		-3						
4	*M-33	4								
3	ADV AAA						+	+	1	1

* HAS LIMITED SAM CAPABILITY

+ INDICATES PROTOTYPE DEVELOPMENT PE 64735

ACQUISITION/HEIGHT FINDERS (PROGRAMMED FISCAL YEARS)

TOTAL	SIMULATOR	ON HAND	PROG	80	81	82	83	84	85	86
2	MSQ-T7	2								
3	MSQ-T8	1	2							
3	MSQ-T11	1			2					
2	TPS-40 (MOD)		2							
1	MPS-T9		1							
1	MPS-14	1								
2	ODD PAIR					+	+	+	+	1
2	BACK NET					+	+	+	+	1
1	LOW ALT THT RADAR				+	+	+			
4	MPS-TZZ					+	+	+1	1	1

+ INDICATES PROTOTYPE DEVELOPMENT PE 64735

GROUND BASED JAMMERS (PROGRAMMED FISCAL YEARS)

TOTAL	SIMULATOR	ON HAND	PROG	80	81	82	83	84	85	86
2	MLQ-T2 (J)	2								
5	MLQ-TX/TY (I&J)					1	1	2	1	
2	MLQ-TZ (UHF, VHF)				1	1				
3	ADV COMM JAMMER								+	+2
1	COMM DATA LINK JAMMER			+	+	+				
1	I BAND COMM DATA LINK JAMMER				+	+				
2	LASER WEAPON SYSTEM				+	+	+	+	1	

+ INDICATES PROTOTYPE DEVELOPMENT PE 64735

THREAT SUPPORT (PROGRAMMED FISCAL YEARS)

TOTAL	SIMULATOR	ON HAND	PROG	80	81	82	83	84	85	86
2	MSR-T1			1			1			
1	SAS	1								
1	XM-60's	1								
1	02/03/04		+	+	+					
1	C^2 SIMULATOR			+	+x	+x	x	x		
1	AIRCRAFT C^2				+	+	+			
1	ADVANCED C^2						+	+	x	x
1	AUTOMATIC IADS								+	+

+ INDICATES PROTOTYPE DEVELOPMENT PE 64735

x INDICATES PRODUCTION PROGRAM PE 2759

PLANNED ELECTRONIC WARFARE SYSTEM GROWTH THROUGH FY86

PROGRAMMED FISCAL YEARS

	ON HAND	PROG	FY80	FY81	FY82	FY83	FY84	FY85	FY86
SAMS	18	17	0	3	7	7	5	9	3
AAA	10	12	-3	0	2	2	1	1	1
EW/HF/ACQ	5	5	0	2	0	1	2	3	3
JAMMERS	2	0	0	1	4	1	3	2	3
TOTALS	35	34	-3	6	13	11	12	15	10
CUMULATIVE TOTAL	35	69	66	72	85	96	108	123	133

ANNEX V

BIBLIOGRAPHY

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2. NAFB Regulation 80-14, 1 March 1979, Range Users Procedures for Operational Test, Evaluation and Training.

ANNEX W

OPERATIONAL TEST INSTRUMENTATION GUIDE

AIR DEFENSE WEAPONS CENTER
Tyndall Air Force Base, Florida

CONTENTS -ANNEX W

ANNEX W

AIR DEFENSE WEAPONS CENTER (ADWC)
Tyndall Air Force Base, Florida

1. Introduction

a. Overview

Tyndall Air Force Base, located near Panama City, Florida, is the home of the Air Defense Weapons Center (ADWC). The Center is responsible for firing tests of air-to-air weapons systems as part of the Air Force Weapons System Evaluation Program (WSEP), and for the initial operational test and evaluation (IOT&E) and follow-on operational test and evaluation (FOT&E) of modifications and new or improved equipment. Tyndall AFB is also the USAF-designated main operating base for the PQM-102 and follow-on QF-100 drone target systems. Limited testing of surface-to-air and air-to-surface weapons systems can also be carried out by the ADWC. The ADWC radar test program provides the Air Force with the capability to operationally test and evaluate pulse doppler fire control radars in a realistic yet controlled range environment. Generally, favorable climatic conditions facilitate test involving aircraft. Limited maintenance facilities on base are available for transients. Special Devices Section facilities on base include the capability to design, fabricate, and produce electronic equipment as well as metal and woodworking facilities to support IOT&E and FOT&E activities.

b. Generic Systems Tested

(1) Primary Tests

The ADWC primarily tests air-to-air weapons systems.

(2) Limited Testing

The ADWC has done limited testing of surface-to-air and air-to-surface weapons systems.

(3) Principal Programs

One of Tydall AFB's principal programs is COMBAT PIKE, the firing portion of the Weapons Systems Evaluation Program. One or more Air Defense squadrons are deployed to Tyndall AFB approximately every three weeks for COMBAT PIKE operations (see Bibliography, reference 6).

2. General

a. Military Units

Air Force Units

4756th ADS

4756th Air Base Group

2d Fighter Interceptor Training Squadron

USAF Interceptor Weapons School

95th Fighter Interceptor Training Squadron

Air Force Engineering and Service Center

475th Test Squadron

Det 5, 38th ARRS

Det 1, 87th FIS

b. Maintenance Capability

(1) Aircraft Maintenance Capability

The base has maintenance capability for Air Force aircraft types T-33, F-101, and F-106; also limited capability for other types.

(2) Commercial Vehicle Maintenance

There is a maintenance capability on base for commercial-type Air Force vehicles (sedans, pickups, vans, etc), but the base facility could not maintain Army-peculiar vehicles such as tanks, APCs, etc.

(3) Special Devices Section

The 475th Test Squadron has a Special Devices Section which includes an electronics laboratory, woodworking shop, machine shop, fiber glass shop, and a paint shop. The electronics lab can design circuits, fabricate PC boards, and assemble and test electronic equipment.

(4) Explosives

Explosives handling personnel and munitions storage facilities are available on base.

c. Access

(1) Air

An airfield is located on base with three runways (10,000, 8,100, and 6,275 feet). The nearby civilian airport (Panama City) is serviced by Republic Airlines and Air Florida.

(2) Rail

There are no rail facilities on base. Panama City is served by the Atlanta and St Andrews Bay Railroad (freight only).

(3) Road

US 98 bisects Tyndall AFB.

(4) Sea

Port Panama City provides extensive deepwater port facilities on the Gulf of Mexico. Tyndall has limited docking facilities for boats assigned to the 4756th ADS.

d. Logistics Support Capability

A reasonable estimate is that quarters and messing facilities for 50-to-75 transients could usually be provided on base. However, six weeks notice should be provided.

e. Recurring Commitments

William Tell, a worldwide weapons meet, severely limits all facilities for a 30-45 day period. The meet is held biannually in even numbered years and usually in the early autumn.

Bold Eagle is an annual joint service exercise held concurrently at Eglin and Tyndall Air Force Bases and severely limits air and ramp space. This exercise is usually scheduled in October and lasts approximately 21 days.

f. Special Operational Restrictions

Only aircraft supporting test projects may fly VFR and only when absolutely required. All others must fly IFR.

g. Environment (Climate)

The environment is mild, subtropical Gulf Coast climate, with warm days, frequent even during the winter. Frequent heavy rain occurs during winter, occasionally lasting several days. There are occasional morning fogs. Freezing weather is almost nonexistent. The climate is similar to that of New Orleans and the Mississippi/Alabama Gulf Coast rather than that of South Florida.

h. Topography

Tyndall AFB is located on the Florida coast. The general nature of the topography of this area is flat and sandy with substantial pine forestation. For further topographical information, see reference 5 of the Bibliography.

i Airspace Restrictions

(1) Warning Area (W-470/W-151)

These warning areas are located over the Gulf of Mexico for the purpose of weapons firing and testing from sea level to unlimited altitudes. Utilization is coordinated by the Executor, Southeast Test and Training Area (SETTA), located at Eglin AFB, composed of representatives of the Air Defense Weapons Center, the Armament Division, and the Tactical Air Warfare Center (Figure W-1).

(2) Cape San Blas Firing Area

This areas (Figure W-1) is used for firing meteorological sounding rockets and anti-aircraft artillery to an altitude of about FL 600. Warning prior to actual firing is provided IFR traffic by Tyndall RAPCON; VFR traffic by NOTAM.

3. Dimensions

a. Landspace

Tyndall Air Force Base consists of approximately 32,000 acres. For a more detailed map, use reference 4 of the Bibliography.

(1) Contiguous Test Areas

There are no land test ranges.

(2) Easements

None impacting OT&E operations.

(3) Impact/Live Firing Areas

There are no live firing areas on the reservation; however, there is a drop zone for unexpended ammunition, missiles, drones, and tow targets.

b. Airspace

(1) Landspace/Airspace Relationship

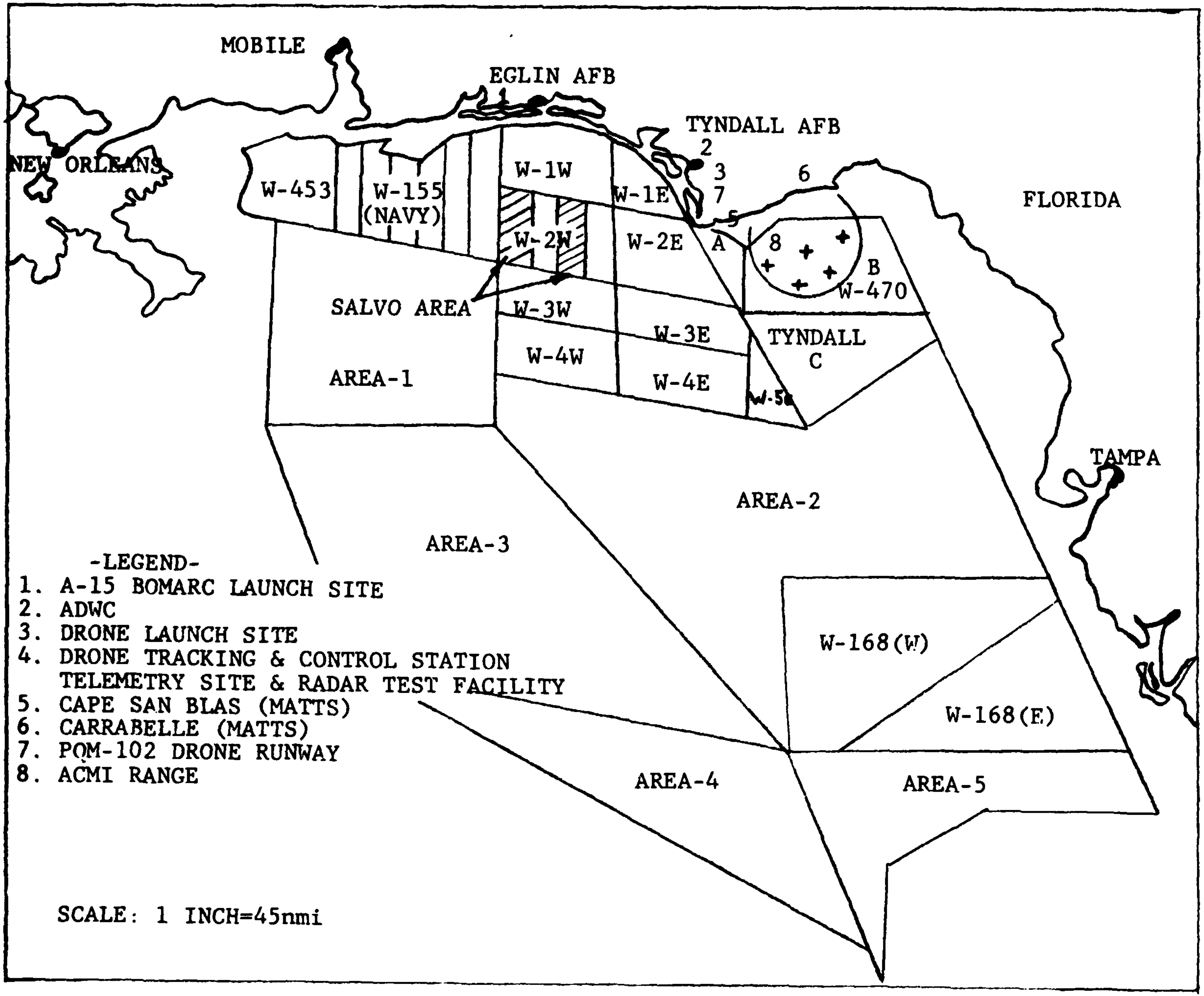

FIGURE W-1. TEST AREAS

Figure W-1 illustrates the relationship of the ADWC landspace to its airspace. Further details can be found in Chapter 3 of reference 2 of the Bibliography.

(2) Unmanned Airborne Systems

(a) Missile/Artillery Firing

Missiles and artillery may be fired out over the Gulf of Mexico only--not over land areas.

(b) Drone Areas

Planned drone flight paths will be over the Gulf of Mexico for all profiles except recovery. Further information on the operation of the BQM-34 A/F drones can be found in Chapter 4 of reference 2 of the Bibliography. All PQM-102 drone profiles are planned to be flown over the Gulf of Mexico with no overland flights except during launch and recovery.

(3) Area Surveillance

Local area surveillance is provided via aircraft range patrol before and during each mission and by the 4756th ADS radar complex. Aircraft radar tracking is also provided by Eglin AFB.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements

(a) Single Objects

None.

(b) Multiple Objects

None.

(2) Airborne Elements

(a) Radar

Some of the test aircraft are radar-equipped. ADWC has three aircraft tracking radars:

AN/FPS-64A

Two AN/MPS-19 (part of AN/MSQ-1A system)

(b) Lasar

None.

(c) Optical

Airborne cameras are available and cinetheodolite support is available from Eglin AFB.

(d) Relative (Miss-Distance)

1 Multiple Airborne Target Trajectory System (MATTS)

a Tracking

The MATTS provides relative azimuth and elevation information for up to three airborne objects when equipped with an appropriate airborne signal source. It is computer controlled to provide realtime position plotting of two objects. Vector separation, velocity, and acceleration of the three objects are obtainable in hardcopy during postmission data reduction.

b Reliability

The reliability of MATTS information increases with altitudes up to 50,000 feet. Normal MATTS scoring missions are conducted between 35,000 and 40,000 feet. MATTS will provide positional tracking information at altitudes over 20,000 feet.

2 Autotracker

A Scientific-Atlanta GKA-17 can track vehicles with L- or S-band transmitters. There is a limited P-band receiving capability which will be phased out at an undertermined date.

3 Air Combat Maneuvering Instrumentation (ACMI) Program

The ACMI provides a facility for training pilots in air-to-air combat and for operational test and evaluation of aircraft and weapon systems. It includes an airspace 30NM in diameter up to 40,000 ft AGL. Eight aircraft can be tracked in the high-activity mode and an additional twelve aircraft in the low-activity mode. Data from aircraft in the high-activity mode include position, velocity, acceleration, attitude, airspeed, Mach No, and weapons system information; while data from aircraft in the low-activity mode include only position. Position accuracies are +25 ft in the X and Y axes and +35 ft in the Z axis. All weapon firings and trajectories are simulated. Aircraft maneuvering actions are displayed in real time on ground control consoles and recorded for post-mission replay.

b. Timing

Four airborne and one ground station IRIG time code generators are available.

c. TV

None.

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d. Photography

(1) Motion Picture Capabilities

Hand-held pod-mounted aircraft cameras are available.

(2) Still Photography

Normal base still photography capabilities are available.

(3) Airborne Capabilities

The following is a list of ADWC's present airborne photographic instrumentation:

Four Camera Pods (specially fabricated by Norton)

One Airflex 16, 16mm Movie Camera

One Photosonic 16mm-VN, Movie Camera (24-200 frames/sec)

One Photosonic 16mm-IVN, Action Master (pistol grip)

Four DBM-44 16mm Movie Cameras, Milliken/Teledyne (1,000 frames/sec)

One DBM-3C 16mm Movie Camera, Milliken/Teledyne

One Nikon FTN 35mm Camera (telephoto/wide-angle)

One Connie-Omega 120mm Portrait Camera

e. Instrumentation Calibration Capabilities

Performed by the base PMEL.

f. Other General Instrumentation

(1) Telemetry

(a) Airborne Capability

Present capability is L-band (1435-1540 MHZ), S-band (2200-2300 MHZ), and P-band (216-260 MHZ) which is scheduled to be phased out. Several airborne telemetry systems are available; others may easily be assembled.

(b) Frequency Ranges

The TM site can receive and record L-band, S-band, or P-band.

(c) Aircraft Recording Capability

Five aircraft are presently configure to record/telemeter aircraft or test data; one other aircraft is available for test instrumentation.

(2) Meterological

Adequate facilities are available.

(3) Survey

No survey facilities are available.

(4) Radio Frequency Interference/Electromagnetic Compatibility

No instrumentation is available.

(5) Visibility

Runway visual range (RVR) instrumentation is available.

(6) Sound Measurement and Analysis

A 606-1B Audio Spectrum Analyser is available (80HZ to 8KHZ) (160 HZ to 16KHZ).

g. Special Purpose Instrumentation

(1) Radar Test Facility

(a) The purpose of the Radar Test Facility (RTF) is to provide the Tactical Air Command and Air Force agencies with the capability to operationally test and evaluate the F-15 pulse doppler fire control radar and associated munitions against an ECM threat.

(b) The RTF provides a ground-based, highly-instrumentated test platform capable of a wide range of OT&E in a realistic, yet controlled, range environment while minimizing actual flight requirements.

(2) Ballistic Data

No instrumentation is available.

(3) Environment Chambers

A high-altitude physiological chamber is available.

(4) Vehicle Performance

Limited instrumentation is available.

(5) Chemical/Biological/Radiological Instrumentation

No instrumentation is available.

5. Threats/Targets

a. Ground

Instrumentation is available only at the RTF on the APG-63/F-15 ground-based radar system.

b. Airborne

(1) Electromagnetic

The F-101s are capable of having ECM equipment, such as the ALQ 41, mounted internally. The F-101 is capable of carrying externally-mounted ECM and chaff pods. The T-33 aircraft carry ALE-72 pods and chaff. In the future, the DLQ-3B will be operational at the ADWC on F-101 and T-33 aircraft and on PQM-102 and follow-on QF-100 full-scale aerial drones.

(2) Weapons

(a) Firing Realism

1 Tow Targets

The following tow targets are available:

TDU-9 - radar and IR target with scoring system and TM capability.

TDU-22 - passive-type radar augmentation target (non-scoring system).

TDU-25 - IR tow target with scoring system.

LCTT - Low Cost Tow Target is a converted Army Ballistic Aerial Target System (BATS) equipped with a DSQ-40 bullet scoring system.

TDU-29 (FIGAT) - fiber glass air-to-air target, with bullet scoring systems.

TDU-10 (DART) - bullet scoring system available.

Minimum tow target altitude is 200 feet; gun-target tow cable length, 2,000 feet; minimum missile-target tow cable length, 26,000 feet.

2 Drones

The BQM-34 Drone Control Facility, operated under contract, provides the capability to control the drone within 1/2 mile of its intended course. The BQM-34A drone can be operated down to about 2,000-5,000 foot minimum altitude. Specifics include:

Drones can be equipped with infrared augmentation pods, radar augmentation, and chaff or active ECM equipment. MATTS, BIDOPS, and DIGIDOP scoring are available.

The present drones are limited in simultaneous dive and turn capability.

Drone recovery boats and helicopters retrieve drones from the water if they are not recovered in the land recovery area. Helicopter provide capability for the mid-air parachute retrieval system.

The PQM-102 drone aircraft is a highly maneuverable, full sized, afterburning target capable of providing increased realism for weapons systems testing and evaluation. This drone system is controlled using FPS-16 radars at Eglin site D-3 and/or the DTCS. A satellite RQM-102 runway is located east of the present Tyndall runway. Twelve PQM-102 drone missions per month are available to approved DOD users.

The BOMARC (CQM-10B) is a high-altitude, high-Mach target used in weapon system testing and evaluation. It is capable of cruising at altitudes between 34,000 to 90,000 feet at speeds varying between Mach 2.3 and 3.2. The BOMARC is a non-recoverable target launched from Eglin site A-15 and controlled by O&M contract personnel from Eglin site A-20.

(b) <u>Scoring Capability</u>

<u>1</u> <u>Missile Scoring Systems</u>

<u>a</u> <u>Scaler Miss-Distance</u>

<u>BIDOPS</u> (now on BQM-34A and TDU-25B)

Scoring radius 100'-BQM-34A, 70'-TDU-25B
Accuracy ±4.5', 95% confidence

<u>Babcock</u> 808B-5 (now on TDU-9B)

Scoring radius - 50'
Accuracy - ±5', 95% confidence

<u>DIGIDOPS</u> (now on BQM-34F/PQM-102

Scoring radius - 200'
Accuracy - ±2', 95% confidence

<u>b</u> <u>Vector Miss-Distance</u>

Not available. (Vector Miss-Distance indicator now in full-scale engineering development).

<u>2</u> <u>Rocket Scoring System</u>

Multiple Airborne Target Trajectory System (MATTS)

Relative missile distance scoring system for scoring rocket firings from F-106/F-101 aircraft.

Accuracy - 50-100 feet or greater.

DSQ-40 Bullet Scoring System

Scoring Radius - 20 feet (approximate)

Counting Capability 95%-20mm (approximate)

3 Drone Control and Tracking Radar (MSQ-1A (Present))

Maximum range (line-of-sight)

Deacon track 150 nm

Position accuracy (skin paint)

Azimuth ±5 miles

Elevation ±5 miles

Range ±20 yards

Computer position plotting accuracy

Elevation ±100 feet

Range ±300 feet

Single drone (BQM-34F) control only

4 Other radars

FPS-16 (ADTC supported)

200/500 nmi ±5 yards

Dual track capability

FPS-64 (GCI radar at Tyndall)

200 nmi ±1%

(c) Physical Realism

Some current tow and drone targets incorporate IR target and test sources (see paragraph 5.b.).

6. Data Handling/Processing

a. Data Storage

(1) Analog

Four Bell and Howell 3700B (two, 1-inch and two, 1/2 inch) machines provide instrumentation tape recording capability.

(2) Digital

(a) Two 9-track magnetic tape units, industry standard 800 BPI.

(b) Two 7-track magnetic tape units, industry standard 800 BPI (currently restricted to MATTS processing).

(c) Six 1.2 million word removable disk drives (two dedicated to MATTS).

(d) Three 32 megabyte drum platter disc drives.

b. Decoding

IRIG Standard PAM, PDM, and PCM capability. All IRIG FM subcarrier channels, IRIG time-standard, and slow codes.

c. Data Recording of Data Output Capability

Six 8-channel pen and ink recorders, rates to 100 Hz

One 18-channel and one 9-channel light beam recorders, rates to 5000 Hz

Audio frequency spectrum analyzer

Three X-Y plotters

CRT graphics display/hard-copy unit

132-column line printer

Teletype

Calcomp Drum Plotter

d. Processing

(1) System and Model

This computer facility possesses a PDP-11/55 computer with 128,000 words of 16-bit memory which can be accessed by up to six users simultaneously. The PDP-11/55 can also be extended through use of an older PDP-11/20 with 28,000 words of memory as a pre-processor for the PDP-11/55.

(2) Language

FORTRAN IV-Plus and Marco II Program Assembly language compilers are used.

(3) Input/Output Options

ADWC has magnetic tapes, cathode-ray tubes, punched cards, paper tape, line printer, plotters, PCM interfaces and analog to digital converters.

(4) Real-Time/Post-Test Analysis

Available through TM-computer interfaces which includes:

PCM/PAM/PDM

Digital to analog converters

Analog to digital converters

IRIG time

7. Improvements/Modernization Planning

a. Future additions and improvements to the ADWC range facilities are planned to maintain an up-to-date operating system. This will include the procurement of new equipment where necessary to keep up with state-of-the-art instrumentation capabilities.

b. A major program to update and improve the ADWC range facilities is underway. This is part of a continuing effort to evaluate our facilities and improve the range to provide a better service to our users.

Improvements planned for the near future are:

A second Scientific-Atlanta GKA-17 Auto-Track Telemetry System will be installed CY 80.

Upgrade and modernization of the 4756th ADS Radar Control Facility.

Additional improvements to the computer operations facility.

Low altitude surveillance radar coverage.

Low altitude ground-to-air voice communications.

Improved flight termination system.

CCTV to record drone launches.

TSPI/drone control.

Improved microwave communications system.

Drone tracking and control system retrofit for BQM-34F.

Dual and low altitude target control capability.

Airborne radiometric measuring equipment.

Additional airborne PCM data encoding packages.

DIGIDOPS scoring for BQM-34A target.

Radar Test Bench Set for the ADWC Radar Test Facility.

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5. Topographic Map, Apalachicola, Florida, US Geological Survey, Washington, DC 20242, NH-16-9, Revised 1967, scale 1:250,000.

6. Aerospace Defense Command Weapon System Evaluation Program Plan, (WSEP), Ent Air Force Base, Colorado, 1 January 1975.

ANNEX X

OPERATIONAL TEST INSTRUMENTATION GUIDE

ROME AIR DEVELOPMENT CENTER
GRIFFISS AIR FORCE BASE
ROME, NEW YORK

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LIST OF FIGURES

ANNEX X

ROME AIR DEVELOPMENT CENTER
Griffiss Air Force Base
Rome, New York

1. Introduction

a. Overview. Griffiss Air Force Base is located approximately one mile east of Rome, New York, and 13 miles northwest of Utica, New York. A detailed map showing the base is presented in Figure X-1. The host activity at Griffiss AFB is the 416th Bombardment Wing of the Strategic Air Command (SAC).

Rome Air Development Center (RADC) is a tenant at Griffiss AFB. RADC's mission is to do research, exploratory and advanced development in various C3I activities. In addition to doing traditional laboratory-type work, RADC also does assigned engineering development. RADC support technology acquisition programs and conducts selective acquisition, primarily in the intelligence area.

RADC comprises various shops, offices, and laboratories on Griffiss AFB proper, but also operates nine off-base sites that total 1,487 acres. However, there are no maneuver or impact areas.

Fort Drum, located approximately 100 miles north of Griffiss AFB, is used infrequently by RADC for testing. This site will be discussed later in the text.

The Rome/Utica area is located in central New York south of the Adirondack Mountains, adjacent to the Mohawk River. Summers are mild and winters are cold and snowy. The terrain is generally hilly.

b. Generic Systems Tested. RADC plans and executes research, exploratory and advanced development in C31 activities for:

Communications
Electromagnetic Guidance and Control
Surveillance of Ground and Aerospace Objects
Intelligence Data Collection and Handling
Information System Technology
Electromagnetic Propagation
Solid State Physics
Electronic Reliability, Maintainability and Compatibility

2. General

a. Military Units

(1) Army Units: None.

(2) Air Force Units:

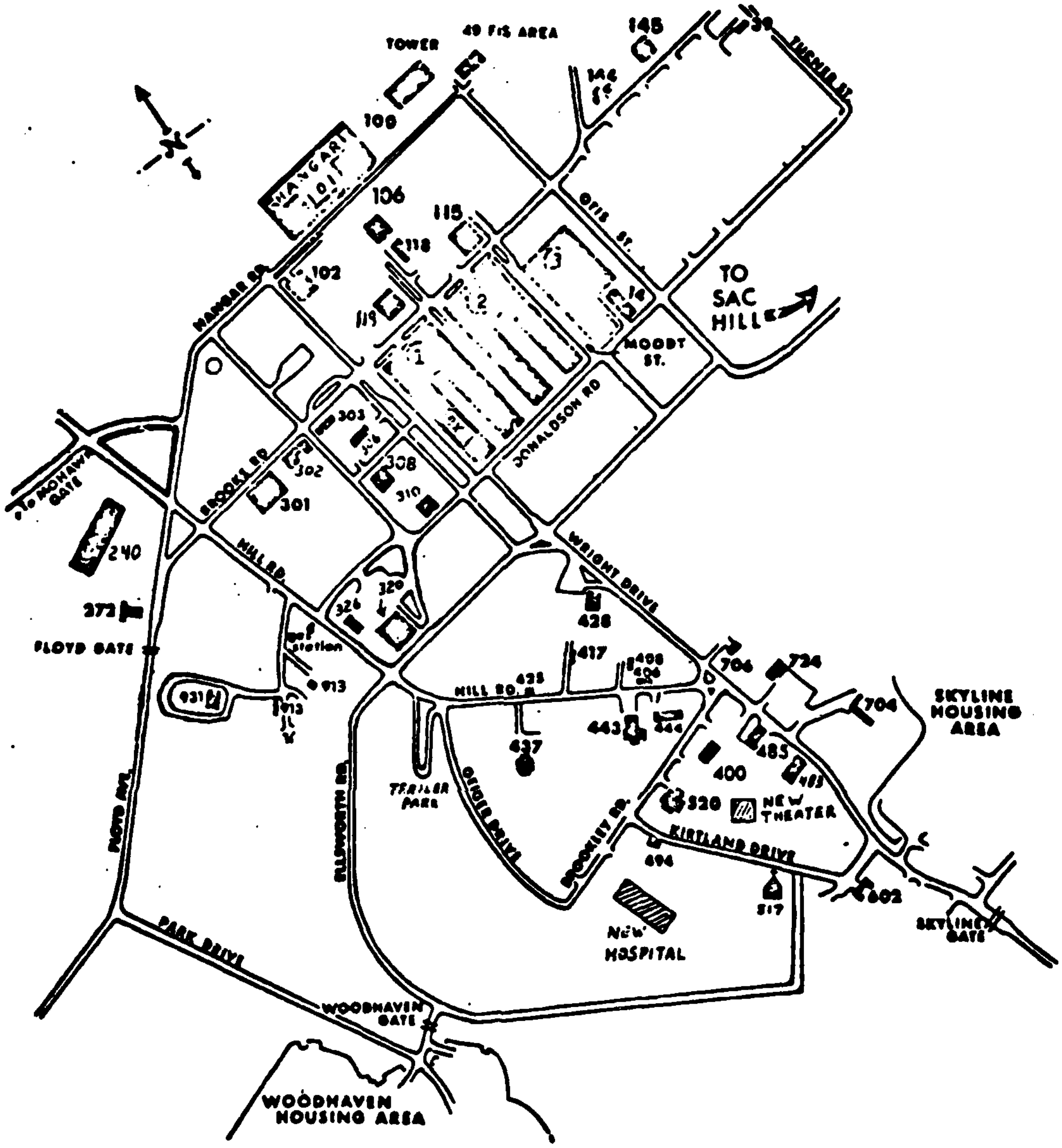

Figure X-1. Griffiss Air Force Base

- Rome Air Development Center (AFSC)
- USAF Hospital
- Det 8, 26th Weather Sqdn (MAC)
- 49th Fighter Interceptor Sqdn
- 416th Bombardment Wind (H) (SAC)
- 416th Combat Support Group (SAC)
- 485th Electronics Installation Sqdn (AFCS)
- HQ Northern Communications Area (AFCS)

(3) Other Military Units

- Airway Facilities Section (FAA)

(4) Nearby Government Installations. The following Army Installations are within a 100-mile radius of Griffiss AFB.

- Fort Drum
- Seneca Army Depot
- Watervliet Arsenal
- Hancock Field (AF)

b. Maintenance Capability. (Truck, Tank, Helicopter). Vehicle maintenance, necessary for trucks, jeeps, etc., is performed by the host organization.

c. Access

(1) Road. Rome Air Development Center, Griffiss AFB, is linked to the New York Interstate thruway system by NY Routes 365, 233, and 49.

(2) Rail. Railroad service is available in Rome by the AMTRAK.

(3) Water. The New York State Barge Canal offers possible water transportation capabilities because it passes through the city of Rome, near Griffiss AFB. The Griffiss AFB Petroleum, Oils, and Lubricants (POL) Terminal is located on the NYS Barge Canal.

(4) Air. Two nearby commercial airports are primarily used for incoming and outgoing air traffic. Utica/Rome airport, located approximately six miles southeast of Griffiss, has a runway length of 6,000 feet. The most commonly used airport is Syracuse Hancock International with a 9,000 foot runway, Hancock offers more extensive traveler facilities, being located approximately 40 miles from Griffiss via the New York Thruway.

Griffiss AFB, a SAC installation, is not open to commercial air traffic. Runway length is 11,800 feet.

d. Logistic Support Capability. Logistic support available at RADC and the 416th Bombardment Wing is very extensive and comprehensive for present operations.

Housing, messing, and other personnel support requirements are absorbable for small groups of units. Larger requirements need further coordination.

e. Recurring Commitments. None.

f. Special Operational Restrictions. Lacking maneuver and firing areas or ranges, there are no operational restrictions. However, RADC is an R&D facility performing work in classified areas and the security is very extensive.

g. Environment. The climate associated with the mid-state New York area, in which all RADC installations are located, varies greatly with the seasons. Spring and fall are pleasant; summers are hot; winters are cold and heavy snowfalls can be expected.

h. Topography. The topography of mid-state New York is generally rolling and hilly, where the hills are either rock-scarred by glaciers or moraines left by retreating glaciers. Streams and small lakes are plentiful. (See Ref 11 of Bibliography.)

i. Airspace Restrictions. Griffiss AFB, although active with SAC and TAC aircraft, does not have any restricted airspace area. Syracuse Hancock International and the Utica/Rome Enrouth Map L25 gives more detail on this airspace. (See Ref 10 of Bibliography.)

j. Power Availability. RADC uses commercial power exclusively for its main facility. The ten remote sites have primary commercial power available; however, portable power units are essential for field work. Some sites only have single phase commercial power.

k. Communications. Communications used by RADC are, again, primarily commercial telephone landlines. Site communications, UHF, and VHF are also used.

3. Dimensions.

a. Landspace. Griffiss AFB/RADC contains a total of 4,971 acres of landspace. Of this, 1,487 acres are used by RADC for nine offsite locations. The remaining 3,484 acres include the main base, runway, housing, etc.

(1) Test Area Contiguity. Griffiss AFB/RACD has no operational or maneuver areas.

(2) Easements. None affecting OT&E.

(3) Impact/Live Firing Areas. None.

b. Airspace.

(1) Lanspace/Airspace Relationship. RADC utilizes the Camp Drum facilities for limited electromagnetic testing and operations. Restricted airspace R5201 encompasses most of the Fort Drum area, allowing uninterrupted use of this airspace/landspace relationship.

(2) Easements. None.

(3) Unmanned Airborne Systems. None.

(4) Area Surveillance. Numerous radars are located at Griffiss/RADC and the test sites. The normal SAC ground control radars are used for area surveillance. Any of the radar systems used elsewhere by RADC could be utilized for OT&E.

4. Instrumentation. RADC, because of its unique feature of a number of off-base sites (nine), will be approached for instrumenation survey purposes in a slightly different manner than performed in other sections. Instead of listing each type of instrumentation equipment, the offsite complexes will each be discussed in turn, including general information pertaining to mission, instrumentation, etc.

This procedure will maintain a high level of continuity for the reader while indentifying the basic instrumentation capabilities. Further information on these sites is available in References 3 thru 10 of the Bibliography.

a. Ava. The Ava Test Annex is an HF transmitting facility presently used for over-the-horizon detection and also as a test facility for HF antenna research. This test facility possesses the capability for transmitting pulse, frequency, and amplitude modulation at power levels 300 KW average and 600 KW peak.

b. Strockbridge/Northeast Test Area. This facility has an AN/FPS-35 radar pedestal with an inverted B-52 aircraft mounted on it. This installation is used for tests of aircraft-mounted antennas. The Stockbridge test site is also presently linked by microwave to Griffiss AFB and Forestport. However, it could be linked to all off-base sites. Stockbridge is also part of the Northeast Test Area.

c. Verona. This facility supports engineering evaluation and operational testing of ECCM, radio frequency interference (RFI), reduction, radar troposcatter communications, satellite communications, millimeter wave research, optical surveillance techniques, and electromagnetic vulnerability testing. The facility also provides special instrumentation for special instrument techniques tests, and precise spatial positioning of test aircraft.

d. Newport. The Newport Site, under technical cognizance of the Test Environment Section, Test and Evaluation Branch of the Technical Support Division, provides versatile and accurate testing facilities for the measurement of free space antenna characteristics.

e. Youngstown. The Youngstown Annex is located just souhteast of Youngstown, New York, on Balmer Road, three miles each of New York state Route 18 in the town of Porter, Niagara County. It is a dual transmitter terminal for the 100- and 200-mile troposcatter communications test links to the Ontario Center and Verona Annexes.

f. Ontario Center. The Ontario Center (Tummond's Hill) is located 20 miles east of Rochester, New York, five miles south of Ontario Center on Tummond's Road in the town of Walworth, Wayne County. It is the intermediate 100-mile receiving terminal of the 200-mile troposcatter communications experimental range in upstate New York.

g. Forestport. The overall mission of this facility is to provide a very low frequency (VLF) transmitting station for experimental purposes and propagation studies. The facility includes a 1,200-foot antenna tower.

h. Vienna Test Annex. The accurately surveyed point on this site makes it ideal for use on projects which require signals from several accurately surveyed locations.

i. Quaker Hill Site. The Quaker Hill Site provides a special facility for the testing of equipment and techniques utilized in positioning, calibrating, and evaluating electronic systems. The surveyed distances between Quaker Hill and other nearby test sites serve as precise baselines in support of ranging and calibrating experiments associated with short-range (5 to 10 miles) geodetic optical and radio frequency measurements.

j. Rome Air Development Center RADC. Technical Areas - Antenna pattern measurements, electromagnetic detection, wave propagation, and electronic counter-countermeasures equipment.

5. Data Handling/Processing

a. Digital Communications Experimentation. The Digital Communications Experimental Facility (DICEF) is located at RADC and dedicated to enhancing digital communications. This facility is primarily used for digital communications research, and has the capability and flexibility to conduct partial OT-1 type tests for digital communications hardware, simulating varying levels of interference, noise, etc. Threat or jamming type stimuli could be simulated in this facility.

b. Processing. The Information Sciences division has dual Honeywell 6000 series computers with Honeywell 355 front-end processors. One system uses the Multiplexed Information and Computing (MULTICS) operating system. The other uses the General Comprehensive Operating Supervisor (GCOS) operating system.

Users may access the systems via a mulititude of commercially available computer terminals with dial-up lines. MULTICS is also accessible from the ARPA Net.

MULTICS has many advanced operating system features. Among them are security through the unique use of a ring-structure and memory management with automatic segmentation, dynamic paging, and virtual memory.

Programs and data as well as parts of the MULTICS system are assigned to operational rings (domains of operation) and explicit access permission must be granted so that a program assigned to an outer ring may access an inner ring. In all, there are eight rings; the outermost normally available for users, the innermost reserved for system use.

In MULTICS, programs are most easily prepared, executed and documented through and interactive keyboard interface which practically eliminates the need for punched cards. Corrected source statements may be entered at the terminal, compiled and logically inserted into the executing program. This allows useful program execution at the earliest possible point.

The MULTICS operating system is written in PL/1. This feature allows the sophisticated user to write his own additions to the operating system. Other languages supported are FORTRAN, APL, BASIC COBOL 74, and others, plus text editors, graphics, data base management systems and file handling utilities.

The other Honeywell 6180 computer system uses the General Comprehensive Operating Supervisor (GCOS III). A hardware relocation register or base address register (BAR) supports sophisticated scheduling techniques within the operating system. If it becomes operationally necessary to preempt jobs of manage the batch queue, GCOS supports removal of jobs from primary storage (core) to secondary storage (disk) and will restore then at a later time to primary memory and resume their processing operation. The H6180 GCOS system uses its hardware BAR to provide protection to jobs in execution. With the processor in slave mode, the hardware automatically compares the address of every memory access to the contents of the BAR. If the address is within the specified limits, the operation is allowed to continue normally. If not, a machine fault is generated, memory access is denied, thus providing both read and write protection. Additionally, GCOS III features multi-processing (up to 4 CPU's), multi-programming (up to 64 concurrent jobs), resource management, and a file management supervisor which manages all the file structures in attached and removable mass storage devices.

Jobs may be submitted from either the local batch, remote batch or time-sharing. Remote batch and time-sharing require access to the front-end processor via telephone data communication. Registered users use designated remote entry computer. Punched cards may be submitted at the site or via a remote computer. Time-sharing users may submit batch card-like jobs using a time-sharing subsystem called CARDIN. Output may be directed either to the user's terminal or may be printed at the site on a high-speed printer.

The GCOS time-sharing system supports ALGOL, JOVIAL, BASIC, FORTRAN, text editors and many input/output utilities. The batch offerings include FORTRAN, COBOL 68, Assembly Language (GMAP), JOVIAL and ALGOL. Several data management systems, including MDQS IV, provide many data base services to create, extract and display data from existing data bases. Simulation languages include GPSS, SIMSCRIPT II.5, and ECSS II. Statistical packages include SPSS and IMSL. Plotting routines are available in FORTRAN for a Zeta plotter.

Unique hardware in the form of a STARAN parallel processor with four arrays, a custom input/output unit, a hardware performance monitor, and variety of peripherals is also available. The STARAN system can perform search, arithmetic, and logical operations simultaneously on any or all bit slices or word slices of its associative memory. The system software is based upon a disk operating system and has a batch processing capability. In addition, language processing and operational software are available. STARAN can be operated in stand-alone mode or as a smart peripheral to MULTICS.

The division also operates a QM-1 Emulation System. It is an extremely flexible machine which can be programmed at two distinct microprogamming at two distinct microprogramming levels (Control store level, 18-bit words; Nanostore level, 360-bit words). The QM-1 provides a basic operating system for writing, editing, running and debugging emulations. Emulations currently exist for such diverse machines at the IBM 360 and PDP-11/10.

c. RADC ARPANetwork Node. The advanced Research Projects agency of the department of Defense (ARPA) began implementation of a network that would allow for the interconnection, via common-carrier circuits, of dissimilar computers at widely spearated, ARPA-sponsored research centers. This network, known as the ARPANetwork, presently includes approximately 20 nodes (including RADC).

ANNEX X

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ANNEX Y

OPERATIONAL TEST INSTRUMENTATION GUIDE

NAVAL AIR TEST CENTER
Patuxent River, Maryland

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ANNEX Y

NAVAL AIR TEST CENTER
Patuxent River, Maryland

1. Introduction.

a. Overview. The Naval Air Test Center, Patuxent River, is located in a sparsely populated area about 60 miles southeast of Washington, DC, on a peninsula of land at the intersection of the Patuxent River and the Chesapeake Bay. It comprises 6,638 acres of real estate, including three long runways, aircraft test and operating facilities, and a substantial quantity of family and single-man housing. The surrounding area is a sparsely populated rural community with the preponderance of the population directly associated with the station. See Reference 10 of the Bibliography.

There are three major groups of activities located at NATC.

- o Naval Air Test Center, the host organization.
- o Naval Air Station (NAS) and its associated support activities.
- o Navy tenants, including squadrons and other activities.

Although the Center is operated and organized to perform certain specific missions, highly sophisticated instrumentation capabilities in various areas permit this facility to handle other related non-Navy aircraft and aircraft systems operations.

The location of the facility, coupled with the over-water drop zones and operating areas, make NATC a candidate for operational testing.

b. Generic Systems Tested. The Center conducts technical and operational evaluations of experimental and new production aircraft for flying qualities, aircraft performance, and carrier/shipboard suitability. Types of testing are: monitoring tests of contractor development, V/STOL tests, catapult and arresting test at center and shipboard sites, automatic carrier landing systems, visual landing aid evaluations, and helicopter quality evaluations. Both laboratory and field testing are performed by the Center.

Technical and operational evaluations conducted by the Center include aircraft propulsion systems, airframe systems, aircraft safety, aero-medical and human factors, and aircraft maintainability and reliability, and service suitability. Weapons and avionics systems also are evaluated including: aircraft electrical, electronics, ordnance, and photographic equipment as individual components and as complete integrated systems in aircraft. The latter evaluations include basic component testing, communications and electromagnetic compatibility testing, ECM, radar, computer, sensor and software system evaluation, as well as ordnance electric and separation testing and evaluations of electronic countermeasures, electrooptical and photoreconnaissance equipment. Surface effects ships are instrumented and evaluated at NATC.

The Center has inhouse capability for designing, building, and installing instrumentation systems required for testing.

The Naval Test Pilot School is located at the NATC. The 11-month course involves intensive flight and classroom sessions in both fixed and rotary wing aircraft. Students of military services, U.S. and foreign governments, and contractors are trained at the school. This is the only school in the United States that includes rotary wing training in the curriculum.

A further insight into the operations and capabilities at NATC can be obtained by referring to References 1, 2, and 4 of the Bibliography.

2. General.

a. Military Units.

(1) Army Units. None.

(2) Other Military Units.

- Naval Hospital
- VQ-4 (Navy Fleet Recon Squadron)
- Marine Aviation Detachment
- Reserve Naval Mobile Construction Battalion Twenty-Three
- VP-68 (Navy Fleet Patrol Squadron)
- VX-1 (Navy Air Development Squadron)
- VXN-8 (Navy Oceanographic Development Squardon)
- Naval Weather Service Environmental Detachment
- NRL Flight Support Detachment
- Naval Aviation Integrated Logistic Support Center
- Sub Board of Inspection and Survey
- Naval Electronics Systems Test and Evaluation Detachment
- Surface Effects Ship Test Facility
- Naval Air Reserve Detachment
- Navy Special Services Administration Detachment

b. Maintenance Capability. The maintenance available at NATC can be organized into three major groups: the Navy squadrons, NAS/Public Works, and NATC.

The various Navy squadrons are organized with the specific type of personnel and supply systems organic to their type of mission/aircraft. Because of the squadrons' position as tenants, their capabilities, although important, are basically unavailable to outside users. The NAS/Public Works units meet the demands of the station in terms of vehicles (cars and trucks) and aircraft maintenance. Public Works units are the general support units for the entire air station with widespread responsibilities. Staffing of Public Works is almost exclusively civilian.

c. Access.

(1) Air. The airfield on the base has the longest runway length of 11,800 feet and can accomodate the largest military aircraft. There are three commercial airports within a 100-mile radius: Washington's National Airport (6,900 feet), Dulles International in Chantilly, Virginia (11,500 feet), and Friendship International just south of Baltimore, Maryland (9,500 feet). Two local county 2,000-foot runway airports are nearby.

(2) Road. Route 5 south out of Washinton, which is 60 miles away, intersects with Route 235, which in turn leads straight to the main entrance to Patuxent River Naval Air Test Center.

(3) Water. The Base sits on a peninsula that is accessible by deepwater vessels directly from the Chesapeake Bay. Three seaplane basins provide sheltered harbors.

(4) Rail. None.

d. Logistic Support Capability. The Base organization includes a Logistics Support Unit which stocks items related to the operating aircraft of the Base and other items for support of the labs and other facilities.

e. Recurring Commitments. None.

f. Special Operating Restrictions. Aircraft using NATC runways are required to fly departure patterns that minimize sound levels over nearby populated areas. Flight obstructions and hazards are identified in Reference Maps 13 and 14.

g. Organization. See Figure Y-1.

h. Environment (Climate). Mid-Atlantic Tidewater climatic conditions prevail. There is suitable flying weather 80 to 90 per cent of the year. The weather ranges from snow or rain to extremely clear.

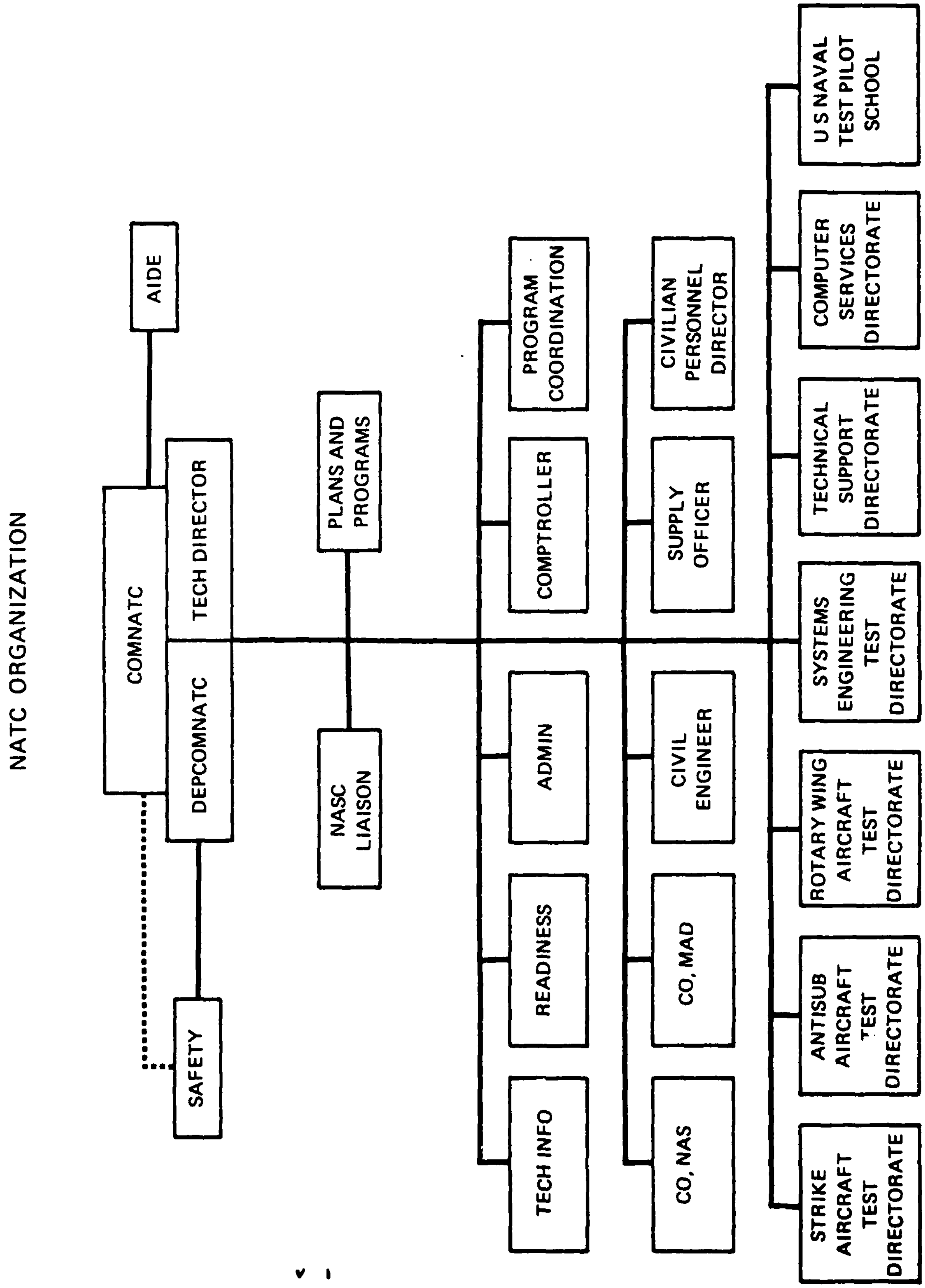

Figure Y-1. Naval Air Test Center Organization

i. Topography. The Base is essentially level with a field elevation of 38 feet above mean sea level. See Reference Maps 6, 7, and 9.

j. Airspace Restrictions. See 3.b.(1).

k. Power Availability. Most labs and a number of field sites on the Base are supplied with 440-volt, 60 Hz power with power capacities up to 500 or 1,000 KVA. (A few have higher capacities.) Reference 15 of the Bibliography gives electrical distribution layout.

Power is obtained from 120-volt, 400 Hz, 60 KVA, three-phase motor generator converter sets. Twenty-five such units are on hand, including both fixed and mobile types. A number of smaller 400 Hz power units are also in the inventory.

A number of 28 VDC power sources at various current levels are available.

l. Communications. Army communications equipment is not part of NATC's inventory. Most equipment is for aircraft-related communications and data transmissions.

3. Dimensions.

a. Landspace.

(1) Test Area Contiguity. The land areas under control of the Center are: the Base itself, consisting of 6,638 acres; the off-Base Chesapeake Bay Range Facility (References 3 and 16) Sites at Pylon, Chesapeake, Bay Forrest, and Point No Point (all less than 13 acres in size), and a satellite installation at St. Ignigoes, Maryland, which is the site of Webster Field.

(2) Easements. See 2.f. and Reference Maps 11 and 12 in the Bibliography.

(3) Impact/Live Firing Areas.

(a) Explosive Rounds. None.

(b) Inert Rounds. Aircraft guns up to 40mm can be tested on the indoor firing range of the Aircraft Ordnance Evaluation Facility. The guns are tested while installed on the aircraft. The range is 300 feet long b 38 feet wide by 27 feet high. Aircraft gun firings can also be performed on the Chesapeake Bay Range.

Aircraft guns can be fired under accelerations of up to 9 g's at the Aircraft Ordnance Facility, in a special centrifuge installation.

Rockets up to Sidewinder and Bullpup size can be fired from static positions at the Aircraft Ordnance Facility, over the Chesapeake Bay Range area.

Aircraft delivery of ordnance, bombs, rockets, or guns can also be tested on the Chesapeake Bay Range of the Aircraft Ordnance Facility.

b. Airspace.

(1) Landspace/Airspace Relationships. The Naval Air Test Center is covered entirely by restricted airspace. The restricted areas are R-4002, R-4005, R-4006, R-4007, and R-6609. Also noted is the Atlantic Ocean operating area--a supersonic (200-mile) corridor. Further information on the restrictions can be obtained from FAA Enroute Low Altitude Maps L-27 and L-28 (see Reference 17 of Bibliography). Special "ATC Assigned Airspace" (Low Tide) is also procedurally available from FAA.

(2) Easements (FAA-High Altitude Air Routes). See above paragraph.

(3) Manned Airborne Systems. Manned airborne systems are tested on the ranges.

(4) Uumanned Airborne. No unmanned airborne systems are on hand at present. DASH DRONES have been tested at NATC.

(5) Area Surveillance. There are numerous radars located at NATC and some are assigned surveillance responsibility.

4. Instrumentation. Most of the equipment described in this section is associated with either the Technical Support Directorate (Reference 2) or the Computer Services Directorate, since their technical capabilities are of general application. Similar capabilities associated with other NATC groups are either highly specialized or pre-dedicated. (See References 1 and 4.)

The Technical Support Directorate also maintains the NAVAIR Instrumentation Pool (NIP) consisting of more than 45,000 items for acquiring data during flight test programs for development, test, and evaluation. This instrumentation pool is available to authorized activities supporting NAVAIR-sponsored programs (see Reference 5 of Bibliography).

a. Space Positioning and Velocity Vector.

(1) Ground Elements.

(a) Single Object.

1 Mobile Phototheodolites. Five Askania-type theodolites are available. Position accuracy is dependent on geometry of the objective and theodolites; accuracy can be better than ten feet. Line-of-sight between objective and theodolites is necessary.

2 Five-Station Contraves Cinetheodolite System. The five-station Contraves cinetheodolite system, installed along a ten-mile baseline, provides positioning data of objects (water surface or airborne) over an area of the Bay that is east and southeast of NATC. Positioning accuracy is one to two feet RMS.

3 Laser. The Automatic Laser Tracking System (ALTS), which is mobile and self-contained, provides space position accuracies of the order of the cinetheodolite system.

4 Radars. Radars used by the test range facility to provide position tracking data for tests are listed in Table Y-1. These radars are used for both tracking and electronic warfare testing. Both skin and beacon tracking are used. Other NATC radars are associated with specific testing systems.

(b) Multiobject. The theodolite (see above) can be used in sets (two or more in a set) and in conjunction with the ALTS to provide precision space position and velocity data on more than one object.

(c) Relative Positions (Miss-Distance). Theodolites mentioned above, or instrumented cameras, can provide miss-distance data for suitable conditions (e.g., bomb drops on Chesapeake Bay Range).

(d) Radar. See 4.a.(1)(a)4 above, as well as Table Y-1 and Table Y-2. NATC's Chesapeake Test Range is being linked via microwave to NASA Wallops Station on the Atlantic Coast to utilize their radars and telemetry to cover ocean operations. The radar data is supplied to the range computer and display to provide real-time testing information.

(2) Airborne Elements.

(a) Radar. See Ground Elements.

(b) Laser. See Ground Elements.

(c) Optical. See Ground Elements.

(d) Relative Positions (Miss-Distance). See Ground Elements.

(e) Airborne-to-ground Target Matching. None.

b. Timing. The standard time code format used at NATC is the IRIG-B format. The time code is used for the correlation of the data recorded at various sites and for correlation of multiple tape playbacks. The system includes an Astrodata 6190 generator which is in synchronization with standard time from WWV. The modulated IRIG-B time code is recorded on telemetry tapes and also transmitted on a standard communication frequency for use by remote sites and test aircraft. A Datatron Model 3000 time code generator is the backup for the Astrodata 6190.

For time code playback, and Astrodata 6222 time code translator/search system is available. This system will also translate IRIG-A and IRIG-C formats. Several Astrodata 5499's and 5200's are available for tape playback. All translators provide slow code outputs for chart recorders and digital outputs for computer entry. The time code systems have a resolution of one millisecond.

c. Television. Television cameras are colocated with two downrange theodolites. Video signals from the cameras are transmitted to the

NASA WALLOPS STATION INSTRUMENTATION RADARS

RADAR NUMBER	RADAR TYPE	FREQUENCY (GHz)	ANTENNA HEIGHT (FEET/MSL)	ACCURACY			
				RANGE (FEET)		ANGLE (MRAD)	
				SPECIFIED	ESTIMATED OPERATIONAL	SPECIFIED	ESTIMATED OPERATIONAL
1	AN/MPS-19	2.7-2.9	25	30	30	1.0	1.0
2	MOD II (SCR-584)	2.7-2.9	23	75	75	1.0	1.0
3	AN/FPS-16	5.4-5.9	41	15	15	0.1	0.2
4	SPANDAR*	2.7-2.9	101	15	15	1.0	1.0
5	AN/FPQ-6†	5.4-5.9	16	9	10	0.05	0.1
6	AN/MPS-19	2.7-2.9	25	15	30	1.0	1.0

*Not available for NATC missions

†Specified range rate precision - 0.1 feet/second

CHESAPEAKE TEST RANGE RADARS

Model	Basic Mission	Frequency Band	Accuracy	
			Angle	Range
AN/TPS-1G	Surveillance Radar	"D" Band	$\pm 1^{\circ}$ (AZ)	3% of Range
SCR-584 (2)	Tracking Radar	"E" Band	±1 mil	±25 yards
AN/MSQ-19 (2)	Tracking Radar	"F" Band	±1 mil (RMS)	±25 yards
AN/MPS-26 (2)	Tracking Radar	"G" Band	± 0.5 mil (RMS)	±10 yards (max)
AN/PPS-3	Tracking Radar	"H" Band	± 0.75 mil	±10 yards
M-33	Tracking Radar	"I" Band	± 0.5 mil (RMS)	±10 yards (max)
M-33/J (Modified)	Tracking Radar	"J" Band	± 0.5 mil (RMS)	±10 yards (max)
DIR	Tracking Radar	"C" Band	± 0.5 mil (RMS)	± 5 yards

Chesapeake Test Range (CTR) via microwave data link. The signals are displayed/recorded at the CTR for project monitoring purposes.

d. Photography. The Technical Support Directorate constructs, installs, and maintains data acquisition instrumentation packages to meet the wide range of NATC requirements. Photographic methods are often used for both laboratory and field measurements, with the latter including airborne vehicles.

Table Y-3 lists the photographic equipment available at NATC. Many types of lenses are available in focal lengths from 3mm to 3,750mm. Most of the cameras have the capability of phot-digital recording elapsed time to one millsecond resolution, and the capability of making real-time correlation with the NATC IRIG-B time code system.

Processing turnaround time is two to three days for non-NATC data. This time can be shortened for NATC-conducted tests.

e. Instrumentation Calibration. Equipment used in calibration of all instrumentation is referenced to standards checked annually with Bureau of Standards units.

Table Y-3

PHOTOGRAPHIC EQUIPMENT AT NATC

16mm Motion Picture Camera	Film Capacity (ft)	Frame Rate (FPS)
Milliken, DBM-2A/2B	50	16 to 48
Milliken, DBM-3C	100	4 to 400
Milliken, DBM-4C	200	4- to 500
Milliken, DBM-5C	400	4- to 500
Milliken, DBM-44	200	2- to 400
Milliken, DBM-54	400	4 to 400
Milliken, DBM-55	400	2 to 500
Arriflex	400	16 to 64
Bolex, H-26	400	16 to 64
Flight Research, Mod-11	50	1 to 40
Gordon Enterprises, Mod N9	50	16 to 64
Eastman Kodak, Mod KB-9A	35	32
Bell and Howell, Autoload	50	16 to 64
Photo Sonics, IW	400	24 to 1000
Photo Sonics, IVN	200	16 to 200
Photo Sonics, IP	200	16 to 500
35mm Motion Picture Cameras		
Flight Research, Mod IV	400	1 to 40
Photo Sonics, Mod 4B	1000	250 to 2500
Traid, Mod 75	100	20 to 80
Mitchell, Mod High Speed	400	24 to 128
Automax, G-2	400	1 to 16
Automax, G-1	400	1 to 16

Table Y-3 (Cont'd)

PHOTOGRAPHIC EQUIPMENT AT NATC

<u>35mm Motion Picture Cameras</u>		
Photo Sonics, Mod 4M	400	20 to 180
Photo Sonics, Mod 4E	1000	6 to 360
<u>70mm Motion Picture Cameras</u>	<u>Film Capacity (ft)</u>	<u>Frame Rate</u>
Hulcher	400	20 FPS
<u>Aerial Cameras</u>		
Maurer, Mod P-220	100	Pulse
Maurer, Mod KB-10	100	Pulse
Fairchild, CAX-11	400	Pulse
Fairchild, CAX-12	100	Pulse
Chicago Aerial, Mod-51B	250	Pulse

<u>Radar and Oscilloscope Recording Cameras</u>

Nikon Mod F, 35mm

Robot Recorder, Mod 24, 35mm

Robot Recorder, Mod 36, 35mm

Tektronix Oscilloscope Mod C-12

Tektronix, Mod C-13

Beatte Coleman, Mod-K-45D

Hewlett-Packard, Mod 196B

Hewlett-Packard, Mod 197A

Tektronix, Mod C-30

Tektronix, Mod C-53

TSD Special Design Using Hasselblad, Mod 500C, 500EL, or SWC

f. Other General Instrumentation.

(1) Telemetry. See 6.a. below.

(2) Meteorological Data Acquisition System.

A beukers Lo-Cate system is used to make atmospheric soundings to obtain wind, pressure, temperature, and humidity profiles throughout the ascent of the soundings. These measurements are used for the preparation of ballistic corrections for the influences of the atmosphere on the trajectories of weapons. Five radiosonde ascensions per day are possible with maxium altitudes of 110,000 feet. Maxium slant-range tracking capability is 125 miles.

(3) Survey. NATC contracts for this service.

(4) Radio Frequency Interference. A large volume electromagnetic isloation capability is provided by a large shielded hangar; this capability is used for interference measurements and test of crypto equipment.

Two 20 x 10 x 10-foot shielded rooms in conjunction with a Fairchild Spectrum Surveillance System, Model FSS-250D (14 kHz-1,000 MHz) provide an electronmagnetic interference measurement capability.

(5) Visibility. None.

(6) Sound Measurement and Analysis. The NATC Sensor Evaluation Facility provides measurements of sonar system performance.

(7) Safety and Security. Airborne ordnance is only fired on the Chesapeake Bay Range. Surveillance is accomplished by radar and optical means.

(8) Soil Conditions. NATC contracts for these measurements.

g. Special Purpose Instrumentation.

(1) Ballistic Data. A firing tunnel 300 feet long by 40 feet wide by 25 feet high is used for ground tests of aircraft guns. Muzzel velocity, cyclic rate, and dispersion patterns are measured.

The Chesapeake Test Range is instrumented to provide measures of aircraft bombing phenomena, prior to and after separation to impact. Water-surface located targets can be used. Only inert rounds can be fired.

(2) Environmental Chambers.

- 80 cubic foot Sand and Dust Chamber
- 80 cubic foot Salt Spray Chamber
- 80 cubic foot Tropical (Fungus) Chamber
- 24 cubic foot Humidity Chamber

Temperature Altitude Chambers.

- o Three, 64 cubic feet in volume
- o One, 27 cubic feet in volume with RH of 20% to 98%
- o One, 12 cubic feet
- o Two, portable, 3.3 cubic feet in volume
- o Two, 1 cubic foot in volume
- o One, walk-in, 343 cubic foot unit interfaced with 300 HP drive stand
- o One Tenny "MITE"
- o One Tenny "Junior" (temporary only)

(3) Vehicle Performance.

(a) Ground Vehicles. NATC has capability of conducting electromagnetic interface (EMI) investigations on all ground vehicles (tanks, command support vehicles, etc.) in a shielded hangar.

(b) Air Vehicles. A major capability of NATC is the testing of manned air vehicles, both fixed and rotary wing. This capability encompasses the full range of performance of the vehicle and most subsystems.

(4) Chemical/Biological/Radiological Instrumentation. None.

(5) Other. Special purpose instrumentation if associated with a large propotion of the NATC facilities, labs, and other elements. Some are oriented towards testing equipment of Navy application only, such as catapult and deck landing systems. Those of possible interest for Army systems (not covered elsewhere) are the following:

(a) The NATC Rotary Wing/VSTOL Test Facility and the NATC Rotary Wing Flight Test and Evaluation Facility are instrumented to evaluate helicopter and VSTOL aircraft performance and flying qualities.

(b) The NATC Airborne Antenna Test Facility has equipment for evaluating the electrical performance characteristics of airborne antennas.

(c) The NATC Antenna Model Range includes two independently remotely-rotatable towers. These are used for evaluating full scale and frequency scale model antennas.

(d) The NATC Photographic Resolution Facility includes four type "A" photo resolution targets, used to test aerial photographic systems.

(e) The NATC Electro-Optical Resolution Target is designed to enable testing of electro-optical sensors in an airborne environment.

(f) The NATC Electro-Optical Sensor Test Bed aircraft permits quantitative and qualitative side-by-side evaluation of electro-optical sensor systems.

(g) NATC possesses the following special purpose instrumenation that is of little apparent interest to the U.S. Army:

- Tactical Support Center (prototype) for antisubmarine warfare
- P-3B Integrated Antisubmarine Warfare Display Laboratory
- Test Aircraft Facility
- Aircraft Armament Ground Equipment Laboratory
- Ordnance Electric Laboratory
- Centrifugal Gun Mount
- Dynamic Complex (for aircraft electrical system evaluation)
- Ram Air Turbine Testway
- Stratosphere Complex
- Circuit Breaker, Switch, and Relay Test Laboratory
- Lightning and P-Static Test Laboratory
- Attack Carrier Warfare Branch Facility
- Aircraft Engine Static Thrust Measurement Facility
- Airborne Instrumentation Facility
- Weight and Balance Facility
- Fixed Wing Flight Evaluation Facility
- Naval Aircraft Launch and Recovery Evaluation Facility
- Arrested Landing Test Facility
- Landing Aids Development and Evaluation Facility
- Data Link Development and Evaluation Facility
- AIMS Prototype Aircraft Checkout Facility (PACF)
- Altitude and Airspeed Calbibration Facility
- Aircraft Service Suitability Evaluation Facility
- Systems Reliability and Maintainability Evaluation Facility

- o Ground Support Equipment Facility
- o Avionics Ground Support Equipment Evaluation Laboratory
- o Aircrew Environment and Equipment Evaluation Facility
- o Survival Systems Laboratory
- o Aviation Physiology Laboratory
- o Bioengineering Laboratory
- o Human Factors Laboratory
- o Aircraft Systems and Propulsion Evaluation Facility
- o Engineering Service Laboratory
- o Surface Effect Ship Test Facility

5. Threats/Targets.

a. Ground.

(1) Electromagnetic. The Airborne Electronic Warfare Evaluation Facility consists of two special signal source vans, an electronmagnetic emission receiving and direction finder station, an aircraft platform for active and passive ECM devices, and jam-to-signal (J/S) instrumentation tied into the Chesapeake Test Range. The facility can perform applied research, development, test, and evaluation work in the field of airborne countermeasures. It has the capability of testing, evaluating, and maintaining noise jammers, repeater jammers, chaff dispensers, homing and warning systems, receivers, and direction finders. The facility can provide an airborne ECM enviroment and an airborne electronic intelligence (ELINT) platform. It has the capability of providing azimuth and evaluation jam-to-signal (J/S) patterns of airborne jammers operating in the D, E, F, G, H, I, and J frequency bands. The receivers have selectable bandwidths and the emitter antennas can be vertically or horizontally polarized. The J/S system is capable of supporting five simulaneous J/S measurements.

(2) Weapons. Available targets include:

- o The Hooper Target array of five surveyed targets, each with a particular application (e.g., visual bombing, radar bombing)
- o The Bombing Accuracy Target, a fixed wood frame with radar reflection
- o A scuttled Liberty ship
- o Various moveable floating targets

(3) Radiological Environment. X-ray laboratory for structural inspection and nondestructive testing.

(4) Other. An electro-optical resolution target is installed on Webster Field, a satellite installation of NATC.

b. Airborne.

(1) Electromagnetic. None.

(2) Weapons. None.

6. Data Handling/Processing.

a. Data Storage and Retrieval Capabilities.

(1) Real-Time Telemetry Processing System (RTPS). The RTPS is a state-of-the-art, computerized, telemetered data collection and processing system. It is presently configured for four concurrent real-time tests or playbacks. The system can handle up to 512 measurement inputs per stream at a rate of 50,000 (16-bit) samples per second. It can be handle PCM bit rates of 1.2 megabits/second and has a capacity of 48 FM coded measurements.

The data streams are transmitted from instrumented aircraft (and augmented by position data and video from the tracking range). Real-time processing and display is one mode of systems operation. Alternately, the data may be recorded for post-test analysis. The system may also be used for post-test processing of data recorded by other systems.

The combination of systems can handle up to five data streams in real-time.

(2) The Chesapeake Range Facility. A data system records data associated with the tracking radars and theodolite stations for later processing. Real-time plots are provided by the system for test project and safety purposes.

(3) Retrieval of Data Retrieval of data recorded by video or photographic systems (cinetheodolites, etc.) is performed by the Computer Services Directorate using:

o Four Telecomputing Corp Model 29E film readers

o A video data extraction system

For photographic sources, measurements are encoded in digital form and outputted via punch cards. For video sources, the output is to a central computer system, floppy disk, CRT terminal and/or printer.

b. Quick-Look Capabilities.

(1) Real-Time Telemetry Processing System. See 6.a.(1), above.

(2) The Chesapeake Range Facility See 6.1.(2), above.

c. Processing.

(1) Systems and Model. The Naval Air Test Center Central Computer Facility provides general scientific and business data reduction and data processing support for the Naval Air Test Center, Naval Air Station, Squadrons, and tenant activities as required. (The two Burroughs B5500 computer systems support both batch and time-sharing operations in the multi-programming mode (Computer Services Directorate).)

Other equipment includes:

- o CMC equipment - key-to-disk processing system (Computer Services Directorate)

- o EAM equipment - punch cards processing system (Computer Services Directorate)

- o Sigma 9/Sigma 3 system (part of Real-Time Telemetry Processing System (RTPS))

- o Xerox 560 System (Range)

- o HP2100 Series and other similar systems - various types with input/output options at various locations

(2) Languages.

(a) Burroughs B5500 System.

- o FORTRAN IV
- o COBOL
- o BASIC
- o ESPOL
- o TSPOL

(b) Burroughs B3500 System.

- o COBOL
- o FORTRAN
- o ASSEMBLY

(c) Sigma 9/Sigma 3/Xerox 560 Systems.

- o FORTRAN IV
- o ASSEMBLY (XEROX)
- o MACROSYMBOL

(3) Input/Output Options.

(a) Burroughs B5500 (Batch System).

- o Central Control (SPO)
- o Card Punch (300 CPM)
- o Card Reader (800 CPM)
- o Line Printer (1,100 LPM)
- o Magnetic Tape/7 Track (5)

(b) Burroughs B5500 (Time-Sharing System).

- o Central Control (SPO)
- o Card Reader (800 CPM)
- o Line Printer (700 LPM)
- o Magnetic Tape/7 Track (3)
- o Terminals - Portacoms 3, DD5000 12, DD4000 6, DD 45001, Omrons 10

(c) Burroughs B3500.

- o Central Control (SPO)
- o Card Reader (1400 CPM)
- o Card Punch (300 CPM)
- o Line Printer (1100 LPM)
- o Magnetic Tape/7 Channel (1)
- o Magnetic Tape/9 Channel (6)
- o TC525 Remote Terminals (5) with Card Reader (100 CPM) and Card Punch

(d) Xerox Sigma 9 System (RTPS).

- o Keyboard Printer
- o Card Reader (1500 CPM)
- o Card Punch (300 CPM)
- o Line Printer (1500 LPM)
- o Magnetic Tape (3)

(e) Xerox Sigma 3 Systems (RTPS)

- CRT Display/with hard copy (2)
- Card Reader (3) (200 CPM)
- Line Printer (2) (600 LPM)
- Digital Displays (8)

(f) <u>Xerox 560 System (RTPS)</u>

- Card Reader (400 CPM)
- Magnetic Tape (2)

Teletype

Line Printer (1250 LPM)

KSR 35 Terminals (2)

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ANNEX Z

OPERATIONAL TEST INSTRUMENTATION GUIDE
NAVAL WEAPONS CENTER
China Lake, California

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Annex Z
NAVAL WEAPONS CENTER
China Lake, California

1. Introduction

a. Overview. The Naval Weapons Center (NWC) at China Lake, California, was established in 1943, as the primary research, development, and test activity of the Naval Material Command. Located about 160 miles northeast of Los Angeles (Figure Z-1), the NWC is an integrated military/civilian complex of about 1,092,000 acres with 4,500 civil service employees and 730 military personnel.

The mission of NWC is to conduct a program of warfare analysis, research, development, test evaluation, systems integration, and fleet engineering support in naval weapons systems, principally for air warfare, and to conduct investigations into related fields of science and technology.

NWC operators more than 25 test ranges and facilities primarily in support of the Center's R&D programs. These facilities have been developed over the years in response to in-house needs arising from assigned weapon R&D projects, as well as to meet the testing requirements of activities external to the Center. Since the testing effort at NWC is an integral part of the R&D mission of the Center, test management is decentralized, and the ranges and test facilities are staffed and operated in a manner designed to optimize the benefits to the R&D programs rather than to maximize the total output of these facilities. The Center's test facilities and ranges are not all in continuous operation, fully staffed and manned. Many of these facilities overlap, sharing common airspace, ground space, and instrumentation, as well as floating work crew. A long-standing policy of NWC has been to govern the overall size of personnel resources involved in test operations to that level required to support the needs and work load of assigned programs. Thus, if the test work load changes over a period of time, NWC alters the personnel complement in this area by readjustment of the allocation of personnel resources within their total authorized complement.

b. Generic Systems Tested. The nature of the test effort can be summarized in the following general categories:

(1) Flight and firing tests of conventional/tactical munitions, including air-to-air, air-to-surface, and surface-to-surface tests.

(2) Flight tests of aircraft armament and fire control systems, and electronic countermeasures systems and tactics development.

(3) Environmental tests of inert and live ordnance, including drop tests, cook-off tests, temperature-humidity tests, vibration and shock tests, and radiographic tests.

(4) Propulsion static tests of liquid, solid, and hybird propellant rocket motor propulsion systems developing up to 1 million pounds of thrust.

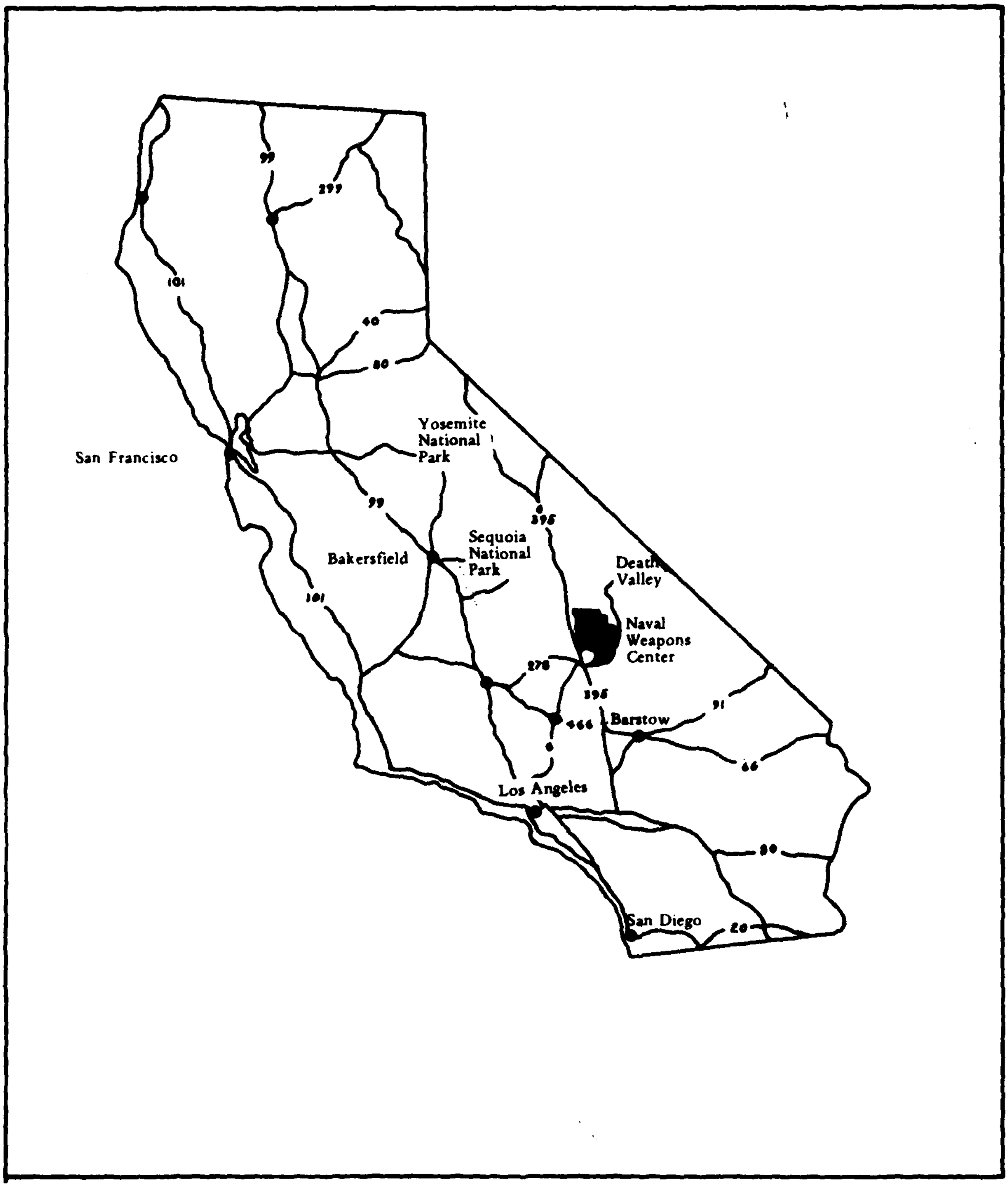


Figure Z-1: NWC Location

(5) Ordnance ground test of rockets, guided missile and projectile fuzes, small and medium caliber gun ballistic and terminal effects, various types of warheads, pyrotechnics, explosives, & explosive propagation, etc.

(6) Various specialized tests, including high-speed track tests, CVA conflagration control tests, aircraft combat damage survivability tests, and tests of lasers and electro-optical sensors.

2. General

a. Military Units

(1) Army Units. The U.S. Army Liaison Officer is the only U.S. Army member stationed at the NWC.

(2) Navy Units. The Naval Air Facility at Armitage Field provides air support for NWC's development and test programs. There are approximately 30 officers and 465 enlisted men located at NAF.

The U.S. Navy Air Test and Evaluation Squadron Five (VX-5) base at Armitage field contains 30 officers and 210 enlisted personnel. The mission of VX-5 is to evaluate new attack systems and to develop tactics for use by the Fleet.

(3) Nearby Government Installations

(a) Edwards AFB

(b) El Centro NARF

(c) George AFB

(d) Fort Irwin

(e) Norton AFB

(f) Pacific Missile Range

(g) Vandenberg AFB

b. Maintainance Capability. The Public Works Department has a limited maintenance capability for U.S. Army items. Minor repairs of tracked vehicles have been performed.

The Naval Air Facility located at Armitage Field has a limited maintenance capacity for helicopters and fixed wing Army aircraft.

c. Access

(1) Air. Commercial air transportation is available to the NWC from Los Angeles (12,100-ft runway), Inyokern (7,300-ft runway) Mojave (9,900-ft runway), and Palmdale (12,000-ft runway).

Military air transportation is available at the Naval Weapons Center, Armitage Field (10,000 feet), and Edwards Air Force Base (15,000 feet).

(2) Rail. The NWC is serviced by the Southern Pacific Railroad.

(3) Road. Highways 6, 14, 178, and 395 provide access to the Naval Weapons Center. (See Figure Z-1).

(4) Water. The port of Los Angeles provides the closest sea access to the NWC.

d. Logistic Support Capability. The Supply Department provides logistical support of all aviation supplies. The Public Works Department is responsible for engineering, utilities, housing, and transportation.

e. Recurring Commitments. None.

f. Special Operating Restrictions. The only current special operating restriction is to keep all hazardous operations to that airspace over NWC property.

g. Facility Organization. The NWC Organization chart is included as reference 11.

h. Environment

(1) Temperature. The yearly mean temperature at the NWC is 64.1 degrees with average high temperatures in the low 100's during July and August. The coolest months are December and January when the average daily low temperature is approximately 30 degrees and the average daily high temperature is 44 degrees.

(2) Precipitation. The yearly average rainfall at the Center is 2.92 inches. The winter months of November, December, January, and February are the most rainy. There are approximately two days a year in which a trace of snowfall appears at the Center.

(3) Wind. Wind gusts with peak velocities exceeding 40 miles per hour occur on the average of 35 days each year. The months of March, April, and May average 6, 6, and 5 windy days, respectively. The prevailing wind direction throughout the year is southwest.

(4) Visibility. On the average the sky is clear 20 days a month, partly cloudy 8 days a month, and cloudy 2 days a month. The average monthly cloudiness is 25%.

i. Topography. The area surrounding the Naval Weapons Center is desertlike.

The base proper is at an elevation of approximately 2220 feet above sea level. Various dry lakebeds are scattered throughout the Center including China Lake, Airport Lake, and Mirror Lake. A large lava bed is located approximately seven miles northwest of China Lake.

Mountain ranges with peaks up to 7500 feet above sea level skirt the Center's western boundry. The eastern portion of the NWC is generally mountainous with peaks reaching 8300 feet above sea level. The COSO Military Target Range is located on a broad mountainous plateau in the northwest corner of NWC. The range covers an area of approximately 19,200 acres and contains various military targets at elevations of 7000 to 8000 feet in rolling hill terrain, covered with pinon pine, juniper trees, and brush.

j. Airspace Restriction. The restricted airspaces under the control of NWC are designated R-2505 and R-2524 and extend from the surface to unlimited altitude. An extension of R-2505, designated as R-2506, is restricted from the surface to 6,000 feet MSL in order to provide for low-altitude run-in to certain of the NWC ranges. The adjoining restricted airspaces include R-2502 (Fort Irwin), R-2509 (George AFB), and R-2515 (Edwards AFFTC). All of these lie within R-2508, which is restricted use airspace from 20,000 feet to unlimited altitude, also under the cognizance of NWC. This aggregation of restricted airspaces is known as the R-2508 airspace complex. The coordination and co-use of this complex by all of the three Military Services is provided for under agreements made through the R-2508 Complex Control Board, which is comprised of representatives from the participating military installations.

k. Power Availability. All major test ranges have adequate power. Portable power generators are available at remote locations.

l. Communications. The communications facility compromises both wire and radio channels that connect the test control center at each range with its instrument sites and vehicles.

Most communications are handled via an FM two-way radio network. Two independent channels are available, and most of the stations can operate on either. Signals from both channels are relayed through a dual-frequency repeater station location on a nearby mountain, which retransmits the message on another frequency. The repeater station transmitters have higher power output than the other network stations, which effectively increases the range of the network. The G-1 and G-2 test control centers operate the repeaters by landline to ensure positive control during critical periods of test operations.

The system presently encompasses over 450 units in fixed, portable, and mobile stations. Communications units are available for temporary installation in special instrumentation units used for particular test programs.

Located in the test control centers are the public address, paging and multichannel intercom systems connecting the assembly buildings, launcher areas, and local instrumentation sites.

Ground-to-aircraft communications are provided in the test control center and at radar plotting boards via two UHF channels.

Standard phone communications are supplied by Continental Telephone and NWC also has several AUTOVON lines.

3. Dimensions

a. Landspace

(1) Test Area Contiguity. The Naval Weapons Center, located at China Lake in the Indian Wells Valley of Southern California's high Mojave Desert country, covers an area of approximately 1,152,000 acres. The complex consists of two main areas. China Lake proper, the largest of the two areas, is roughly rectangular (26 miles east to west, and 42 miles north to south), and contains 640,000 acres. The second area under NWC control is located 25 miles to the southeast of China Lake and contains approximately 512,000 acres.

(2) Easements/Encroachments

(a) Indian Claims. There is a continued effort by the Owens Valley Tribe of the Pauite-Shoshone Indians to obtain a hot springs area located seven (7) miles within the NWC's westernmost boundary for development as a health and recreation spa.

(b) Goethermal Power Exploration. The geothermal area of Coso Hot Springs/Devils Kitchen lies inside the northwestern boundary of NWC. The area consists of 41,600 acres. Active surface evidence of a large thermal area underlying the region has attracted the interest of geologists to the area as a potential source for producing electric power. Pressures to open this land for their development are increasing.

(c) Mineral Exploration. There exists large deposits of pumice within NWC; however, no mining activities have been permitted.

(d) Forestry. There is no forestry activity allowed within NWC.

(e) Cattle Grazing. Cattle grazing is presently allowed in the northern portion of NWC on a leasing basis.

(f) Hunting. Public hunting is allowed within certain NWC areas on a low priority basis on weekends only, consistent with State seasonal regulations.

(3) Impact/Live Firing Areas

(a) Guided Missile and Ballistic Ranges

1 G-1 Guided Missile Range. Largest and most completely equipped of the ground ranges.

Used primarily for testing of all types of air and ground launched weapons such as guided missiles, rockets, and unguided ordnance.

Covers a sector running 37 miles to northern boundary of NWC.

Heavily instrumented downrange with electronic and optical instrumentation, augmented with wide variety of mobile instumentation.

South apex of sector is test-control center and normal location of mobile instrumentation radars and permanent fire control radars.

Has remote control station for controlling and/or terminating drone target flights.

Has complete telemetry and timing stations; missile-storage, assembly, checkout building; ammunition magazines; target sites; launch sites; and special launch sites for testing of specific missiles.

Includes the experimental surface weapon-control testing facility.

2 G-2 Exterior Ballistics Range. Overlaps G-1 range to use same downrange areas and instrumentation.

Also has its own electronic and optical instrumentation, including velocimeters, for the study of launching and early-flight parameters of gun and rocket-launched ordnance.

Special installations include a 550-foot track launching ramp elevated 6 degrees to horizontal for aircraft-weapon separation studies, and a gun-firing facility.

3 VICTOR (V) and G-3 Explosives Hazard Range. Equipped with instrumentation and barricades for explosives hazards testing of full-scale reinforced concrete cubicles, full-scale and earth-covered steel-arch explosives storage magazines, blast-loading tests, and the testing of warheads to determine their sensitivity to fragments traveling at low and medium velocities.

4 K-2 Terminal Ballistics Range. Features a two-rail, 1,500-foot track launcher. Particularly adapted to study of rocket and guided-missile warhead performance and fuze testing.

Provides limited capabilities for exterior ballistics studies and the high-speed crosswind firings of small caliber guns and rockets.

Includes a special-purpose test facility designed to obtain experimental data on re-entry bodies, and a 3,280-foot small-caliber gun facility used to gather exterior ballistics information on gun projectiles or small rockets (designed specifically for 20mm projectile study).

5 K-3 Crosswind Firing Range. Designed around 2.8 mile, standard gage railroad track with super-elevated curves. Test item placed on launching platform mounted on flatcar and towed through one of three launching sites to obtain crosswind data.

Instrumented to provide precise photographic coverage to 30,000 yards.

6 CT-4 Vulnerability Range. Equipped to determine vulnerability of ordnance items to severe environments such as gasoline fire (cookoff tests).

Ideally suited for high-hazard tests of weapon systems containing up to 10,000 pounds of HE and for tests involving limited quantities and types of radioactive material.

7 Randsburg Wash Area. EW Range: A self-sufficient simulation facility for the study for the study of electronic counter-measures and aircraft tactics against surface-to-air systems. Consists of various types of radars operating in various frequencies, digital computers, display and recording equipment.

Fuze Range: Used for developmental testing of guns, rockets, and guided-missile fuzes.

Equipped with two pairs of wooden towers, for suspending bomber-size targets up to 250 feet above ground, and a 150 foot steel tower for launching rockets and guided missiles in free-space environment.

Vertically emplaced guns and an impact area for the intact recovery of vertically fired VT fuzes.

Permanently mounted naval guns.

Target areas for impact, arming, countermeasures, and maximum-range measurement tests.

(b) Supersonic Track Ranges. Consists of three high-speed tracks having different lengths, weight capabilities, precision of track alignment, braking, and muzzle clearance. Tracks are used for captive-flight, aeroballistic, fuze, inertial-guidance system, aircraft damage, crosswind firing, rain erosion, and terminal ballistics tests requiring subsonic, supersonic, or hypersonic velocities.

1 Supersonic Naval Ordnance Research Track(SNORT). Longest, heaviest, and most precisely aligned of the tracks, used primarily for tests requiring maximum speed or duration of run, heavy carriages, minimum of transverse or vertical calibration, extensive or complex instrumentation, or controlled deceleration.

Approximately 4.0 miles long, 56.6-inch gage, 171 lb/yd dual-rail track, uses water brake for sled deceleration and termination of run.

Equipped with trackside photographic instrumentation, both fixed and mobile; telemetry receiving and recording station; range timing system; velocity measuring system (VMS) and a programming system.

Sledborne photographic and electric instrumentation for recording test events in transit.

Special installation: 2,500 foot rain erosion installation used primarily for environmental testing of radomes. Facility provides a controlled rain simulation capability in intensity ranges of 1 to 4 inches per hour, with corresponding median drop-size diameters of 2 to 2.8mm.

2 B-4 Track Range. Used primarily for standard missile component tests. Because of its less precise alignment and the fact that it can be repaired more easily, it is also used for tests that are likely to result in track damage.

Approximately 14,500 feet long, 56.6 inch gage, 75 lb/yd dual-rail track. Uses sand brake for deceleration.

Equipped with much the same trackside and sledborne instrumentation as SNORT, with its own programing and timing systems.

Model machine shop, serving all three tracks, provides capability of fabricating or repairing test vehicles.

Special installation: Target profile recognition facility (fuze testing). Has three structures, each capable of suspending a target weighing up to 75,000 pounds over the track to a height of 40 feet. A single target can be used, or two or three targets can be suspended in tandem, at various yaw and pitch angles.

3 G-4 Track Range. An essentially terminal ballistics track seldom used to obtain straight track-run data. Muzzle of track overlooks 500-foot deep desert sink, permitting unencumbered, free-flight, exterior, and terminal ballistics testing.

Two-rail precision installation, 3,000 feet long, inclined at a constant grade of +2.8%; 171 lb/yd crane rail laid at 33-7/8-inch gage.

For the occasional test run at G-4 in which test vehicles are to be recovered, braking is accomplished by retro rockets.

Uses portable photographic, electronic, and programing instrumentation provided by SNORT and B-4.

(c) Aircraft Ranges. These consists of B-range, C-range, and the Coso military target range, collectively covering approximately 450 square miles over western half of Naval Weapons Center. Instrumentation is designed around the basic mission of each range, but ranges are not restricted to particular missions. Basically, the following applies to all three ranges:

Each range has its own control tower or center and is equipped with a varying quantity of radars, cameras, timing instrumentation, communications networks, impact-spotting stations, and a plotting center.

A wide variety of targets and target areas is available; special targets can be constructed or provided when required. HE tests are restricted to specific target areas on B and C ranges unless complete recovery of duds can be assured.

Support facilities are available for processing film, reducing photographic and telemetered data, measuring atmosphere phenomena.

1 B-Range. B-Range is the most extensively instrumented of the three ranges. In addition to the above mentioned facilities and instrumentation,

it has a network of 18 Askania theodolites and four mobile tracking mounts, arranged for optimum triangulation of high-altitude missile trajectories and aircraft flight paths. A C-band precision instrumentation tracking radar, AN/FPS-105, in conjunction with Automatic Data Processing Equipment (ADPE), high-speed printer, and other peripheral equipment and software provides trajectory data on 1-m^2 targets to 150 nmi in a skin-track mode and 32,000 nmi a beacon mode.

B-Range is used primarily for developmental testing of conventional ordnance items, air-to-ground missiles, and bomb-director systems that require extensive instrumentation and camera coverage.

There are two large target-impact areas, each divided into a 100-foot-square grid pattern to determine location of cluster-type bomblets and their dispersion characteristics. A special instrumentated fire-bomb target, consisting of 21 reinforced concrete targets, each equipped with seven calorimeters to obtain flame-temperature data, is available. Temperature data are transmitted by underground cable to a central recording site.

2 C-Range. C-Range is used for tests needed less extensive instrumentation coverage but requiring immediate information on impacts and flight path profiles.

Its primary mission is the developement of flight tactics by VX-5 and the training of Fleet pilots in delivery of both conventional and special weapons, and conducting operational evaluation tests for Operational Test and Evaluation Force squadrons.

Radar is used for comparing actual flight maneuvers with ideal flight maneuvers. This technique is especially useful for training pilots in loft bombing where a specific normal acceleration must be established and maintained.

3 Coso Military Target Range. This range is in mountains terrain with elevations of 7,000 to 8,000 feet, maintained as nearly as possible in its natural state. Presentation of targets in their natural setting provides realistic environmental conditions for development of specific weapons and weapon systems.

Instrumentation is limited, relying primarily on voice communications, radar and impact spotting. B and C-Range cameras and telemetry equipment are used when required; spotters are used to determine impact information.

Various military targets are strategically located to simulate tactical conditions. The range control station is located for immediate negation of attack, when necessary.

A simulated SAM site with nonoperating radars is used as a special target.

The range provides an ideal tactical training area for Fleet squadrons and for development of tactics for OPDEVFOR development Force squadron.

(d) Explosives Testing Ranges

1 Burro Canyon. The range is located approximately 12 miles north of G-north of G-Range control complex. It is used primarily for testing ordnance items in the 200- to 2,000-pound explosive weight class.

It is equipped with standard 40-foot ordnance drop tower, barricades, and optical and electronic instrumentation.

There are five firing sites, with underground instrument and firing power lines.

Each camera barricade is equipped with permanently installed camera mounts.

2 Area R. This area is used for explosives research and evaluation of ordnance items containing up to 200 pounds of explosives.

It is equipped with multiple camera and personnel barricades.

It uses optical and electrical instrumentation such as frame and streak cameras, electronic fire-control, a dual-channel 100-kV flash X-ray unit, 600 kV single- and double-channel flash X-ray units, and 300 kV single-and double-channel flash X-ray units.

b. Airspace

(1) Landspace/Airspace Relationship. This relationship is described in Paragraph 2.j.

(2) Easements (FAA Air Routes). Continuing pressure from the FAA to "better utilize" R-2508 for commercial aviation is considered a definite and continuing problem that may require DOD involvment in the future. Tests were conducted recently to ascertain the feasibility of integrating commercial traffic with RDT&E activities through Jet Route 110. NWC considers the test results inconclusive and is concerned with safety of flight inasmuch as Jet Route 110 lies immediately north of the heavily used R-2505. NWC has opposed further use of J-100 whenever R-2508 is activated. A counter proposal to establish a route much further to the north that penetrates the northeast corner of R-2508 is currently under consideration.

Many of the aircraft run-in lines to the NWC to the ranges lie in generally south-to-north direction. A special-use airspace (R-2506) was established to provide for a low altitude run-in line to some of these ranges. There is considerable privately owned land within R-2506, some with commercial and housing developments on it. Continued development of this land could place some restrictions or limitations on low altitude approach runs. NWC has conducted studies related to noise level from aircraft operations in these areas and is exploring ways of resolving this problem.

(3) Manned Airborne Systems

(a) Naval Air Facility Aircraft Inventory

Transports	Fighters	Attack
1-C117	4-F4	10-A4
1-C131	1-TF9	3-A6
1-U3A		4-A7

(b) VX-5 Aircraft Inventory

4-A4

7-A7

1-AH-1J

2-UH-2A

(4) Unmanned Airborne Systems. The following remotely controlled drone aircraft are available at NWC:

10 - BQM 34A

3 - QF 9

8 - QT 33

2 - QF 86 (will have 30 within 1 year)

These aircraft are controlled by a specially-modified drone control radar at Armitage Field.

(5) Area Surveillance. The is presently no area surveillance available at the NWC. An airspace surveillance radar is proposed in the current two year plan.

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements

(a) Single Object

1 Cinetheodolites. The Optical Instrumentation Branch personnel maintain and operate the fixed and mobile cinetheodolite stations. Both the Askania and Naval Weapons Plant cinetheodolites feature (1) accurate positioning of the instrument and film plane, with respect to a surveyed point, (2) a film plane on the lens axis, (3) binary-coded timing, azimuth, and elevation-dial reading, with the frame number photographed on the film, (4) a synchronized pulse rate, which ties all stations together precisely, and (5) provision for camera leveling and orientation to within a few seconds of arc. The instruments can be equipped with any of a variety of

lenses having focal lengths of 24, 44, 48, 72, and 88 inches--the lens selection being made according to station location and test requirements.

The permanent stations are supplemented by additional semipermanent stations downrange that afford effective photographic coverage over a downrange distance of approximately 30 miles for gathering data on events from ground level to altitudes above 70,000 feet and extending over a distance of about 45 miles.

Of the Center's 47 cinetheodolites, 23 are housed in permanent air-conditioned astrodome stations situated in an array along each side of the guided missile line of fire in such a manner as to cover both G-1 and G-2 ranges.

The instruments are normally operated at 5 pulses/sec but the rate can be varied to 4, 2, or 1 (or less) as predetermined by test specifications. Each instrument is equipped with an interchangeable 20-power or 12-power telescope having an illuminated recticle for night tracking. Communication radios are installed in all active stations. Fifteen of the stations are equipped with the NWC target acquisition system (TAS) to help align the telescope on a moving object.

The stations equipped with TAS can acquire any target (missile, drone, or aircraft) that carries a missile intercept data acquisition system (MIDAS) transmitter or that can be tracked by radar. MIDAS and radar inputs can be used simultaneously to aim the cinetheodolites. The presentation to the cinetheodolite operator is a fourlight display in the tracking telescope; two of the lights indicate elevation, and the other two indicate azimuth. The operator acquires the target by training the instrument in the direction of the appropriate lights.

2 CZR-1 Bowen Camera Units. An instrument array, consisting of one or more CZR-1 systems, is used for measuring position, velocity, acceleration, and attitude on track tests, and during that portion of free-flight tests in which the trajectory is predictable enough to permit the use of fixed camera systems. Such operations include tests of ground-launched missiles, terminal-trajectory determinations of impacting missiles, trackrange tests involving high-speed sleds and ordnance launched from the sleds, fragment-velocity studies, and similar dynamic-testing operations.

The CZR-1 Bowen ribbon frame camera unit is composed of three main parts: The camera, a precision mount to support the camera, and electrical and electronic control gear to operate the instrument. The camera can be operated at 30, 60, 90, and 180 fr/sec giving a picture 5-1/4 inches long, varying in height from 0.906 inch at 30 fr/sec to 0.151 inch at 180 fr/sec. A 10-inch-focal-length lens is standard; however, 5- and 24- inch lenses are available on several of the systems. This camera is supported in a precision three-axis mount, with each axis equipped with a scale reading to 0.005 degrees. An instrument cabinet contains the control circuits and the range-timing receiver. The complete system is a mobile unit carried on a four-wheeled trailer. It requires only a surveyed location and a 208-volt, three-phase power source for operation.

3 Tracking Mounts. Tracking mount personnel operate powered mounts fitted with cameras having long-focal-length lenses to obtain detailed close-up pictures for missile-attitude measurements, intercept data documentation, and the observation of component functions on items being tested at any of the NWC ranges.

The basic instrument used is a modified M-45 camera-carrying machine gun mount spring-mounted on a trailer fitted with stabilizing jacks and leveling devices. Tracking rates up to 60 deg/sec are possible, although tracking beyond 40 deg/sec is seldom required. Each mount is powered by its own 30-kW diesel generator mounted on a 2-1/2-ton truck, which is also used as the prime mover for the mount. Radio communication and timing equipment is placed on the trailer with the mount. Each mount is equipped with two arms designed to support a variety of camera and lens combinations. The usual combination is a 35mm Mitchell camera on one arm for coverage of the entire flight, and a high-speed recording camera on the other arm for high frame rate (up to 8,000 fr/sec) detailed studies of motion, separation of booster from missile, seat ejections, etc. Lenses from 2-to-150 inches in focal length are available for use on either arm. Usually a 96-inch lens is used on one side and a 48-inch is used on the other. Cameras employed are the 70mm Mitchell and Photo-Sonics, 35mm Mitchell and Photo-Sonics, and 16mm Mitchell, Milliken, and Photo-Sonics, all of which are equipped to record 1,000-pps binary-coded timing.

Fourteen mounts are available for use on the various ranges. Normally, a mount requires only one operator.

Tracking mount personnel operate the tracking-radar boresight systems used on the guided-missile ranges. The systems utilize 35mm and 70mm cameras with lenses having focal lengths of up to 150 inches. Also, the tracking mounts are used with closed-circuit television cameras to funnel real-time visual data to range control.

(b) Multiple Objects. None.

(c) Relative Position - Miss Distance. A system consisting of television cameras mounted on two cinetheodolites, a split screen video tape recorder and bar-dot generator is used for bomb drop scoring. Single frame playback is used and allows relatively accurate and short turnaround time for scoring bomb drops.

(d) Radar. None.

(2) Airborne Elements.

(a) Radar. Several tracking radar installations are used for tests on the aircraft and guided missile ranges, and several mobile units are available for use at other locations as needed. These radars, which are all equipped with optical trackers for target acquisition and identification, beam pulsed RF signals at airborne targets, measure the reflected signal delay time to obtain range data, and provide angular information by using directional antennas to track targets automatically.

One AN/MSG-3A acquisition and tracking radar with computer/ plotting system provides a mobile facility for use in drone control exercises, for tracking rockets and projectiles, and in weather modification programs.

A digital AN/MSG-34 radar is installed at G-2 behind the 5-inch guns to measure projectile trajectory and velocity. Digitized information is sent to G-1 fire control via cable and recorder at the UNIVAC 1218 computer. Velcocity and trajectory data are presented on plotting boards in real time and logged for off-line reduction.

Characteristics of the various NWC radars are shown in Table-Z-1.

(b) Laser. The Joshua Ridge Electro-Optical Field Laboratory was established because the Navy had no suitable facility that was equipped to collect the far-field engineering data needed for development programs to evaluate sensors under field conditions. The establishment of this Laboratory at the Naval Weapons Center (NWC), China Lake, California, was a key action in improving the Navy's E/O research and development capability.

The primary objective was to establish, equip, and operate a general-purpose E/O field laboratory for laser far-field studies, E/O equipment evaluation and calibration, and optical target signature measurements.

The Joshua Ridge Electro-Optical Field Laboratory has been constructed and instrumented so that the far-field laboratory-type experiments can be performed in the real-world atmosphere. Geodesic domes protect personnel and instruments from the elements and are equipped with a variety of lasers, detectors, tape recorders, oscilloscopes, timing receivers, multiplexers, and other laboratory equipment.

A listing of the laser sources at Joshua Ridge is shown in Table Z-2.

The primary laboratory and target sites are located on elevated ridges so that the optical paths between them have hundreds of feet of terrain clearance over most of the path lane. Basic target sites are located at 1.9, 5.6, and 9.7 kilometers from the primary laboratory, but other target sites (up to 27.4 kilometers) are available through a controlled access area.

(c) Optics. The Joshua Ridge Electro-Optical Field Laboratory contains the optical measuring equipment shown in Table Z-3.

Table Z-1

NWC RADAR CHARACTERISTICS

UNIT	FREQ MHz	POWER Pk. Kw	POL	PRF PPS	PULSE WIDTH n SEC	BEAM WIDTH DEG	BEACON	RANGE MAX N.MILE	RANGE ACCURACY YD	AZIMUTH RATE MILS/SEC	AZIMUTH ACCURACY MILS	ELEVATION RATE MILS/SEC	ELEVATION ACCURACY MILS
Capri AN/FPS-105	5450-5825	1000	VERT	160-640	0.25, 0.5 1.0	1.2	Yes	32000	±5	850	0.1	500	0.1
NIKE-AJAX & HERCULES	8500-9600	250	VERT	1024 512	0.25	1.3	Yes	131	±10	750	0.5	750	0.5
MPS-26	5450-5825	250	HOR VERT CIR	320 - 1707	0.25 1.0	1.4	No	200	±10	1030	±0.5	515	±0.5
MOD	2700 - 2900	80	HOR VERT	341 - 1707	0.8	2.5	Yes	200	±15	700	±1.0	350	±1.0
M-33	8500 - 9500	250	VERT	1000	0.25	1.1	No	50	±15	700	±1.0	500	±1.0
MSG-3A	8500 - 9600	400	VERT	1350	0.25	1.7	No	50	±15	700	±1.0	500	±1.0
AN/MAQ-33	10100 - 10250	0.2	VERT	CW	CW	1.8	No	10	-	425	-	425	-
AN/MPQ-39	-	2	VERT	CW	CW	1.8	No	18	-	425	-	425	-

Table Z-2

JOSHUA RIDGE ELECTRO-OPTICAL
FIELD LABORATORY LASER SOURCES

LASER	WAVELENGTH, um	OUTPUT POWER, W	CW OR REPETITION RATE pps	PULSE WIDTH, sec	BEAM DIVERGENCE, mrad
CO_2	9.6 to 10.9	50 100	CW Single to 1 kHz	1 to 1×10^4	2.2
ND:YAG	1.06 1.06	11×10^6 300×10^3	Single to 10 CW to 10 kHz	17×10^9 to 1×10^6	0.4 1.0
GAAS	0.904	1×10^3	Single to 10 kHz	150×10^9	8.0
Dye	0.36 to 0.70	6.25×10^3	Single to 100	8×10^9	2.0
Ruby	0.69	1.5×10^6	Single to 6 (ppm)	17×10^9	3.0
HENE	0.6328 0.6328	15×10^3 1×10^3	CW CW	....	1.0 1.0
Nitrogen	0.3371	1×10^5	Single to 100	1×10^8	30.0

Table Z-3

JOSHUA RIDGE OPTICAL INSTRUMENTATION

Item	Range: Wavelength, um	Range: Sensitivity
Hewlett-Packard Radiant Flux Meter	0.3 to 3	0.1 to 10^{-6} to 100 x 10^{-3} W/cm^2
EG&G Model 580 Radiometer	0.35 to 1.2	4.2 x 10^{-12} to 6.9 W/cm^2
EG&G Model 580/585 Spectro-radiometer		
Scienteck Model 3604 Disc Calorimeter	0.3 to 3	0.5 to 50 W
Scienteck Model 3600 Calorimeter	0.3 to 3	1 x 10^{-3} to 3 W
Gamma Scientific 700 Log-Linear Photometer	0.3 to 0.7	1 to 10^4 ftc
U.D.T. Model 40A Opto-Meter	0.45 to 0.95	10^{-9} to 10^{-2} W/cm^2
EG&G Model 590 Calibrated Lamp System[a]	0.25 to 2.5	200 and 1,000 W
Beck Wavelength Spectro-scope	0.4 to 0.8 readible to 0.0002	

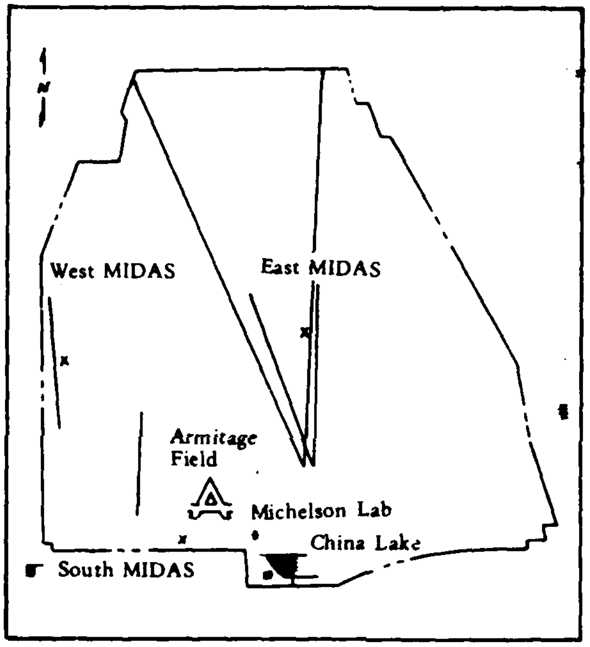
[a] Maximum 3% uncertainty based on NBS accuracies. Spectral irradiance calibrated at 0.005 um intervals.

(d) Relative Position Miss-Distance. See Section 4.a.(1)(a).1

(e) Airborne-to-Ground Target Matching. None

(f) Multiple Objects

1 Missile Intercept Data Acquisition System (MIDAS)



South, East, and West MIDAS Sites

MIDAS is a trajectory, miss-distance, impact-location measurement system that can be track two airborne vehicles simultaneously. There are three MIDAS sites at NWC, as shown above. MIDAS uses electronic interferometers to measure phase differences of RF signals received at antenna pairs from airborne tranmitters. Signal sources are telemetry transmitters, normally installed in developmental missiles, and CW signal sources specially installed in target aircraft. The phase measurements provide angular data in the form of direction cosines referred to antenna fields located near the B-2, G-2, and SNORT ranges. From these angular data, instantaneous spatial coordinates of the vehicle are computed. For aircraft control and range safety, realtime information is sent to plotting boards at G-1 range test control by way of microwave and the UNIVAC 1218 computer. For later assessment or playback on plotting boards, MIDAS data are recorded on tape and processed on the UNIVAC 1218 or reduced on the UNIVAC 1108 computer at Michelson Laboratory. MIDAS pointing information is also transmitted to theodolites via TAS, and data on trajectories of airplanes flying tests at Baker range can be sent from MIDAS to that range via microwave.

The antenna pattern is omnidirectional; however, to maintain optimum system accuracy, each MIDAS antenna field must receive tracking information above a minimum (and below a maximum) elevation angle. A less accurate continous track is maintained at other elevation angles.

2 Target Acquistion System - TAS. A target acquistion system (TAS) has been installed on the ground ranges to assist Askania camera operators in finding and tracking targets, particularly small targets or those at high altitudes. Digital data from the east, west, and south MIDAS stations are transmitted by microwave to G-1 test control where they are combined with digital data from any or all of the three tracking radars. The combined data are then transferred to the UNIVAC 1218 computer at G-1. The computer edits the data and computes the solutions, makes parallax corrections, and generates messages containing pointing instructions for each of the Askania camera stations. The messages are distributed to the receiving stations at a rate of 10 per second.

At the instrument receiving sites, the transmitted instructions in digital form are compared with camera-pointing data. Differences are displayed in the form of right/left asimuth and up/down elevation lights mounted in the periphery of the field of view of the spotting telescopes. The operator's problem is thus reduced to one of moving the camera so as to extinguish the data display lights, which results in the camera axis being aligned so that the target is visible in the spotting telescope.

b. Timing. The timing and Control Section develops, maintains, and operates all timing and control equipment on the ranges.

Timing services are provided routinely, usually as specified in the experiment specifications (ES) issued by the Scheduling Office. Special arrangements are seldom necessary. Timing data are transmitted 24 hours a day, primarily in IRIG-B format. They are transmitted by microwave link from the central timing station in the G-1 test control building to the main timing transmitter station on B Mountain, where the microwave data are received and processed. Timing is then retransmitted on a frequency of 141 MHz for use throughout the Center. A pulse code modulation (PCM) timing system augments the IRIG system for the control of instrumentation at downrange locations.

Additional stations for specific range use are located at G-2, K-2, and the supersonic track (SNORT, B-4, and G-4) ranges, and the aircraft ranges (B and C-Range).

The central station operator can accomodate requests for changes in functions being transmitted, or in instrumentation checkout procedures as required. When special frequencies, control functions, or receiving stations are required the Head of the Timing and Control Section is to be contacted.

c. Television. Television was initially utilized at the NWC for safety and security purposes, however it has been increasingly used for data purposes. The Television Center located on G-1 Range contains the general purpose TV receiving, recording, and re-tranmission equipment. TV cameras are mounted on mobile tracking mounts, radars, or at fixed installations.

Four portable closed-circuit television links provide remote coverage of ordnance tests. Include in this TV system are four cameras, nine monitors, and five video tape recorders. The recorders are used to record and reproduce optical events covered by the TV cameras.

d. Photography

(1) Motion Picture. The NWC can perform all the standard black and white and color motion picture photography. The 16mm and 35mm color laboratory is being converted from Ansco to Eastman processing. Printing and processing currently takes approximately 2 to 3 days. NWC processed approximately 7 million feet of motion picture film in FY-72.

(a) 16mm Cameras. Photo-sonic 1B prism cameras, 400 to 1,000 fr/sec, 100- to 1,200 ft. film capacity.

Fastax WF-4 prism cameras, 1,000 to 8,000 fr/sec, 100- to 400- ft film capacity.

Hycam K2054E prism cameras, 100 to 11,000 fr/sec, 100- to 400-ft film capacity.

Hycam K2520E prism cameras, 20 to 7,000 fr/sec, 200- to 2,500-ft film capacity.

8mm (1/2 frame 16mm) Fastax WF-1 prism cameras, 2,000 to 12,000 fr/sec, 100-ft film capacity.

Mitchell pin-registered cameras, 16 to 400 fr/sec, 100- to 1,200-ft film capacity

Milliken DBM-5 pin-registered cameras, 4 to 400 fr/sec, 100- to 1,200-ft film capacity.

(b) 35mm Cameras. Fastax WF-8A full frame prism cameras, 200 to 2,000 fr/sec, 200- to 500-ft. film capacity.

Photo-Sonics 4B prism cameras, 500 to 2,000 fr/sec, 400- to 1,000-ft film capacity.

Mitchell pin-registered cameras, 16 to 120 fr/sec, 100- to 1,000-ft. film capacity.

Automax G-1 intermittent-movement, cinepulse cameras. Cine rate 16 fr/sec, pulse rate 0 to 10 fr/sec, 100- to 400-ft. film capacity.

(c) 70mm Cameras. Photo-Sonics 1A pin-registered cameras, 100 to 400 fr/sec, 80-ft. film capacity. Frame size 2.25 to 0.218 inches.

Photo-Sonics 1B pin-registered cameras, 360 fr/sec, 100- to 1,000-ft. film capacity. Frame size 2.25 by 0.218 inches. Mounted on 3-axis mount. 1/10,000-second shutter speed.

Photo-Sonics 10A pin-registered cameras, 20 to 80 fr/sec, 100- to 1,000-ft. film capacity. Frame size 2-1/4 by 2-1/4 inches.

Hulcher Model 102 sequence cameras, 5 to 20 fr/sec, 100-ft film capacity. Frame size 2-1/2 by 2-1/2 inches.

(2) Still Photography. NWC possesses a complete still photography capability which includes; reducton, copy and video tape transfer to 16 mm color film with sound in the near future.

(3) Airborne Capabilities. The standard chase plane photography is available at NWC.

e. Instrumentation Calibration Capabilities. The capabilities of the Calibration of the Calibration Laboratory are shown in Table Z-4.

f. Other General Instrumentation

(1) Telemetry. The Telemetry Section develops, maintains, and operates the central radio-telemetry facility at G-1 and at B-1 ranges, which is used for guided missile and space-vehicle data gathering; the mobile telemetry recording stations; the missile airborne-telemetry facility and the landline telemetry equipment used in studies of blast, launcher parameters, missile shock and vibration, and missile temperatures.

The four main types of radio telemetry facilities at the NWC missile ranges include FM/FM, PAM, PCM, or PDM/FM. The telemetry building is headquarters for these facilities. Facilities for communicating with and monitoring launcher control, range, and other critical areas are available to the test conductor in the flight observer areas of the telemetry building. The facility also contains equipment for observing real-time data for making magnetic tape and oscillograph records.

In addition to the fixed stations, mobile stations consisting of antenna, preamplifier, receivers, and two tape recorders, are available for downrange operation or for backup of the fixed stations. The magnetic tape recorder can be played back in the telemetry building for presentation of the data on oscillographic film or paper.

Table Z-4

CALIBRATION LABORATORY CAPABILITIES

MEASUREMENT	RANGE	ACCURACY
1. DC Voltage	0 to 100 v 100 to 1000 v 1 kv to 5 kv 5 kv to 30 kv	1 10 PPM 1 20 PPM 1 0.03 % 1 1.0 %
2. DC Current	0.01 nA-300 A	±0.01 %
3. AC Voltage	10 nv to 1Mv 1 Mv to 500 v 1 v to 1100 v 1.1 kv to 30 kv	± 3% ±0.03% ±0.02% ±2.0%
4. AC Current	1.5 mA to 20 A 1 A to 50 A	±0.1% ±2.0%
5. Resistence	0.01 n OHM to 1 OHM .01 OHM to 120 m OHM	± 0.04% ±10 PPM
6. Capacitance	10 PF to 1 nF 1 nf to 11 nF 100 PF to 1 nF	±5 PPM ± 0.05% ±0.03%
7. Inductance	0.1 nh to 1h 1 Mh to 1 h	1 0.2% 1 0.2% 1 1.0%
8. Distortion	5Hz to 600 KHz	±6%
9. Phase Shift	30 Hz to 18 GHz	±1.5%
10. Noise Figure	0 to 10 dB	±0.5 dB
11. Frequency	100 kc to 5 MHz .008 Hz to 12.4 GHz	±5 parts 10^{10} ±1 part 10^{5}
12. RF Power	0 to 100 Watts to 18 GHz	±5%
13. RF Voltage	20 nv to 0.2 v to 400 MHz 0.2 v to 100 v to 100 MHz	±4 to 10% ±1%

(a) FM/FM Stations. The telemetry building houses five 12-band FM/FM stations. Each station consists of two phase-lock crystal-controlled telemetry receivers, one 7-track magnetic tape recorder, one 12-inch recording oscillograph, and any 12 of the IRIG standard subcarrier discriminators, all of which are equipped with wow-and-flutter compensation. Calibration and monitoring equipment is available to all stations.

There are ten 8-channel and one 52-galvanometer direct-writer recorders with patch capabilities. These recorders can patched to either or both decommutator stations and any number of discriminators in any order to provide a total of 50 quick-look data channels. A tape playback station is available and consists of two 12-subcarrier discriminator stations with wow-and-flutter compensation, 12-inch recording oscillographs, one 45-channel decommutator unit, four 8-channel directwriter recorders, and a tape recorder capable of playing back either 7-track one-half-inch tape or 14-track one-inch tape.

The antenna system for the real-time recording station comprises one quad helix with remote control (located in the operations area), two bifilar manual-track helices, and two 28-ft. parabolic antennas.

Radio-relay data from areas not serviced by the present telemetry-receiving system can be provided on a limited test-to-test basis.

The missile-telemetry facility provides complete acceptance testing, calibration, and checkout of telemetry units before they installed in test items.

(b) PCM/PAM/PDM/FM Stations. Each of the two time-division telemetry stations comprises a helical antenna, a preamplifier, a multicoupler, a receiver, a 7-channel one-half-inch magnetic tape recorder, and an Arnoux Model TDS decommuutator system.

The decommutators include one 45-channel PAM/PDM unit and one 30-channel PAM/PDM unit, which will handle all standard IRIG communication rates. Decommutator output can be presented on four 8-channel direct-writing oscillographs in real-time or on playback from the flight tape. An 18-inch bargraph oscilloscope is used as a monitor, and includes a high data rate PCM system with a 20-channel digital-to-analog conversion capability for readout. A high bit rate PAM/PCM system is in partial operation, giving the facility a capability for handling pulse modulated telemetry data.

(c) Special Recording Telemetry. This facility consists of four vans and a permanent installation on the G-1 range. Three wirelink carrier systems--a Wiancko 30kHz dual system, a Hathaway 5-kHz system, and a CEC 10-kHz system-- are available. Provision is made for recording data on CEC oscillographs, a Visicorder, both 35mm-strip and Polaroid Land camera film, and magnetic tape, using both direct and wide-band FM.

The special recording facilities are used to measure a wide variety of phenomena is guided-missile, track-range, and blast tests. Transducers are available to measure motion, high-level transient sound, horizontal and vertical accelerations, strain, and air-blast and earth pressures. In addition, equipment is on hand for the precise calibration of the transducers used in these measurements.

(2) Meteorological. Permanent weather reporting stations are maintained at all the Center test ranges. A tabular of all the weather instrumentation in use at NWC is presented in Tables Z-5 and Z-6.

(3) Survey. NWC has three (3) first order baselines and is capable of performing second order survey.

(4) RFI/EMI Compatibility. NWC has a limited RFI measurement and monitoring capability. Close coordination is affected with the DOD Western Area Frequency Coordinator located at Pt. Mugu, California.

(5) Visibility. See Table Z-3.

(6) Safety and Security

(a) Range Control. The range control system consists of equipment at the various ranges to gather and display flight path data of airborne test items. The data are used for assessing trajectories; the displays provide quick-look information and are also used by the range engineer to assure that test parameters are being met.

The principal range control system (RCS) is divided into two subsystems--plot and MIDAS. The plot subsystem receives data from the tracking radars or MIDAS, with the data being processed in one of two UNIVAC 1218 digital computers and their peripheral equipment. The outputs of the computers, which are logged on magnetic tape to be used for assessment, are also used to control mumeric displays and the plotting boards. The information can be displayed on any combination of four 30-by 30 inch plotting boards for real-time readout and for use by the range engineer in conducting the test; and the magnetic tape data can be played back to make additional plots after the test. Two analog computers are used as backup for the digital computers, but no data logging capability exists with the analog machines.

(b) Flight Termination and Radio Command Control. During the early flight-testing stages of missile development, a command flight-termination system is usually employed. The system is designed to destroy the test vehicle if its course of flight becomes a safety hazard. This command system is also used for radio command of target (such as the QF-9 and BQM-34A), for flight termination of high-altitude research balloons, and for remote control of various developmental project operations.

The ground station comprises two fixed FM transmitter systems (each containing two AN/URW-15 tranmitters); two trailermounted mobile systems (each containing two AN/FRW-2 transmitters); and related monitoring equipment. The fixed systems, one installed in the range operations tower building and the other in the radar tower building, are remotely controlled from a station located at the plotting boards in the G-1 test control building. If a malfunction occurs in the operational transmitter, the integrated automatic sensing-control equipment switches to the standby

Table Z-5

LOCATION OF WEATHER INSTRUMENTS

INSTRUMENTS	AIRCRAFT RANGES B-1	AIRCRAFT RANGES C	AREA "R"	ARMITAGE FIELD	INST. LAB
For <u>Surface Measurements:</u>					
Instrument shelter	X	-	X	X	X
Mercury wet-and-dry bulb thermometers	-	-	-	X	X
Mercurial barometer	-	-	-	X	X
Aneroid barometer	-	-	-	X	X
Hygrothermograph	X	-	X	X	X
Microbarograph	-	-	-	X	X
Aerovane anemometer AN/UMQ-5	X	-	X	X	X
Rain gage	-	X	-	X	X
Temperature recorder (Speedomax)	--	-	-	-	X
For <u>Aloft Measurements:</u>					
Radiosonde recorder (TMQ-5A)	-	-	-	-	-
Radiosonde recorder (SMQ-5)	-	-	-	-	-
Rawin set, GMD-1B	-	-	-	-	-
Single-theodolite station	X	X	-	X	X

*Portable equipment is available for use at locations not normally instrumented

Table Z-6

WEATHER INSTRUMENTS ON GROUND AND TRACK RANGES

INSTRUMENTS	SUGAR LOAF	SNORT	K-3C	K-3B	D-3A	K-2	D-4	RW*	G-2	T8 G-1	G-1	CT-4
For <u>Surface Measurements:</u>												
Instrument shelter	X	X	-	-	-	X	-	2X	X	X	X	X
Mercury wet-and-dry bulb thermometers	-	X	-	-	-	-	-	2X	X	X	X	-
Mercurial barometer	-	-	-	-	-	-	-	-	-	X	-	-
Aneroid barometer	-	-	-	-	-	-	-	-	-	X	-	-
Hygrothermograph	X	X	-	-	-	-	-	2X	X	X	X	-
Microbarograph	X	-	-	-	-	-	-	2X	-	X	-	-
Aerovane anemometer	X	X	-	X	X	X	X	5X	2X	X	2X	X
Rain gage	-	-	-	-	-	-	-	-	-	X	-	-
Temperature recorder (Speedomax)	-	-	-	-	-	-	-	-	-	-	X	-
For <u>Aloft Measurements:</u>												
Radiosonde recorder (TMQ-5A)	-	-	-	-	-	-	-	-	-	X	-	-
Radiosonde recorder (SMQ-5)	-	-	-	-	-	-	-	-	-	X	-	-
Rawin set, GMD-1B	-	-	-	-	-	-	-	-	-	2X	-	-
Single-theodolite station	-	-	X	X	X	-	-	-	X	XX	X	X

*Randsburg Wash fuze and projectile range transmitter in approximately 100 milliseconds. The transmitters, which can be operated in 0.1-MHz increments in the frequency range of 406 to 549 MHz, have a maximum RF output power of one kilowatt, with a maximum deviation bandwidth of 350 kHz. The RF signal is frequency-modulated by any one tone, or any combination of 20 different tones, each of which corresponds to a particular function of the test vehicle.

Monitoring of transmitted signals is accomplished by inputs from a self-contained monitor/receiver to an audio-decoder, the output of which is recorded on 30-channel Brush recorders. Either a right-circularly polarized antenna, having a 45 degree beamwidth at the half-power points, or a vertically polarized omnidirectional antenna, with hemispherical coverage, is available. Both resonate at the frequency assigned to the ground ranges for this type of operation.

(7) Soil Conditions. None.

g. Special Purpose Instrumentation

(1) Ballistics Data. See Section 4.a.1 and 4.a.2.

(2) Environmental Test Chamber for Live Ordnance. Used to test and evaluate all types of live ordnance developed at NWC. Facilities include:

Vibration and Shock Test Facilities: Three complete vibration facilities, are equipped to test items weighing up to 2,000 lb in weight with dimensional limits of 10 ft. long by 2 ft. diameter. Various test fixtures permit vibration through the horizontal, the tranverse, and the vertical axes. Sinusoidal sweep, dwell, and random vibration profiles can be conducted to any specification. Air-conditioning tents and chambers are available and can be controlled from -100 to +200°F; a 30-ton refrigerator is on test site. All frequency-versus-amplitude data are recorded on electronic tape, then reproduced as X-Y plots. Facilities can impart shock pulses of 100-g level of 40 msec to ordnance up to 500 lbs. in weight and 5 ft. in the major dimension.

Drop-Test Facility: Designed to fulfill drop test requirements up to 50 feet. The impact area is reinforced concrete 15-ft. square and 2 ft. thick, with covering of steel armor plate. An overhead structure has hoisting capability of up to 2 tons. Test-unit dimensions are practically unlimited. Tests, which are remotely controlled, can be monitored by direct view periscope. Photographic instrumentation is also available.

Fast Cookoff Facility: This area, located remotely from NWC headquarters, is 200 feet in diameter and contains a square pit, 30 feet across, that is lined with polyethylene moisture-proofing. The cookoff pit has a capacity of 2,000 gal. of JP-5 aviation fuel. Blast pressure measurement equipment is available when needed. There is also photographic coverage and digital instrumentation and recording equipment for fast response.

Slow Cookoff Area: This approximately 100-acre site can handle ordnance of any size or weight combination. Remote equipment controls the temperature outputs on a fixed basis or can be sequenced to include any program desired. Underground ovens are generally used for these tests.

Temperature/Humidity Test Facilities: Requirements of hardware exposure to various temperature and humidity conditions are simulated by storage under high-and low-temperature conditions with varying degrees of humidity. The site has 8 temperature-controlled storage ovens of various sizes, the largest being 6ft. square by 20ft. long. Units of up to 4,000 lb. can be handled. Temperature of 065 to +180°F can be maintained indefinitely.

Salt Spray Chamber: This facility is a chamber 6ft. by 6ft. by 14ft. for conducting salt spray tests to determine the resistance of missile systems to salt atmosphere.

(3) Vehicle Performance. Testing of fire fighting equipment can be performed at NWC.

(4) CBR Instrumentation. None.

(5) Other

(a) Propulsion Test Facilities

1 Skytop

This facility consists of four bays for the captive testing of rockey motor propulsion systems to support the R&D effort for all systems developed at NWC and other systems as required.

Bay I: Is capable of handling a steady-state rocket thrust up to 1,000,000 pounds.

Bay II: Is equipped with two adjacent test pads. One provides horizontal and vertical test capabilities; the second consists of a low-pressure (vacuum) chamber. It provides up to 250,000 lb. thrust in horizontal attitude. It uses a low-presure chamber and rocket-exhaust diffusers to provide altitude simulation. Vaccum pumps are used to preevacuate the chamber and diffusers to the desired pressure prior to motor ignition.

Bay III: Is a remote suspect-motor test site. It uses the Mobile Van Instrumentation System (MIST) for data recording.

Bay IV: Is used to test liquid propellants and solid motors. It is equipped with two adjacent test pads. One offers a horizontal and the other a vertical attitude test capability. It accommodates thrust ranging up to 250,000 pounds.

Control Room #1: Houses IBM 1800 data acquisition and control system, and associated recording equipment.

Control Room #2: Contains a ground link providing digital data acquisition.

In addition there is available a Cine-X continuous X-ray capability which is mobile and can be used in all test bays. This capability will give continuous X-ray movies of the reaction within the motor during firing.

(b) Nondestructive Testing Facilities. Radiographic: Located at SWPL facility. It provides dock storage area and equipment for handling ordnance items weighing up to 15 tons; a separate dock is available for radiographic and attenuator studies. Radiographic equipment includes 150, 250, and 400 KVP X-ray machines, a 1.0 MEV Resetron, and a 25 MEV Betatron.

Licensed Source Material: Cobalt-60 sources are maintained to perform radiographic work on items needing extremely long exposure times. One Cobalt-60 source is maintained in a portable Uranium-238 case for field use.

(c) Special Test Facilities. Michelson Laboratory. Michelson Laboratory, with more than 10 acres of floor space, is the Center's chief research and development facility. The laboratory comprises weapon program offices, specialized laboratories for basic and applied research in chemistry, physics, optics, and aerodynamics; weapon design facilities; computer centers; a flight simulation facility; and a modern machine shop for the production of prototype weapons and weapon components. In Michelson Laboratory a weapon can be taken from the initial feasibility study through design, fabrication, and simulated environmental testing.

Solid State R&D Facility. The Solid State R&D Facility, completed in the summer of 1970, provides laboratory and work areas and spaces for research and development in lasers, radar, electomagnetic interface, detector chemistry, microelectronics, and fuzes. About 25 percent of the 30,000 square-foot building consists of Class 100 clean rooms.

Radio Frequency Measurement Facility. The Radio Frequency Measurement Facility comprises an outdoor antenna range, a microwave anechoic chamber, a VHF anechoic chamber, and an RF component test area. The VHF anechoic chamber is capable of operation from 30 through 30,000 megahertz.

Small-Charge Test Area. Consists of two test sites used in warhead blast studies. This area is equipped with optical and electronic instrumentation plus measurements instrumentation for study of shaped-charge pressures, vaporific pressures, and fragmentation velocities of small ordnance items. It is limited to 20lb. of HE.

CT-6 FAE Firing Test Range. Used for FAE (Fuel-air-explosives) drop tests, this range is equipped with a drop tower and electronic instrumentation; optical instrumentation is brought in from other areas when needed. Hotair balloons are used for carrying drop-test items.

SNORT Complex Aeroballistic Test (SCAT) Range. Three ground-to-ground flight lines are 300, 400, and 480 feet west of and parallel to the SNORT centerline, with two fixed target sites, one located 6,000 feet and other 15,500 feet downrange.

Sugar Loaf Mountain Fuze Range. Thirty miles northwest of SNORT, the range is built to simulate air-to-ground firing conditions for fuze tests in support of the Hypervelocity Aircraft Rocket, Tactical (HART), Zero Antiaircraft Potential (ZAP) rocket, and like programs. The launch area is located on the mountain peak, impact areas are located in valleys below. The range is equipped with temporary buildings, roads, and utilities to make the facility as self-sufficient as possible.

Automatic Formation Drone Control (AFDC) Facility. The primary out-of-sight dual-target control facility located on G-1 range provides control of single, dual, or formation aircraft targets, either manually or by computer, with full data-logging capability. It is instrumentated to provide all-attitude and preprogrammed flights.

Aircraft Survivability Facility (ASF). Located at the D-2 ground range. It consists of three complexes: (1) The main test site containing a 60-ft square concrete test pad with a tie-down pad and an approach ramp, a gun tower, a mobile aircraft lifting vehicle, and airflow generator, fire-fighting equipment, and an instrumentation and fire-control barricade; (2) a three acre instrumentation and maintenance compound for instrument repair, maintainance and overhaul of test aircraft and experimental fuel systems; (3) a six-acre aircraft park and storage yard, providing parking for 35 test aircraft and storage for portions of air-frames, structural parts, etc. It accommodates 100,000 lbs. full-scale captive aircraft at thrusts up to 50,000 lb (including afterburner). It is equipped with gun systems (ranging from 7.62mm to 37mm) and fragmentation simulators for use in ballistic evaluations of varying aircraft mission conditions. Photo-optical and electronic instrumentation are used for data gathering.

Aircraft Carrier Conflagration Control Test Facility. Located on K-3B range this facility provides simulation of a portion of an aircraft carrier flight deck for evaluation of deck fire-fighting techniques and agents. The present deck is steel-surfaced with a 36 x 64-foot fuel burn area. This installation provides for storing, pumping, and distributing aircraft fuels; and simulation of deck winds, using C-97 aircraft. Instrumentation includes cameras and thermocouple recording equipment. Other instrumentation can be accommodated. Expansion in progress will provide an 80 x 120-foot deck (with an 80 x 90-foot concrete burn area), which will accommodate up to six fighter-size aircraft.

T-Range. Located approximately 9 miles northeast of the China Lake housing area, this range is used for aerodynamic heating tests. A bay houses an aerodynamic heat stand capable of thrust up to 10,000 pounds and heat up to 800°F at a heat rate of 250°/minute. Magnetic tape and oscillograph recorders are used for data backup, storage, and quicklook presentations. There is also a small high pressure heated air facility for testing air breathing propulsion units.

Pyrotechnic Test Area. Located approximately 10 miles northeast of the China Lake housing area, this area is used for evaluating the light output of pyrotechnic devices. Two test sites are instrumented to record candle power and infrared radiation. At the light-tunnel complex, a photometric light tunnel (8 x 8 x 100-ft long) and a 7,000 cubic foot vacuum chamber capable of altitude simulation to 250,000 feet are used for test firing.

(d) Tenant Instrumentation: Range Measurement System (RMS-2)

1 Background. The Range Measuring System (RMS-2) owned by DDR&E is presently located at China Lake (ECHO Range) for use in the Phase I Electronic Warfare Joint Tests (EWJT). This system is a line-of-sight system and is used to determine the position of aircraft in a mock battle situation in real-time.

2 System Configuration. BMS B Unit. The B or transponder unit is carried on aircraft, is lifted with an antenna, and is used to determine the aircraft position.

RMS A Station. The A Station, or interrogator station, is a semi-mobile radio link between the B and C stations. The station consists of an RF transmitter and receiver, thermoelectric generator and power supply, omnidirectional antenna, and associated logic.

Display System. The display system provides the display player position in real-time for use for evaluation of the exercise by the test conduct personnel.

The system presently consists of seven (7) A stations covering a circular area with a radius of approximately 15 miles. Six (6) additional A stations are being added to the Northern boundary increasing coverage to 20 miles in that area. The system can determine in real-time the position of 5 to 10 high performance aircraft.

3 System Modifications. The RMS-2 system is being updated for possible use in the AF Continental Operating Range (COR). The following components are being modified or designed for the RMS Simulated Combat Operations Range Equipment (SCORE) system:

Aircraft Subsystem. Mounted on an aircraft will be a AIM-9 pod which contains an air data set, inertial reference unit, signal conditioner, and an RMS B unit. This unit will be used to determine aircraft attitude, position, velocity, and weapon status.

RMS D Station. The D Station is semi-mobile relay station which is used to extend the range between A and C stations.

Data Processing Subsystem. A Sigma 8 computer system located in a separate van will provide the computational capability for positional information to the Aircraft Subsystem.

The RMS/SCORE system is designed to operate with 30 or more aircraft (high performance) or up to 1023 low performance players. The A stations will be converted to low power battery packs with a life expectance of approximately six (6) months.

This system is under development and if further information is required, it may be obtained by contacting:

General Dynamics
Electronics Division

5. Threats/Targets

a. Fixed Radar Targets - China Lake Proper. Several renovated and modified radars and manufactured target simulators are in use as targets for missile tests on both the ground and aircraft ranges.

These radars may be used as live-fire targets in which case the radar antenna is usually separated from the electronics. Table Z-7 contains the listing of NWC target radars.

b. Fixed Targets - COSO Range. COSO Range is divided into target area A and target area B. Area B is covered with pinon pine, juniper trees, and brush-type vegetation, which presents a fire hazard when rockets or high explosive ordnance is fired at targets located in this area. Area A is more arid, with less vegetation, hence the fire hazard is less.

To preserve the natural ground cover and to avoid forest fires and excessive cratering, it is necessary to limit the type ordnance used in either area. Area A is reserved for inert practice bombs, in addition to 2.75 inch, and 20-mm ball ammunition. Area B is reserved for inert ordnance only. Other types of ordnance are considered under special situations.

These targets are listed in Table Z-8.

c. Fixed Targets - ECHO Range. Listed below are the equipment items available to provide a threat environment on the ECHO Range:

Main Range

(1) 1 ea. SA-3 Simulator

(2) 2 ea. SA-2 Simulator

(3) 1 ea. SA-1 Simulator. Range 1

(4) 1 ea. SA-2 Simulator. Range 2

(5) 1 ea. SA-3 Simulator

(6) 1 ea. ECM/Jammer. Dispersed

(7) 2 ea. AAA Simulator

(8) 1 ea. ECM/Jammer

d. Mobile Targets - China Lake Proper. There are presently 8 - QM56 remote-controlled vehicles at NWC. These targets are capable of up to 30 mph speeds, do not have a gun turret, but consist of the undercarrige only. These may be replaced by the QM41. Visual sighting is used for control.

Two Volkswagen dune buggies are equipped with an on-board television system for use in remote control. Speeds up to 60 mph are achievable.

Table Z-7

RADAR TARGETS

Radar	No. of Units	Frequency (GHz)	PRF (pps)	Pulse Width (usec)	Asimuth (deg)	Type Scan	Scan rate (Hz)	Peak Power (kw)	Antenna polari-zation	Notes
Mk12	1	0.92-0.98	480	1.0	+10	Phased	60	100	horizontal	1.2
CPS-1	1	2.7-3.1	350	1	360	none	none	240	vertical	1
CPS-4	1	2.7-3.1	var.	1	360	Nodding	none	450	vertical	1
CPS-6 (a)slant (b) Vert	 2 3	2.7-3.1	var.	2.0	 360 350	V-beam	none	400	 diagonal vertical	1
FPS-6	1	2.7-2.9	350	2.0	+10	Nodding	none	4500	vertical	
SCR584	20	2.7-3.1	var.	0.8	360	Conical	30	250	circular	
SCR584	3	4.9-5.1	var.	0.8	360	none	none	250	vertival	
MPG-2	2	8.5-9.6	var.	0.5 0.2	360	Palmer Conical	30	60	vertical	2
SCR-584	2	8.5-9.6	var.	0.25	360	Nutating	30	200	horizontal	2
545-1	6	2.7-2.9	var.	0.4 to 2.0	360	Conical or TWS	30 or 0-16	400	vertical or horizontal	2
545-2	4	4.9-5.1	var.	0.4 or 0.8	360	Conical or TWS	0-16	200	vertical or horizontal	
545-3	6	8.5-9.6	var.		360	Conical or TWS	0-16	200	vertical or horizontal	
545-4	3	---	---	---	360	none	---		horizontal	2
545-7	2	---	---	---	360	Lewis	16	---	vertical and horizontal	
RSI	2	---	---	---	360	none	---	100	horizontal	

1 Special permission required if live-fire is used
2 In storage

Table Z-8

COSO FIXED TARGETS

Target No.	Type of Target	Target No.	Type of Target
(1)	Army Tank	(13)	Jeep Convoy
(2)	Three Howitzers	(14)	Single Revetted Gun
(3)	Truck Convoy	(15)	M-4 Army Tank
(4)	Helicopter Landing Strip and Supply Dump	(16)	Radar Van
(5)	Gun Emplacement	(17)	Amphibious Vehicles
(6)	Two Tracked Vehicles	(18)	SAM Site
(7)	Bridge Target	(19)	M-37 Truck Convoy
(8)	Amphibious Vehicle	(21)	Railroad Tunnel
(9)	Radar Van	(22)	Missile Supply Dump
(10)	Radar Van	(23)	Bridge Target
(11)	Three Antiaircraft Guns	(24)	Bridge Target
(12)	Three Searchlights	(25)	Railroad Tunnel

The above targets are not destructible. A trailer behind the AM56 has been used when high explosive munitions are used, with towing speeds up to 20 mph.

6. Data Handling/Processing

a. Data Storage and Retrieval Capabilities. The NWC Computer Center's UNIVAC 1108 is located in Wing 5 of Michelson Laboratory. Various remote terminal are located throughout Michelson Laboratory, and in other laboratories at NWC, Card handling and keypunch equipment is available for general use. The computer center also has an FR-80 COM (Computer Output Microfilm) device for alphanumeric and graphic output. A CALCOMP plotter located in Room 1025 of Michelson Laboratory and under the control of Code 4064, is available for off-line plotting.

These capabilities are applied to aid in the solution of a variety of NWC scientific, engineering, and management problems. Additionally, members of the programming staff give formal courses in the major programming languages and in the executive system language as the demand requires; they also prepare handbooks and other materials for general use, and write/coordinate system software designed for NWC requirements.

b. Quick-look Capabilities

(1) Telemetry Data. Telemetry data recorded on magnetic tape are normally duplicated immediately after a test or, in the case of PDM and some FM/FM data, can be digitized directly for processing through the 1108.

Permanent type oscillograph records are normally available in one day for delivery to the customer.

(2) Radar Data. The Capri and two Nike Ajax radars can be interfaced with the Center's PDP-7 and PDP-9 computers for real-time printout of range, azimuth, elevation, velocity and time.

The M33 radars are normally used for flight safety and control by the test conductor. Real-time plots on 30 inch by 30 inch plotting boards of X, Y, and Z are available.

(3) Track Data. Track-coil data recorded on magnetic tape are digitized for computer processing which requires approximately two days.

Direct-wire data are usually recorded on oscillographic paper and magnetic tape and are processed in one day.

c. Processing

(1) System and Model. The NWC 1108 1 x 1 system terminals are shown

(2) Language. The basic languages used at NWC are Assembly, FORTRAN, and COBOL.

(3) Real-Time/Post Test. The NWC 1108 computer system is a post test processing system.

d. Distribution. The worst case turn-around time using the 1108 computer system is 6 to 7 hours.

e. Displays. The 11-8 system utilizes a graphic display system using Cathode Ray Tubes (CRTs). The various tracking radars M-33's, Capri, NIKE's, can drive 30 by 30 inch plotting boards in real-time.

f. Description of Analog Computing Capabilities. The analog computers presently available for use in the NWC Simulation Laboratory are:

o 4 Electronic Associates 231R o 1 Electronic Associates 231R	These are vacuum tube type consoles. They require manual control and range in age from 6 to 12 years.
o 1 Applied Dynamics 256	This is a solid-state console acquired by NOL Corona in 1966 and transferred to NWC China Lake in 1970. It is manually controlled.
o 1 Electronic Associates 7945 System consisting of 3 Electronic Associates 7800 analog consoles with a Model 640 controller.	This is a solid-state system initially acquired in 1970 and expanded to its present capacity during 1971 and 1972.

The tube-type equipment is obsolescent, but remains in use for studies that employ a fixed simulation which does not require top accuracy or rapidly sequenced runs.

The Applied Dynamics, Inc., (ADI) 256 is a good machine. It has sufficient assortment of self-contained logical elements to permit use for repetitive operation on problems of a size it can accomodate. The ADI 256 is used for problems that reside on the machine for several weeks. It is not capable of automatic setup and checkout.

The Electronic Associates, Inc., (EAI) Model 7945 Simulator System consists of three EAI Model 7800 analog consoles with an EAI Model 640 digital controller. The 7945 also is equipped with Automatic Function Generators (AFGs) that are controlled by the 640.

The EAI Model 7945 is the largest machine in the Simulation Laboratory. It is also the most effective by far, because of its digital control capability, which is complete except for the interconnetion of simulation elements by manual insertion of patch cards.

ANNEX Z - BIBLIOGRAPHY

Reference Documents

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2. Instrumentation Operation of System Development Department Ranges, Naval Weapons Center, NWC TP 2692, Revision 3, March 1969.

3. Aircraft Ranges, Naval Weapons Center, NWC TP 4684, February 1971, FOR OFFICIAL USE ONLY.

4. Joshua Ridge - Electro-Optical Field Laboratory, Electronics Branch, Electronics Systems Department, Naval Weapons Center, January 1973.

5. Pilot's Handbook - COSO Military Target Range, Naval Weapons Center, TN 335-1, FOR OFFICIAL USE ONLY.

6. Naval Weapons Center Test Resources, Test Resource Review Committee, 14 March 1972.

7. Range and Test Facility Briefs, Naval Weapons Center, April 1971.

8. Your Guide to the NWC Computer Center, Naval Weapons Center, 29 March 1972.

9. Climatological Summaries for 1946 through 1970, Naval Weapons Center, April 1971.

10. Optical and Electro-Optical Systems, Excerpts Naval Weapons Center.

ANNEX AA

OPERATIONAL TEST INSTRUMENTATION GUIDE

PACIFIC MISSILE TEST CENTER
Point Mugu, California

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LIST OF FIGURES

ANNEX AA

PACIFIC MISSILE TEST CENTER
Point Mugu, California

1. Introduction

a. Overview. The Pacific Missile Test Center, Point Mugu Complex, is located in Ventura County, California, at the western end of the Oxnard Plain and adjacent to the Pacific Ocean. Approximately 4,600 acres completely surround one of the last remaining salt-water marshes on the West Coast - the one-time Indian Harbor, Mugu Lagoon - and include six miles of sandy beach frontage and the summit of nearby Laguna Peak. Point Mugu is located near the population centers of the city of Oxnard, six miles to the northwest; the city of Camarillo, seven and one-half miles to the northeast; and the city of Los Angeles, 50 miles to the southeast.

Pacific Missile Test Center is a national missile range operated by the Navy. The mission of the Pacific Missile Test Center (PMTC) is to provide range support for the Department of Defense and other government agencies for launching, tracking, and collecting data in guided missiles, satellites and space vehicle research, development, evaluation, training programs, and actual operations. To carry out these varied assignments, PMTC maintains close liaison with other national ranges at all levels. In addition, PMTC also acts as Western Area Frequency Coordinator.

b. Generic Systems Tested. The Pacific Missile Test Center conducts tests and evaluation of air-to-air missiles such as Sparrow and Sidewinder; air-to surface missiles such as Walleye and Shrike; surface missiles such as Aegis and Redeye; and the integration of the new F-14A aircraft with its missile and avionic systems. Additionally, sophisticated electronic warfare systems are developed and the Navy Astronautics Group (NAG) Navigation Satellite System is operated from facillties at Point Mugu.

2. General

a. Military Units.

(1) Army Units At present no Army units are located at the Pacific Missile Test Center complex.

(2) Other Military Units. The following is a partial list of other major military units presently located at the PMTC complex.

- Navy Astronautics Group
- Air Test and Evaluation Squadron Four
- Naval Air Reserve Forces

In addition, numerous other tenant organizations are located at Point Mugu. For a description and listing of these other organizations, refer to section 2.g and reference 40.

(3) Nearby Government Installations. Point Mugu is convenient to military installations at San Diego, Los Angeles, Long Beach, Seal Beach, Port Huenme, and San Francisco. Navy bases at Miramar and Lemoore, US Marine bases at El Toro and Twentynine Palms, California, where aircraft weapon sytems are tested, are all within easy flight range with no major logistics problems, as are George, Hamilton, and Edwards Air Force Bases.

b. Maintenance Capability. Due in part to the complexity and wide variety of operations conducted by PMTC, an extensive and comprehensive maintenance system is available. This is supplied by the Naval Air Station (NAS), a component of the Pacific Missile Test Center. Capabilities appear to be sufficient for supporting any reasonable increase in activities caused by an outside user. In addition, a separate aircraft maintenance department under the Naval Air Station is available. This department, although primarily Navy oriented, could provide intermediate level aircraft maintenance capabilities for an outside user.

c. Access.

(1) Air. The Ventura County Airport is located in the city of Oxnard, approximately seven miles northwest of Point Mugu. The airport is owned and operated by the Ventura County Department of Airports and Harbors. Passenger service is provided by Golden West. Freight service is provided by Cherokee Airlines. In addition, two runways (11,000 x 200 and 5,500 x 200 feet) are available at the Point Mugu complex itself.

(2) Rail. The area is served by the main line of the Southern Pacific Railroad between Los Angeles and San Francisco. Switchyards are located in Oxnard. The Ventura County Railway provides connecting service between the Port of Hueneme and the Southern Pacific main line. No rail service to the Point Mugu complex is provided.

(3) Road. The Point Mugu area is currently served by two freeways. US Route 101, the Ventura Freeway, is located six miles north of the Pacific Missile Test Center, Point Mugu Complex. It is a major north-south highway in the state system, although it is aligned in an east-west direction in this area. US Route 101 is completed to full freeway standards between Oxnard and Los Angeles. Driving time from Point Mugu to downtown Los Angeles is approximately one hour.

State Route 1, the Pacific Coast Highway, forms the north-east boundary of the Point Mugu Complex. It is a four-lane freeway from Calleguas Creek to Channel Islands Boulevard, then it is aligned along Oxnard Boulevard through central Oxnard and northward to El Rio where it joins US Route 101. South of Callegas Creek the Coast Highway is not improved to freeway standards. Interchanges at Wood Road and Las Posas Road provide access to Point Mugu.

(4) Sea. The Port of Hueneme is the only major deep water commercial harbor between Los Angeles and San Francisco. it is jointly used by the Oxnard Harbor District and the Navy Construction Battalion Center. Today, the harbor is primarily engaged in the movement of bulk cargoes. Materials to support offshore oil activity have begun to move through the Port to production sites in the Santa Barbara Channel.

At present the harbor has two deep water berths. Plans are being developed for harbor expansion and improvement within the next two to three years. funds have been appropriated for this program. The Port will ultimately accommodate berthing for five large ocean-going, deep-draft vessels as well as sport fishing facilities.

d. Logistic Support Capability. Besides the usual logistical support capabilities that would normally be associated with a large military facility, which in this case is supplies by NAS, PMTC can provide both launch and recovery capabilities for various missile systems. In addition, PMTC also maintains both ship and aircraft to support missile and space programs that require instrumentation support over a greater area within a given time than is possible with standard surface-based equipment. PMTC appears to be the largest, best instrumented, and most fully equipped missile range available and, as such, is capable of providing almost any type of logistical support necessary.

e. Recurring Commitments. The Naval Air Reserve Forces, a tenant organization at Point Mugu, is made up of approximately 400 fulltime active duty reservists and 1,300 part-time inactive duty reservists. The various individual reserve units utilize the facilities at Point Mugu throughout the year in the course of their training. Since these activities are planned in advance, range scheduling should prevent any problems.

f. Special Operating Restrictions. Because of the nature of work done at the Point Mugu complex, the area immediately around Point Mugu is restricted. Reference 38 depicts restricted airspace, ocean surface, and submerged zones.

g. Facility Organization Charts. Reference 41 shows the Pacific Missile Test Center command organizational structure.

h. Environment. Point Mugu is subject to the typical southern California costal weather; i.e., cool summers and mild winters with a relatively small range in the mean monthly temperatures during the year.

The most characteristic feature of the Point Mugu climate is the night and morning low cloudiness and sunny afternoons which prevail during the spring and summer months and occur often during the year. This cloudiness can severely degrade visibility on the coast. Combined with the westerly sea breeze, this coastal low cloudiness assists in keeping temperatures mild throughout the year. The daily temperature range, near 12 to 15 degrees in the spring and summer increases to 17 to 19 degrees in the fall and winter. The mean monthly temperature ranges from 53 degrees in January to 64 degrees in August.

i. Topography. The average elevation of Point Mugu is 12 feet above Mean Sea Level (MSL). The terrain rises gradually north and northwest to the foothills of the Topa Topa mountains. Two miles to the east lie the principal terrain features of the area: Laugna Peak (1,457 feet) and La Jolla Peak (1,567 feet). The hills on the eastern side of these two peaks merge into the Santa Monica mountains which are generally 2,000 to 3,000 feet in altitude. Other inland mountain ranges within 40 miles of Point Mugu attain heights of over 8,000 feet.

j. <u>Airspace Restrictions</u>. The following airspaces in the vicinity of the Point Mugu complex are restricted.

NO	NAME	ALTITUDE	TIME	APPROPRIATE AUTHORITY
R-2526	Navy BOMARC Launch Point Auguello, Facility, CA	Unlimited	Continuous	Comdr., SAMTEC Vandenburg AFB, CA
R-2517	Navy BOMARC Launch Point Auguello, Facility, CA	Unlimited	Continuous	Comdr., SAMTEC Vandenburg AFB, CA
R-2519	Point Mugu, CA +FAA, Los Angeles ARTC Center or ares FSS.		Unlimited	Continuous Comdr., Pacific Missile Test Center Point Mugu, CA
W-289	Point Mugu, CA +FAA, Los Angeles ARTC		Unlimited Contact Plead control on 280.7 MHZ 126.2 MHZ 5080 KHZ or Los Angeles Center/FSS	Intermittent Center or ares FSS. Comdr., Pacific Missile Test Center Point Mugu, CA
W-289N	Point Mugu, CA +FAA, Los Angeles ARTC		To F_L 240 Contact Plead Control on 280.7 MHZ 126.2 MHZ 5080 KHZ or Los Angeles Center/FSS	Intermittent Center or ares FSS. Comdr., Pacific Missile Test Center Point Mugu, CA
W-290	San Diego, CA	TO F_L 800	Intermittent Beaver on 264.0 326.5 126.65 or Los Angeles Center FSS.	Fleet Air Control and Surveillance Facility San Diego, CA
W291	San Diego, CA	TO F_L 800	Intermittent Contact Beaver on 264.0 326.5 126.65 or Los Angeles Center FSS.	Fleet Air Control
W-537	Santa Barbara, FAA, Los Angeles ARTC CA		Unlimited Contact Plead Control on 280.7 MHZ 126.2 MHZ 5080 KHZ or Los Angeles Center/FSS.	Intermittent Center or area FSS.

NO	NAME	ALTITUDE	TIME	APPROPRIATE AUTHORITY
WQ-532	Navy BOMARC CA	Unlimited	Intermittent Contact Plead Control on 280.7 MHZ 126.2 MHZ 5080 KHZ or Los Angeles Center/FSS.	Comdr., Pacific Missile Test Center Point Mugu, CA

+Controlling Agency

k. Power Availability. Electrical power for the Point Mugu complex is purchased from Southern California Edison Company at 16.5 kV. The electrical distribution system is served by three Edison feeders to the switching station at Gate 2. A Navy-owned system extends to the main distribution center, and then to eight substations for further distribution and transformation to utilization voltages. The AN-FPS/16 Radar Site is served by an additional Edison Feeder, at 16.5 kV, along Arnold Road to a jointly-owned substation.

In addition, portable electrical power is available from the Naval Supply System. These wheel-and-skid-mounted vans contain control and engine-alternator units to supply 120/208-volt, 3-phase power over a 4-wire distribution system.

l. Communications. Local telephone service for the Point Mugu complex is purchased from the General Telephone Compan;y. The Administrative Communication Center Office has a 2,000 line capability with approximately 1,600 lines and 5,400 extensions in service. These totals include service for tenant activities and contractors who are required to erimburse the Navy for services rendered.

In addition to telephone service, various communication facilities are available not only at Point Mugu, but also at the offshore channel islands, and in the Pacific. For a description of these locations, refer to section 3.

m. Launch Facilities. Various launch facilities are available not only at Point Mugu, but also at the offshore channel islands, and in the Pacific. For a description of these locations, refer to section 3.

3. Dimensions

a. Landspace. The Pacific Missile Test Center is composed of facilities located along the California coast, on the offshore channel islands, and in the Pacific. The ocean area off Point Mugu itself and around the offshore channel islands constitute the Sea Test Range, which is monitored by equipment at Point Mugu and on San Nicolas and Santa Cruz Islands. The facilities in the Pacific are referred to as the Downrange Facilities.

The Pacific Missile Test Center, Point Mugu Complex consists of a total of 4,595.24 acres--4,531.08 acres in fee title land; 1,281 acres in easements and 51.35 acres under lease. Of the total base acreage, 298.98 acres is restricted by leases, easements, and other public rights held by outside organizations. Part of the total acreage, 38.92 acres in fee title land and 0.22 acres in easements, is located on nearby Laguna Peak. The Complex is approximately three miles long in a north-south direction and an average of two and on-half miles wide in an east-west direction. Near Camarillo, the Department of the Navy leases an additional 51.35 acres from the Air Force. This land is presently used for 315 units of Capehart 3 housing, which are shared by Navy personnel from Point Mugu and the Naval Construction Battalion Center in nearby Port Hueneme.

(1) Test Area Contiguity. The location of the Downrange Facilities is described below in section 3.a.93)(b).

(2) Easements. Although the Point Mugu Complex contains 1,281 acres as easements, this is in the support area and does not directly affect any range usage.

(3) Test Areas

(a) Sea Test Range. The area around the channel islands (shown in Figure AA-4) and off of Point Mugu itself is referred to as the Sea Test Range. Within this range selected ocean sections may be utilized for both impact and live firing upon coordination with the PMTC Range Safety Office. In addition, a land impact area is available on San Nicolas Island.

San Nicolas Island comprises an area of 14,000 acres and lies within the Sea Test Range, about 60 miles to sea from Point Mugu. The island is a site for precision instrumentation used in operations within the Sea Test Range and in launchings of polar-orbit vehicles from SAMTEC (see Appendix U). The 10,000-foot runway on this island provides a capability for the retrieval of drones and the launch of small missiles and high altitude probes. Logistics flights are made to San Nicolas Island daily from Point Mugu. Santa Cruz is used as a relay link in the San Nicolas Island/SAMTEC/Point Mugu Instrumentation Data Transmission Systems (IDTS).

(b) PMTC Downrange Facilities. The downrange facilities in the mid-Pacific Ocean are located on the Hawaiian Islands and Midway Atoll. The Commander, Pacific Missile Range Facility, Hawaiian Area (CDR PMRF HAWAREA) is responsible for operation and maintenance of all PMTC downrange facilities.

1 KAUAI. Headquarters of PMRF HAWAREA is located at Barking Sands, Kauai, Hawaii. The facilities at Barking Sands include instrumentation and base support systems, which are used in support of ICBM and space missions; probe launches; air, surface, and underwater launches; and Fleet exercises.

The Barking Sands Tactical Underwater Range (BARSTUR) provides the basic underwater tracking capability. This BARSTUR, which became operational in August 1967, was developed primarily to support Fleet Anti-submarine Warfare (ASW) operations. The Underwater Range was located

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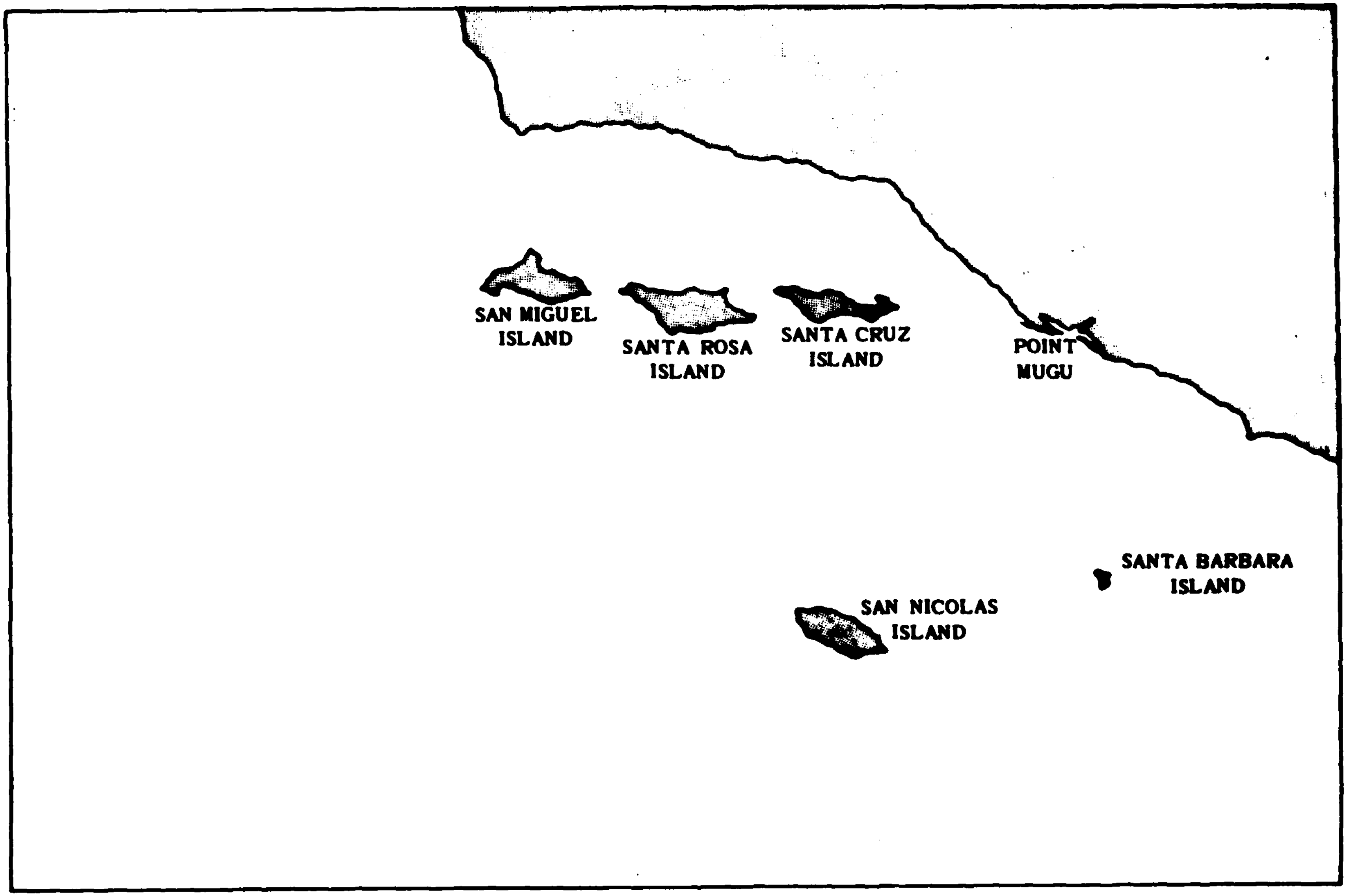
at Barking Sands to take advantage of the existing instrumentation, airfield, and other base support facilities. Operational and technical personnel were already available. All facilities, whether they were specifically installed to meet Underwater Range requirements or whether they were already available as part of the National Range resources, are used interchangeably.

The Range is located in the Hawaiian Island chain about 130 nautical miles northwest of Pearl Harbor, between the islands of Kauai and Niihau. Range shore facilities are located on Kauai at Barking Sands, Makaha Ridge, and Port Allen.

FIGURE AA-1: Offshore Islands



Surface and airspace areas are controlled and scheduled by PMRF HAWAREA. The instrumented surface of the Underwater Range extends 40 nm on an azimuth of about 205 degrees true to 030 degrees true from the 1,500-foot-high Makaha Ridge, 7 nm northeast of Barking Sands. Above-surface tracking is limited only by radar capabilities. The instrumented underwater portion of the Range measures 5 by 10 nm and is approximately 7.5 nm west of Makaha Ridge at its closest point. The underwater components (hydrophones) are connected by cables to equipment at Barking Sands for processing, recording, and display of data.

The newest addition to these facilities is the Barking Sands Underwater Range Expansion (BSURE) which provides for a 1,000 square mile enlargement of the existing underwater range. The BSURE configuration consists of two instrumented cable strings containing a series of hydrophones which are float-mounted on a 25-foot tether cable above an electronics housing called the Terminal and Transmission Unit (TATU). The cable strings are approximately 60-65 miles long and spaced about seven and one-half miles apart with the hydrophones located about every two and three-quarter miles in the range area. Tracking data from pinger-equipped targets is received by the hydrophones, amplified and multiplexed on the SD cable in the TATU, and transmitted to shore-based signal conditioning and processing equipment for display and control of target position.

2 Oahu Although most PMTC downrange facilities are located on Kauai, there is an additional area on Oahu, at Mauna Kapu.

A permanent frequency monitoring building of 1,000 square feet near the top of Mauna Kapu Mountain and a 20-foot chase van are part of the frequency management system of PMTC.

The CDR PMRF HAWAREA, as DOD Frequency Coordinator for the downrange (mid-Pacific) area, is responsible for coordination of all RDT&E radio frequency assignments and usage in the downrange area in addition to management and control of radio frequencies used by PMTC in this area.

3 Midway Atoll. PMTC has a MILS shore installation at Midway Atoll.

The MILS in the Pacific Ocean are systems of underwater hydrophones that record various hydracoustic phenomena such as impact points of missiles and data capsules falling within the listening range. Generally, a SOFAR signal is required as a sound source. This signal, detonated at a specific depth in the ocean, travels best in a sound channel at depths between 1,500 and 3,000 feet. The time of receipt of the signal by multiple hydrophones is used along with the velocity of the sound propagation to determine the origin of the signal.

In addition to locating PMTC missile impact points, the MILS is used to locate SOFAR signals in the Broad Ocean Area (BOA) of the Pacific for sea-air rescue and is involved in many experiments, analyses, an data-processing programs pertaining to oceanography, ship tracking and positioning, underwater phenomena, tsunami research, and classified military projects.

Midway MILS is on Sand Island of the Midway Atoll in the North Pacific Ocean about 1,150 nm northwest of Honolulu, Hawaii. The MILS building contains the ground facilities for the ten hydrophones that terminate there. The communications center, also in the MILS building, includes teletype, radio, and telephone facilities. Midway MILS provides primary support for the Miniature Impact SOFAR System (MISS) area operation. Four suspended hydrophone sites (eight hydrophones) installed north of the Midway Islands are geographically positioned to locate missile impacts at the Nominal Impact Point (NIP) in MISS operations. Midway has very accurate impact-locating capability. Its MILS has a total of five hydrophone sites (10 hydrophones), including the four used for MISS operations. All 10 hydrophones are available for support of BOA projects. Coverage in the BOA is limited only by blockage of a 30-degree sector to the southeast by the Hawaiian archipelago, and partial blockage in the west and southwest created by sea mounts in the local Midway area.

There is a 10,000-foot runway on Sand Island, and Midway is serviced for air transportation and mail by the Military Airlift Command.

b. Airspace. Refer to sections 2.j. and 3.a.(3).

4. Instrumentation

a. Space Positioning and Velocity Vector

(1) Ground Elements. None.

(2) Airborne Elements

(a) Radar. Table AA-1 describes the type and location of the various radar tracking systems employed by PMTC. In addition, and Extended Area Tracking System (EATS) is available. EATS would extend the tracking beyond the normal line of sight capability and "relay track" multiple targets simultaneously.

(b) Laser. None.

(c) Optical. Table AA-2 describes the type and location of the various optical tracking systems employed by PMTC.

(d) Relative (Miss-Distance). Camera pod and AN/DRQ-3A scoring systems are available for use with some targets. Film data reduction service is available at the PMTC. The gathering and reduction of data may be performed by either PMTC or by the range user with the AN/DRQ-3A Miss-Distance Indicator (MDI), a device used to indicate the closest approach of a missile to its target. Two pieces of ground-station equipment required to perform this function for the MDI are installed on SNI. This equipment provides a capability of simultaneously recording closest approach of a missile to two targets that are flying in formation.

The Photon Miss-Distance Indicator (PMDI) is also available for use with some targets. Data can be transmitted over the normal target telemetry system and received at any telemetry station. Computer reduction

Table AA-1
PMTC SPACETIME POSITION IN AIR (RADAR)

Spacetime Position in Air	Point Mugu	San Nicolas	Makaha Ridge, Kauai, Hawaii	Barking Sands Kauai, Hawaii	USNS Wheeling T-AGM-8
Electronic Tracking Radars					
AN/FPS-16, (2,000 NM Range)	1				
AN/FPS-16, (4,000 NM Range)	2				
AN/FPS-16, (8,000 NM Range)		1			
AN/FPS-16, (32,000 NM Range)					1
AN/FPS-16, (2,000 NM Range) (Pulse Doppler)	1	1			
AN/MPS-25, (2,000 NM Range)	1				1
AN/MPS-25, (32,000 NM Range)				1	
AN/MPS-25, (42,000 NM Range)			1		
AN/FPQ-10, (4,000 NM Range)	2	1	2		
AN/FPQ-12, (Track-While-Scan & IFF)			1		
M-33				1	

Table AA-2
PMTC SPACETIME POSITION IN AIR (OPTICAL)

Spacetime Position in Air	Point Mugu	San Nicolas	Santa Cruz	Port Hueneme
OPTICAL TRACKING				
ASKANIA CINE THEODOLITE	4	6	1	1
MOBILE OPTICAL TRACK UNIT	1	2		
1 SOTU, LAGUNA	1			
CZR-1	8			
BOWEN RC-2		5		

is available at PMTC. Alternatively, manual reduction is quite accurate and relatively simple.

Scoring is discussed further in Section 5.a.(4).

(3) Ocean Elements. Table AA-3 describes the type and location of the various ocean systems employed by PMTC.

b. Timing. The available formats include IRIG, A, B, C, D, and E. The available pulse rates are theodolite and radar burst.

c. Television. Table AA-4 summarizes the television capabilities of the Pacific Missile Test Center.

d. Photography. Table AA-4 lists the photographic capabilities of the Pacific Missile Test Center.

e. Instrumentation Calibration Capabilities. The Pacific Missile Test Center Standards Laboratory, located at Point Mugu, maintains measurements capabilities with activities based on standards calibrated by or directly traceable to NBS. In conjunction with this activity, PMTC is able through its Design and Fabrication Department to not only maintain and repair, but also to calibrate almost all equipment in use by PMTC. This includes not only the standard instrumentation, but also the numerous prototype equipment developed.

f. Other General Instrumentation

(1) Telemetry. Table AA-5 displays the telemetry capabilities of PMTC.

(2) Meteorological. Equipment is available at PMTC for meteorological studies.

(3) Survey. PMTC has a survey team at Point Mugu capable of higher order survey. This team provides all necessary survey capabilities.

(4) RFI/EM Capability. PMTC has the responsibility of Western Area Frequency Coordinator. To carry out the responsibility, and to insure clear channels for telemetry, tracking, and communications information, Range Operations has several facilities. Table AA-6 lists the locations and types of facilities.

(5) Visibility. The Pacific Missile Test Center Standards Laboratory maintains facilities for light level measurements.

(6) Sound Measurement and Analysis. The Pacific Missile Test Center Standards Laboratory maintains facilities for both sound measurement and analysis.

(7) Safety and Security. Table AA-7 depicts the locations and types of surveillance radars used by PMTC. It is also noted that the EC-121K aircraft can be used for surface search by use of the AN/APS-20 radar system.

Table AA-3

PMTC SPACETIME POSITION IN WATER

SPACETIME POSITION IN WATER	BARKING SANDS KAUAI HAWAII	MIDWAY ISLAND
UNDERWATER TRACKING HYDROPHONES	37	
(MILS INSTRUMENTATION) MISS (HYDROPHONE PAIRS)		4*
SPLASH DETECTION SYSTEM		
BOA CAPABILITY LOCATIONS (NO. OF HYDROPHONE PAIRS		5
TOTAL NO. OF HYDROPHONES	37	9

*INCLUDED IN BOA CAPABILITY COUNT

Table AA-4

PMTC PHOTO/GRAPHICS SERVICES

Photo/graphics services	Point Mugu	San Nicolas	Barking Sands Kauai	Off-station Deployment	Shipboard Deployment
Photographic capability					
Still Photo Services	X	X	X	X	X
Aerial Photo					
Fixed Wing Photo Chase	X			X	
Rotary Wing Photo Chase	X	X			
Vertical Mapping and Obliques	X			X	
Camera Pods 16/35/70 NM	X			X	
TV Pods (w transmitter)	X			X	
Underwater Photo Services					
Still (B&W and color)	X			X	
Motion Picture (B&W and color)	X			X	
TV (B&W)	X			X	
Surface Launch and Impact Surveillance					
Fixed Pad Cameras	X	X	X	X	
Tracking Mounts	X	X	X	X	X
Cline Sextant (200 F.L.)	4	2		X	X
IFLOT (Up to 150 F.L.)	2	1		X	X
M-45 (Up to 96 F.L.)	1			X	X
Instrumentation Video	X			X	
Static Test Photo Inst	X			X	
Tech Film Production	X			X	X
Documentary Film Production (16mm Color)	X	X	X	X	X
Television Production	X			X	X
Laboratory Services					
Still	X	Limited	Limited		
Motion Picture Processing (Color 16/35/70 mm)	X				
Motion Picture Processing (B&W 16/35/70 mm)	X		Limited 35/70		
Motion Picture Printing 16/35/70 mm	X				
Kinescope Recording (Tape to 16 mm Film)	X				
Optical Printing 16/35/70 mm	X				
Film Library	X				

Table AA-4 (CONTINUED)

PMTC PHOTO/GRAPHICS SERVICES

Photo/graphics services	Point Mugu	San Nicolas	Barking Sands Kauai	Off-station Deployment	Shipboard Deployment
Technical Publication Services					
Technical Report Preparation	X				
Library (Scientific and Technical	X				
Presentation Services					
Visual Aids. Briefing					
Materials	X				
Exhibits Interior Design and Displays	X				

* Cine sextants accommodate multiple camera lens or other sensor payloads to 1000 poinds. Camera frame rates to 400 FPA available.

x=have capability

Table AA-5

PMTC TELEMETRY

Telemetry	Point Mugu	San Nicolas	Mahaha Ridge Kauai Hawaii	Barking Sands Kauai Hawaii	Kokee Park Kauai Hawaii	USNS Wheeling T-AGM-8	EC-121K Air Craft No. 309	EC-121K Air Craft No. 311	EC-121K Air Craft No. 890
Telemetry Support Fixed									
Antennas									
Low Gain (UHF/VHF)	5	2	2			1(A)	1	1	1
Med Gain (UHF/VHF)	4	3	3			1			
Receive/Record System	4	4	4			2	1	1	1
Separation/Display Sys	6	3	2			2			
Data Retransmission Sys									
Transmit/Receive						1			
Receive Only	4	1	1	1					
MISS Distance Indicator VHF		2							
MISS Distance Measurement UHF	1	1	2						
Video Doppler Data Analysis	1	1	1	1					
Quality Assurance	2								
Telemetry Support (Transportable									
Antennas									
Low Gain (UHF/VHF)	3	1							
Receive/Record System	2		1						
General Purpose System	2	1			1				
MISS Distance Indicator VHF	1		1						

(A) No VHF Capability

Table AA-6

PMTC RANGE COORDINATION

Range Coordination (Frequency Management)	Point Mugu	San Nicolas	Makaha Ridge Kauai Hawaii	Barking Sands Kauai Hawaii	Mauna Kapu Oahu Hawaii	Laurel Mountain Calif.
Interference Control Center	X			X		
Fixed Facility	X	X			X	
40 Ft. Van Semi Fixed Facility	X					X
28-Ft. Van, Mobile Facility	X			X		
20-Ft. Mobile Chase Van	X				X	

x=have capability

Table AA-7

PMTC SURVEILLANCE RADARS

Surveillance Radars	Point Mugu	San Nicolas	Santa Cruz	Barking Sands Kauai Hawaii
ARSR-1 Air Search (also IFF)		1		
AN/SPS-8A Height Finder	1			
AN/SPS-10 (also IFF)	1			1
AN/APS-20 Surface Search	1	1	1	
ASR-7 Air Search (also IFF)	1			
AN/FPS-114	1	1	1	

(8) Soil Conditions. Soil condition measurements are carried out by the Public Works Department.

(9) Geodesy. Table AA-8 lists the geodesy facilities and locations at PMTC.

(10) Oceanography. Table AA-9 lists the oceanography facilities and locations at PMTC.

g. Special Purpose Instrumentation.

(1) Ballistic Data. None.

(2) Environmental Chambers. The Environmental Branch at Point Mugu maintains a variety of environmental chambers.

(3) Vehicle Performance. Many standard pieces of equipment are available for measuring vehicle performance. In addition, the Engineering Division designs and develops one-of-a-kind hardware items required by PMTC for use in aeronautics, mechanical, and electrical projects.

(4) Chemical/Biological/Radiological Instrumentation. This area is outside the normal capabilities of PMTC. However, again with the aid of the Engineering Division, special purpose instrumentation for this application could be obtained.

(5) Physical Testing Capabilities. In addition to its environmental chambers, the Environmental Branch at Point Mugu also maintains several large physical test facilities.

(6) Shipborne Instrumentation. PMTC has several surface craft for range support. Table AA-10 lists the major capabilities of these surface craft. Although a few of the items listed in this table have been described under previous sections, the table serves to show the overall shipborne instrumentation available.

(7) Airborne Instrumentation. In addition to the instrumentation previously described, PMTC also has seperate aircraft instrumentation capabilities.

5. Threats/Targets

a. Real. The Threat Simulation Department provides standard and specially configured operational aerial and surface targets. The targets are used for surface-to-air, air-to-air, and air-to-surface weapons. They can also be used for radar calibration and for checkout of various weapon subsystems such as radar and IR-seeking components. Chaff, jammers, and decorp radar reflectors are available for use with some types of targets.

(1) Surface. Surface targets are divided into four types: (1) moving sea targets, such as AVR target boats; (2) fixed sea targets, such as target barges; (3) radar-emission targets, such as the SCR-584; and (4) fixed surface targets, such as bridges.

Table AA-8

PMTC GEODESY

Geodesy	Point Mugu	San Nicolas	Barking Sands Kauai Hawaii
Wild T-2 Theodolite	1	1	1
Wild T-3 Theodolite	2	1	1
Wild T-4 Theodolite	1		
Wild N-3 Level			1
Gravity Meter	1		
Geodimeter	1		

Table AA-9

PMTC OCEANOGRAPHY

Oceanography	Point Mugu	San Nicolas	Barking Sands Kauai Hawaii	Ship A/C
Datawell Oceanwave Profile Recorder System	1	1		
Sea Water Sample Analysis	X			
Bathy Thermograph (XBT)	X		2	X
Current Meter	X			
Bottom Core Grab Sampler	X			
Salinity Temp Depth Recorder	X		X	
Wave Recorder	1	1		
Sea Water Temperature	1		X	
Sound Velocimeter	X			
Fathometer	X			

Table AA-10

PMTC SURFACE CRAFT INSTRUMENTATION

USNS WHELLING (AREA CODE 87) T AGM-8 EQUIPPED WITH:	CAPABILITY
Ship Navigation Equipment	
Master GYRO: MK 14, MOD 1A	X
Radar: CRP-CX-1402	X
Direction Finder: AR8714A	X
Ship Position & Attitude Measurement System	
SINS: MK3, MOD 4	X
GYRO COMPASS: MK 19, MOD 5	X
Dead Reckoning: Analyzer	X
Radio Navigation Systems	
AN/SRN-9, LORAN "A", LORAN "C"	X
Other: EM LOG, SQNAR	X
Tracking Radar Systems	
Tracking Systems: AN/FPS-16 (32D NM Range)	X
AN/MPS-25 (2K NM Range)	X
Acquisition Aid: MK 51, Telemetry Antenna Systems, Computer	X
Display System: VIA Computer (See Control Processing Below)	
Other: DORCS, (Digitized Optical Radar Collimation System)	X
Telemetry System	
Antennas	
Low Gain (UHF)	X
Medium Gain (UHF/VHF)	X
Receive/Record Systems	X
Separation/Display Systems	X
Data Retransmission System	X
Central Data Processing System	
Computer: CP 855(v)UYK/(UNIVAC Model 1230)-2 each	X
Display: 5-Post, Plot Boards	X
Height Versus Time Record	X
Time Event & Pickle Gen	X
Data Transmission Equipment: Collins TE-216D Modem	X
Other: RAW & Corrected Data	X
Recorders, Buffers	X
Timing System	
Available Formats: IRIG A,B,C,D, & E	X
Available Pulse Rates: Theodolite & Radar Bursts	X
Elapse Time and Lift-Off System	
Communications System	
Ship to Shore-HF: 12 Recvrs, 5-10 KW Trans SSB	X
Ship to A/C, ETC-VHF: 1 Trans & Receiver, 2 Trans	X
Ship to A/C, ETC-UHF: 2 Trans/Recvrs, 2 Recvrs	X

Table AA-10 (CONTINUED)

PMTC SURFACE CRAFT INSTRUMENTATION

USNS WHELLING (AREA CODE 87) T AGM-8 EQUIPPED WITH:	CAPABILITY
Ionosperic Sounder Receiver	X
Crypto	X
Internal Communications: 2-wire Comm Batt. Telephone	X
Intercomm & PA (IMC)	X
Dial Telephone	X
Teletype: 6-TTY-60 & 100 WPM AN?FGC-60V	X
Command Control System	
Transmitter Type: Dual 75 Watt Trans Exciter	X
AN/URW-14A & Dual 10 KW PA	X
Antenna: 8-Ft Parabolic	X
Meteorological System	
AN/SMQ-(1) Radiosonde Receptors	X
Facsimile Recorder, Alden Model 519	X
TT-128/UG Teletype Printer	X
Buships Type "B" Wind sys	X
Bathytheromograph (SXBT)	X
Other Capabilities	
Beacons	X
Operations Control Center	X
Range Safety Function	X

X=have capability

(2) Airborne. Aerial targets are grouped into three types: (1) target aircraft, such as the QF-9J Cougar; (2) missile targes, such as the BQM-34A FIREBEE; and (3) miscellaneous aerial targets, such as ballons. Targets are currently undergoing T&E or are in an engineering development stage and may eventually be added to the inventory.

(3) Control. Command control of targets is accomplished by the use of a UHF radio command-control link. There are fixed ground-control stations at Point Mugu and San Nicolas Island (SNI). Airborne control stations are available in DF-8F, DP-2E, DT-28B, DT-33C, and NTF-9J aircraft. Self-propelled and towed mobile ground stations are also available for command-control purposes.

Targets can be controlled either in-sight or out-of-sight. for in-sight control, the mobile control stations are generally used. For out-of-sight control, the fixed stations that display the target-position data on automatic plotting boards are used.

(4) Scoring. Scoring systems are generally of two types: firing-error indicator (FEI) and miss distance indicator (MDI). The FEI's provide a vector missdistance while the MDI's provide a scalar miss distance. Both scoring systems are generally either radioactive, static charge, magnetic, acoustic, photographic, or electronic.

(a) Firing Error Indicator. Static-charge, magnetic, and acoustic FEI and MDI systems are limited in range and accuracy. The Navy has adopted photographic pods for the FEI system. The Navy had adopted MDI systems, termed cooperative and noncooperative. A cooperative scoring system is one in which the scoring components are contained in both the missile and the target. A noncooperative scoring system is one in which the scoring components are contained in either the missile or the target, but not in both.

The Air Force is currently evaluating a target-contained nncooperative scorer that to date appears quite successful. Although interested in the outcome of the Air Force's evaluation, the Navy is itself continuously involved in testing and evaluating cooperative and noncooperative scoring devices.

(b) Photon Miss Distance Indicator (PMDI). The Photon Miss Distance Indicator (PMDI) system has been used with the BQM-34 jet-powered missile target, the supersonic AQM-37 missile target, and the QF-9 target drone.

The PMDI system consists of a redioactive source attached to stationary wings of a missile; one or more nuclear detectors installed on a target to detect radiation from the "tagged" missile; and a data-analysis system for relating the detected radiation to distance separation. The system operation is independent of altitude, clutter, electromagnetic interference, chaff, and closing velocity (to at least 5,000 ft/sec). Multiple systems can be operated simultaneously and no virtual, false, or reflected detections are possible. For use outside PMTC, prior approval from the ERDA and appropriate outside activity must be obtained.

b. Simulation

(1) Tactical Environment Simulation (TES). The TES (Tactical Environment Simulation) is a complete laboratory facility operated by the Electronic Warfare Division of the Systems Evaluation Directorate. TES can provide support in the following developmental and evaluation areas:

- Evaluating threat or friendly weapon system susceptibility to ECM.
- Defining recommended countermeasures.
- Evaluating new EW equipments.
- Determining relative effectiveness of EW equipments and techniques with changes in the electronic environment.
- Determining system effectiveness degradation due to interference and blanking from onboard and offboard equipments.
- Defining aircraft installations of EW equipments.
- Supporting flight tests of EW equipments.

The TES consists of three distinct simulators: the Radar Simulator, the Multiple Environment Simulator, and the Jamming Technique Simulator. Although distinct, any combination of the three simulators can be used simultaneously. The design philosophy incorporated in building the TES reflects the desire to utilize standard laboratory equipment in a flexible arrangement to achieve a simulation that can easily vary its critical parameters.

(a) Radar Simulator. The Radar Simulator is a closed-loop system capable of simulating all conical scan and track-while-scan pulse-type radars. The radar simulator consists of a transmitter/modulator, receiver, range and angle processor, and manual operator controls and displays. A reasistic moving target is synthesized to require the simulated radar to track in range and angle and to compensate for changes in target signal strength. Associated with the Radar Simulator is a "missile filter" which operates on the radar's tracking error to provide an estimate of missile miss distance. There is also a real-time data reduction capability to provide a statistical analysis of the radar tracking errors and missile errors.

(b) Multiple Environment Simulator (MES). The MES is an open-loop system, operating in the 1 GHz to 18 GHz range, which can synthesize 8 to 12 radars by producing the selected radar's frequency, pulse width, PRF, and antenna modulation characteristics, as well as those factors contained in the one-way radar range equation. Also, the time or event oriented characteristics expected in a tactical scenario are synthesized. MES characteristics are shown in Table AA-11.

(c) Jamming Technique Simulator (JTS). The JTS includes RF equipment similar to that of the Multiple Environment Simulator and an assorted selection of special purpose modulation generation equipment.

Pulse repeater techniques such as swept harmonic, false targets, and inverse gain, as well as AM and FM noice modulated CW jamming techniques can be generates. JTS characteristics are shown in Table AA-12.

(d) Data Outputs. The principal data outputs of the TES include, but are not limited to:

- The monitoring of ECM output at a particular frequency for comparison between one-on-one and multiple and/or interference environments.

- Measurement and statistical analysis of radar tracking error.

- Monitoring of technique appearance on tracking displays and appearance of threat identity indicators and radar warning scopes.

- Weapon miss distance data based on simplified weapon simulations.

The component simulators which make up the TES can be used collectively or individually. Different simulators can be used to conduct several distinct tests simultaneously or the simulators can be combined as required for specific test.

The TES is considered to be an engineering tool to answer EW questions in an unacomplicated manner and can be modified to accommodate many varied applications in a short time-frame. Table AA-13 presents a summary of TES capabilities.

(2) Simulation Laboratory

(a) General. Simulations at the Pacific Missile Test Center Laboratories range from purely digital model solution on batch processing computers and commercial time-sharing terminals to real-time models incorporating complex combinations of man, special-purpose signal generating equipment, hybrid computers, and production, prototype, or mockup hardware.

The weapons integration systems simulation laboratory is a large general-purpose analog-digital facility that provides real-time, quick-response, analog and hybrid computational services. The laboratory is specifically designed for general-purpose simulation to meet a variety of simulation requirements with special emphasis on problems involving flight dynamics, systems hardware, and human operators.

Closed-loop simulations utilize nonlinear mathematical representations of missile aerodynamics, missile seeker, autopilot and control systems, and target kinematics. These mathematical models are verified by comparison with flight-test data, wind tunnel data, and laboratory component tests. The resulting simulations are also verified by comparison with flight test data.

Missile flight simulation investigations play a vital role in providing an adequate Navy Technical Evaluation with the limited number of missiles scheduled for firing. Such simulations usually include the

Table AA-11

MULTIPLE ENVIRONMENT SIMULATOR CHARACTERISTICS

PARAMETER	CHARACTERISTIC
Radio Frequency (Maximum Total = 12)	2 - 4 GHz (maximum 3) 4 - 8 GHz (maximum 3) 8 - 12 GHz (maximum 6) 12 - 16 GHz (maximum 3)
Radio Frequency Power	1 Watt (nominal)
Pulse Repetition Frequency	50 Hz to 5 MHz
Pulse Width	0.1 usec to 10 msec
Attenuation Pulse Programmed	 80 dB dynamic range 80 dB linear dynamic range
Pulse Agility Stagger Jitter	 4 level 0 - completely random
ECM Antenna Pattern	Computer Variable
Target Motion	Computer Variable
Tactical Situations	Air-to-air Sea-to-air Surface-to-air
Scan Types	Palmer-Raster Raster Conical Scan Spiral Track-While-Scan Sequential Lobe Loro Search Nodding
Radar Types	Pulse Pulse Compression CW Pulse Doppler

Table AA-12

JAMMING TECHNIQUE SIMULATOR CHARACTERISTICS

PARAMETER	CHARACTERISTICS
Simulated Jammer Power	1 to 10,000 Watts
Amplitude Modulation	0 to 100 Percent
Amplitude Modulation Mode	Synchronous, Nonsynchronous
FM Noise Bandwidth	1 to 500 MHz
AM Noise Bandwidth	1 to 20 KHz
Conical Scan Manual Phase	0 to 360 degrees
Swept Frequency	0.01 to 100 KHz
Range Gate Capture Walk-Off Mode	Linear, Parabolic
Walk Time (Inbound and Outbound)	0.5 to 9 sec
Dwell Time	0.5 sec
Pulse Width	0.3 to 0.75 usec
False Targets	2

Table AA-13

TES CAPABILITIES

Radar Simulator

Track-While-Scan
conical Scan
Sequential Lobing
Fire Control Acquisition

Multiple Environment Simulator

Track-While-Scan
Conical Scan
Sequential Lobing
Acquisition
Monopulse
Pulse Dopper
Search
On-Board Avionics
Additional ECM Equipment

Aircraft Simulation

Modern Aircraft
Cross Section versus Aspect Angle
Scintilation Effects
Target Echo Delay

Radar Circuits

Simulated Servo
Tracking Dynamics
Range, Angle Trackers
Operator Consoles/Controls
Assorted IF Strips
RF/IF Converters
Video Processors

ECM

Interface to REal Equipment
Breadboard thru Production
Interrnal Generators to Synthesize Proposed Techniques

AM, FM, PM of CW, Swept or Noise Generators
Video Generators for Generating ECM Waveforms

ECCM

IAGC (Instantaneous Automatic Gain Control)
AGC (Automatic Gain Control)
FIC (Fast Time Constant)
STC (Sensitivity Time Control)
Bandwidths Variation
Frequency Sequencing

Radar Displays

B Displays
A Displays
Spectrum Analyzer

Antenna Patterns

2 Dimensional Track Radar Patterns via Function Generators
360^{o} Search RAdar Patterns
Diode Function Generator Patterns

Tagging and Blanking

Interference Blanking
Missile Correlation Signals

airframe aerodynamics, kinematics, environmental functions, and related effects such as nonlinearities. Intial prelaunch conditions required may be calculated from equations taken from any of the fire control systems in use.

Flight simulations provide the following information: (1) Missile performance envelopes for a wide variety of situations. (2) Effects of system and target noise on miss-distance. (3) Effects of various electronic countermeasures devices and techniques on missile performance. (4) Missile intercept trajectory data for use in missile lethality and effectiveness analyses. (5) Quantitative measurement of overall seeker-autopilot transfer functions. (6) Failure mode analyis by duplication of flight test parameters in a simulated flight. (7) Missile system sensitivity investigations that may indicate desirable hardware or procedure modifications.

(b) LIS/SITS Hybrid Simulation System. The F-14A SITS (System Integration Test Station) and the Phoenix AIM-54A LIS (Laboratory Integrated System) compose a facility for laboratory evaluation of the F-14A/Phoenix missile.

The F-14A SITS has the capability of integrating the F-14A avionics or proposed avionics to make an operating aircraft system. The F-14A weapon system in SITS can be used actively against real targets by rolling the test stand onto the balcony of the main laboratory and using the radar infrared subsystems to detect and track actual flying targets.

The AIM-54A LIS can simulate any Phoenix missile flight test using active AIM-54A guidance and control sections or only computers. The missile aerodynamics and kinematics are simulated by the sophisticated hybrid simulation system comprised of both digital and analog computers. A target and clutter radio frequency environment is generated for the test. The LIS/SITS facility initially designed to support the F-14A/Phoenix program, is intended to be used for T&E of other sophisticated weapon systems as well.

6. Data Handling/Processing. The Range Instrumentation Systems Department is the centralized data processing and computer facility of the Pacific Missile Test Center. Through a planning staff, an administrative office, and three divisions, the department uses complex computer systems to reduce range test, scientific, and management data to meaningful information. The department provides mathematical analysis and computer programming services to the PMTC and associated activities. Tape, strip charts, graphs, and photographs are reduced to charts and tables for the range user. Duplicate tapes and compilations are provided when required, and rapid printing equipment and optical readers help provide timely reduction of data. Real-time computers provide automated control of scheduled range activities, while other computers provide management data processing, including production of the payroll for PMTC employees.

a. Data Storage and Retrieval Capabilities. The basic computer capabilities of PMTC are available on request to PMTC.

B. Quick-Look Capabilities. The Range Instrumentation Systems Department has numerous software available to provide quick-look capabilities. In addition to the standard software, PMTC also has the capability to provide special purpose software to fill the needs of a specific program.

c. Processing.

(1) System and Model. The major digital data processing capabilities of PMTC are available upon request.

(2) Language. Languages currently utilized by PMTC include FORTRAN IV, CS-1, TIAL, SYCOL, SNOBOL, PL-1, ALGOL, and COBOL.

(3) Input/Output Options. Inputs/Output options for the various data processing systems are available upon request.

(4) Real-Time/Post-Test

(a) Real-Time

1 Spectrum Analyzer. A real-time spectrum analyzer is available at PMTC.

2 Real-Time Operation Support Software (ROSS). The system will accept and process radar tracking data only. The radars involved are the following:

- 4 beach radars
- 2 radars at Building 53
- 4 radars on San Nicolas Island
- 2 FPS-16's at Vandenberg
- 1 TPQ-10 at Vandenberg
- 2 radars from Edwards
- 1 at Point Pillar
- 2 radars on USNS Wheeling

The type displays and outputs are discussed in Appendix A of Reference 10.

(b) Post-Test. An extensive post-test processing capability exists at PMTC, the magnitude of which is beyond the range of this document. In addition, PMTC has the capability of providing special purpose software to fit the needs of specific test programs. A representative sample is contained in Reference 33.

d. Distribution. Turnaround time at PMTC is a function of the complexity of the program and the information desired. It may vary from several minutes to several weeks, depending on the nature of the task.

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ANNEX BB

OPERATIONAL TEST INSTRUMENTATION GUIDE

FALLON NAVAL AIR STATION
Fallon, Nevada

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ANNEX BB

FALLON NAVAL AIR STATION
Fallon, Nevada

1. Introduction

a. Overview. Fallon naval Air Station (NAS), Nevada, is a relatively small (approximately 19,000 acres) Naval air station located 70 miles east of Reno, Nevada, and six miles southeast of the town of Fallon. The station is in the southern portion of a basin composed of the Carson Sink; Lahontan Valley; Carson Lake; and a large, flat, and marshy Stillwater Wildlife Management Area. This basin averages from 3,900 to 4,100 feet above mean sea level (MSL) with a few hills rising to 5,000 feet.

The mission of Fallon Naval Air Station is to train pilots, primarily Navy, in air-to-ground gunnery, bombing techniques, and electronic warfare. The facility is primarily Naval; however, other services use the electronic warfare ranges located at Fallon NAS.

b. Generic Systems Tested. Fallon Naval Air Station is primarily a training facility for pilots. However, some testing of airborne systems electronic countermeasures and electronic counter-countermeasures (ECM and ECCM) can be conducted at Fallon NAS.

2. General

a. Military Units

(1) Army Units. No Army units are presently stationed at Fallon NAS.

(2) Other Military Units. All Naval units at Fallon NAS are deployed to the station.

b. Maintenance Capabilities. Maintenance facilities at Fallon NAS are limited to organizational level maintenance with intermediate level maintenance on ground support and avionics equipment.

c. Access

(1) Air. Commercial air service is available into Reno, Nevada (9,000-foot runways). A 5,000-foot asphalt runway is available at Fallon Municipal Airport. Fallon NAS has a 14,000-foot runway.

(2) Road. Road access to Fallon NAS is via U.S. 95 from Reno, Nevada, or U.S. 50 from Carson city, Nevada. There are no interstate highways in the immediate vicinity.

(3) Rail. Southern Pacific Railroad (SPRR) provides rail service to Fallon, Nevada.

d. Logistic Support Capability. Present logistics facilities at Fallon are sufficient to support the programs and personnel stationed at Fallon. Further expansion of programs at Fallon NAS will require evaluation of these facilities.

e. Recurring Commitments. No information available.

f. Special Operational Restrictions. Attack passes at Bombing Range 16 must be from the north.

g. Facility Organization. A faclity organization chart for Fallon NAS is available upon request.

h. Environment. The weather at Fallon NAS can be classified as temperate with temperatures running from a mean minimum of 32°F in January to a mean maximum of 92°F. Temperatures over 100°F during July abnd August are not uncommon, and temperatures below 0°F are not uncommon in December and January. In addition, some morning fogging conditions can occur during the winter months, including very infrequent severe fog conditions.

i. Topography. Fallon Naval Air Station is located in the southern portion of a basin composed of the Carson Sink; Lahontan valley; Carson Lake; and a large, flat, and marshy Stillwater Wildlife Management Area. This basin averages from 3,900 to 4,100 feet above MSL, with a few hills rising to 5,000 feet.

The mountains surrounding this basin aree oriented as follows:

(1) The Desert Mountains (5,000-7,400 feet) are oriented east-west, 17 miles south of the field.

(2) the Sands Spring Range (5,000-7,400 feet) ios oriented north-south, 25 miles southeast of the field.

(3) The Stillwater Range (5,500-8,000 feet) is oriented north-east-southwest, 15 miles east to 60 miles northeast of the field.

(4) The West Humboldt Range (5,000-6,400) feet) is oriented northeast-southwest, 32 miles north to 65 miles northeast of the field.

(5) The Hot Springs Mountains (5,000-7,000 feet) are oriented northeast-southwest, 38 miles northwest of the field.

(6) The Pyramid Range (5,000-8,700 feet) is oriented north-west-southeast, 70 miles northwest and 45 miles west-northwest of the field.

(7) The Pinenut Mountains (6,500-9,450 feet) are oriented north-south, 45 miles west-southwest to 55 miles southwest of the field.

(8) the Sierra Nevada Range (6,000-14,495 feet) is oriented northwest-southwest, 100 miles northwest to 80 miles southwest of the field.

There is a significant amount of surface water in Lahontan Basin comprised of the Lahontan Reservoir, Carson Lake, and an extensive irrigation canal system. The Carson River and large areas of irrigation runoff are in forms of small lakes, ponds, and marshes. Larger, more distant water features are: (1) Pyramid Lake, 50 miles northwest of the field; and (2) Lake Tahoe, 70 miles west-southwest of the field.

j. Airspace Restrictions. Table BB-1 lists the restricted airspaces associated with Fallon NAS.

k. Power Availability. Power is furnished to Fallon NAS by the Sierra Pacific Power Company, Fallon, Nevada. there is not dual power availability at Fallon NAS except for standby engine generators located in critical areas on the station.

l. Communications. All communications at Fallon NAS are standard military units. No special communications equipment exists for testing and/or possible OT&E use.

3. Dimensions

a. Landspace

(1) Test Areas. Five test areas exist at Fallon NAS. These areas are:

o Bombing Range 16 (17,280 acres), located nine nautical miles southwest of Fallon.

o Bombing Range 17 (21,400 acres), located 23 miles southeast of Fallon.

o Electronic Warfare Training Range (34,380 acres), located north of the adjacent to Bombing Range 17.

o Bombing Range 19 (17,330 acres), located 16 miles south of Fallon NAS.

o Bombing Range 20 (8,960 acres), located 31 miles northeast of Fallon. (Refer to Figure BB-1).

Facilities at the bombing ranges are very limited. They consist of a control building and several spotting towers used for manual scoring.

The equipment at the Electronic Warfare Taining Range is primarily housed in mobile trailers located at surveyed points.

(2) Easements. There are several inactive mining claims in the area around and within the bombing and test areas. These claims should not present any opeational problems.

(3) Impact/Live Firing Areas. Bombing Range 16 is the only impact area restricted to inert rounds at Fallon NAS. All other bombing ranges (B17, B19, B20) have designated inert and live ordnance impact areas. (See Figure BB-1).

b. Airspace

TABLE BB-1

RESTRICTED AIRSPACE

Restricted Airspace	Bombing Range	Altitude	Time Coverage
R4802	B20	0-8000 ft	Mon-Sat 1400-0800Z (DT 1300-0700Z)
R4803	B16	0-8000 - 0-18000 ft	Continuous 1400-0800Z (DT 1300-0700)
R4804	B17	0-18000 ft	Continuous 1400-0800Z (DT 1300-0700)
R4810	B19	0-17000 ft	Continuous 1400-0800Z (DT 1300-0700)
R4812	B17	0-18000 ft	Continuous 1400-0800Z (DT 1300-0700)
R4813	B20	0-18000 ft	Continuous 1400-0800Z (DT 1300-0700)
R4816 N&S	EW RANGE	0-18000 ft	Mon-Fri 1630-2330Z (DT 1530-2230Z)

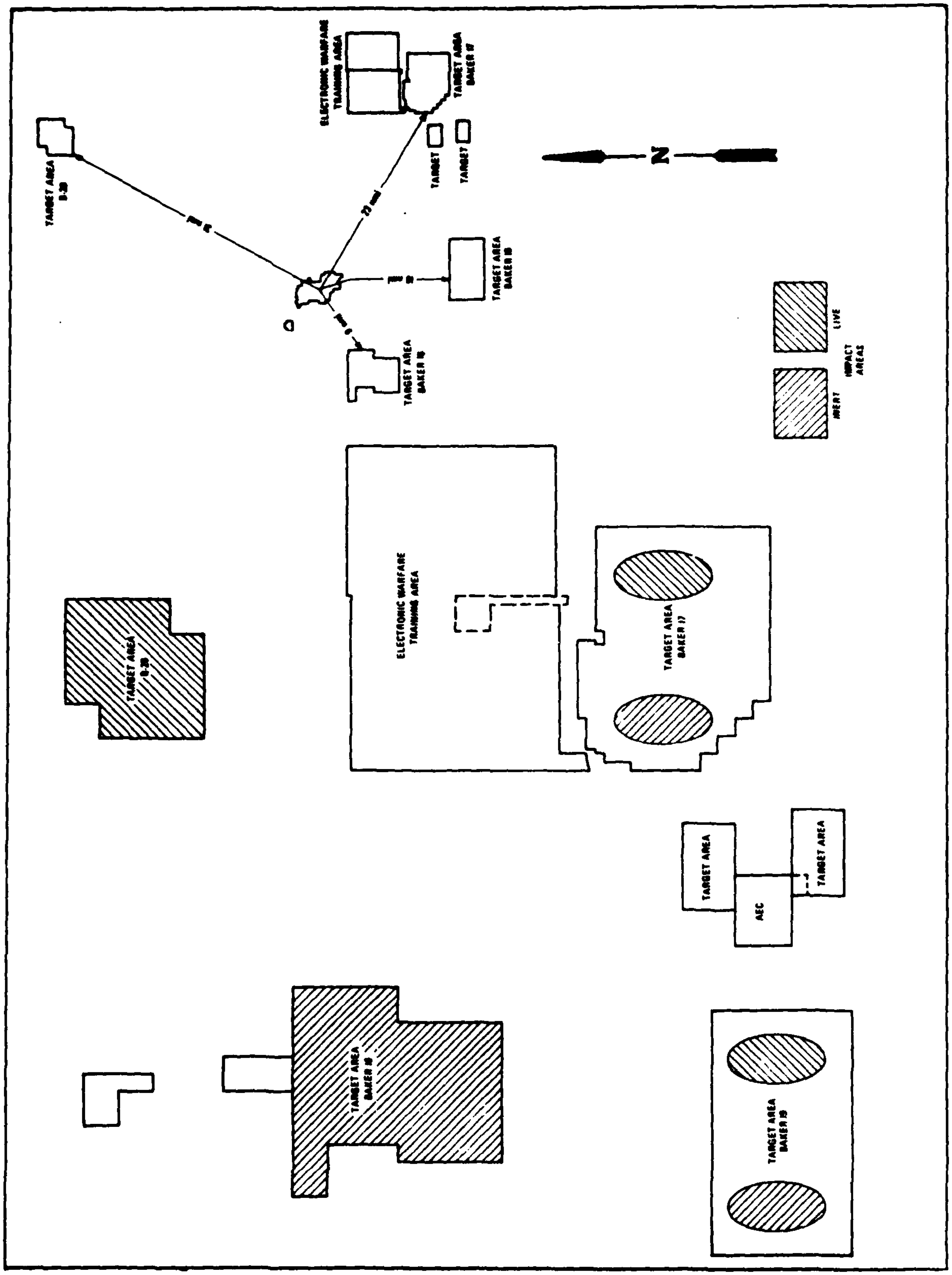


FIGURE BB-1 FALLON NAS Test Areas

(1) Easements. High altitude jet traffic corridors are permitted 24,000 feet or higher above the restricted areas at Fallon NAS, except above Bombing range 16 which has a maximum of 18,000 feet.

(2) Manned Airborne Systems. At the present time, all military aircraft are permitted to utilize the facilities at Fallon NAS.

(3) Unmanned Airborne Systmes. None permitted.

(4) Area Surveillance. All area surveillance at Fallon NAS is visual.

4. Instrumentation. Instrumentation at Fallon NAS, due to its training status, is very limited. The available instrumentation includes the following:

a. Meteorological. A typical set of meteorological equipment is available at Fallon NAS for use by the Weather Forecasting detachment.

b. Photography. Photography is limited to hand-held still photography with no information available concerning development or turnaround time.

5. Threats/Targets. An Electronic Warfare Training Facility is located at Fallon NAS, north of Bombing Range 17. This facility is used for training air crews in electronic warfare tactics.

The Electronic Warfare Training Range, located in Dixie Valley, has facilities for simulating the Soviet SA2, SA3, FIRECON, AAA, WHIFF, FIREWHEEL, FLAPWHEEL and SPOONREST RADARS. All of the facilities (real and simulated) are dynamic and operate in a real-time environment. The facilities are capable of simulating both friendly and hostile electromagnetic realism (frequency, pulse, PRF, power, signature) and exhibit a high degree of firing realism.

The scoring of training flights against the electronic warfare range are performed in real-time and relayed to Fallon NAS via a microwave link. After flying against the range and performing an attack run in Bombing Area 17, pilots land at Fallon NAS where they are debriefed on their flight tactics.

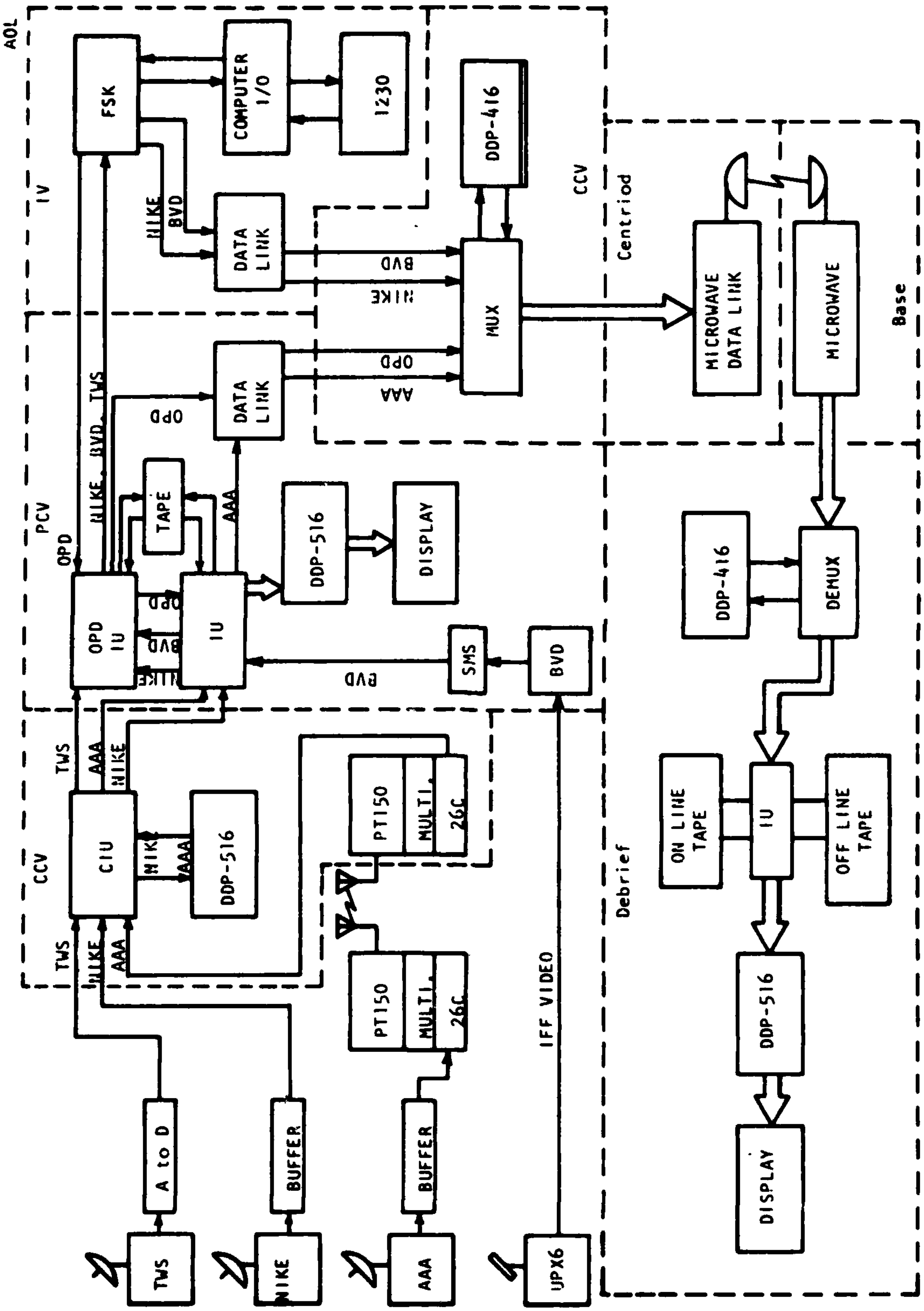
The training cycle begins when the pilot is first inaugurated in electronic warfare using a weapons system trainer such as the A7E trainer at Lemoore NAS. The pilot then makes several runs at varying altitudes approaching from the north against the Electronic Warfare Training Range located in Dixie Valley. Then the pilot may fly on and perform a bomb run into Bombing Area 17, after which he lands for a debriefing. After several flights, he is allowed to approach the Dixie Valley facility from any angle and at any altitude he desires. The pilot lands after the actual bomb drop or air gunnery strafing missions.

Figure BB-2 gives the data flow of the electronic warfare equipment located in Dixie Valley at Fallon NAS.

Scoring of bomb drops or air-to-ground gunnery attacks is performed manually using spotting tower personnel. The scoring results are relayed to Fallon NAS for use in pilot debreifings or directly to the pilot via UHF radio.

6. Data Handling/Processing. Extensive computer facilities are associated with the Electronic Warfare Training Range located in Dixie Valley. These computer facilities are used exclusively for real-time simulation and debriefings. There are no additional computer facilaities.

FIGURE BB-2 Data Flow Chart



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