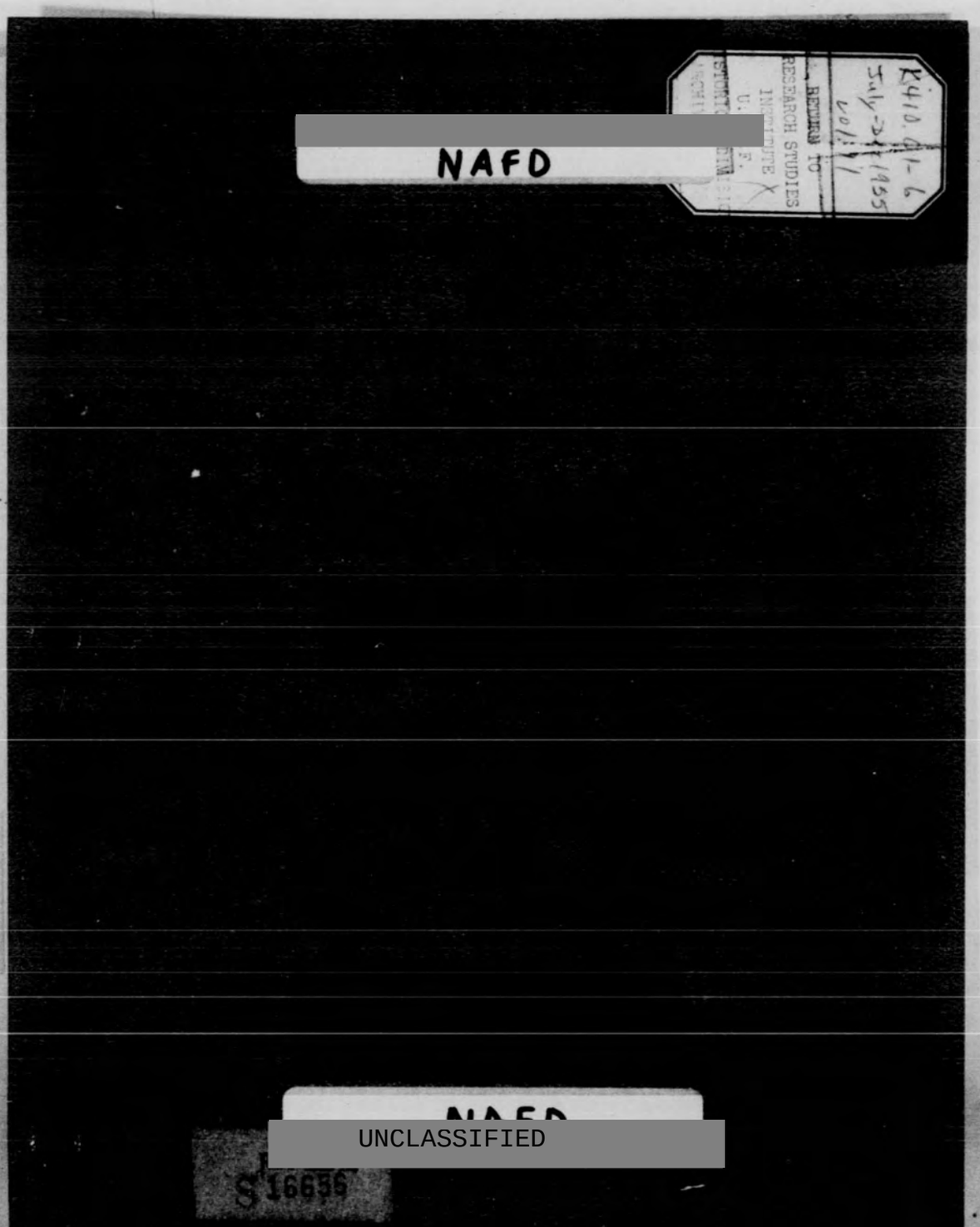
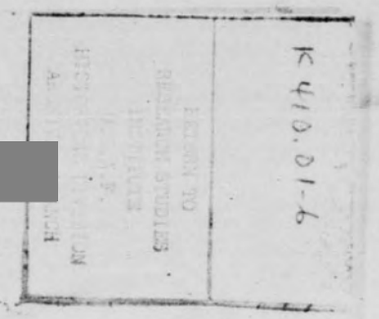

NAFD
RETURN TO
RESEARCH STUDIES
INSTITUTE
NAFD
S 16656



CONTINENTAL AIR DEFENSE COMMAND

AND

AIR DEFENSE COMMAND

HISTORY

July - December 1955

SUPPORTING DOCUMENTS

VOLUME X

NOS. 329 - 364

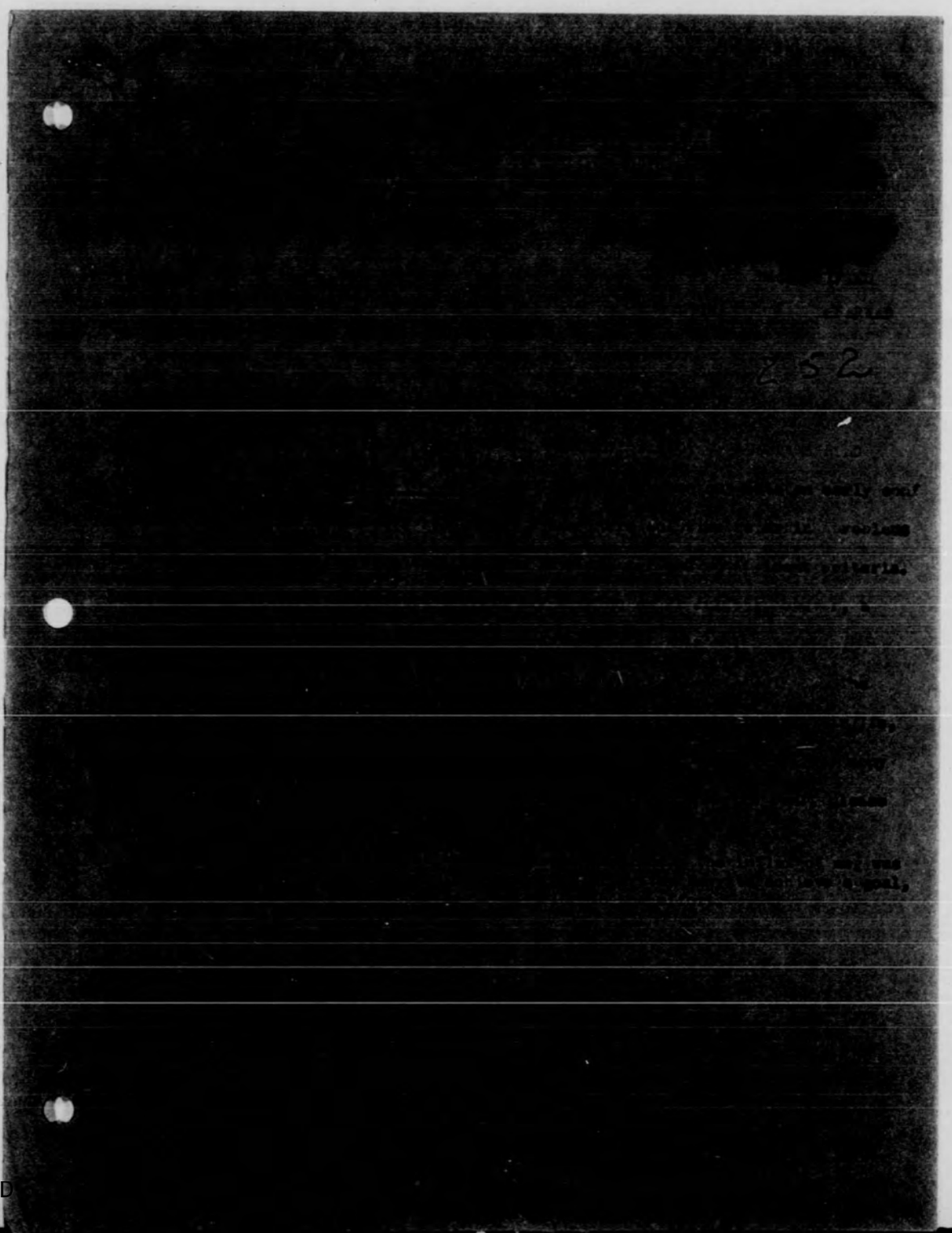
Consisting of 130 Pages

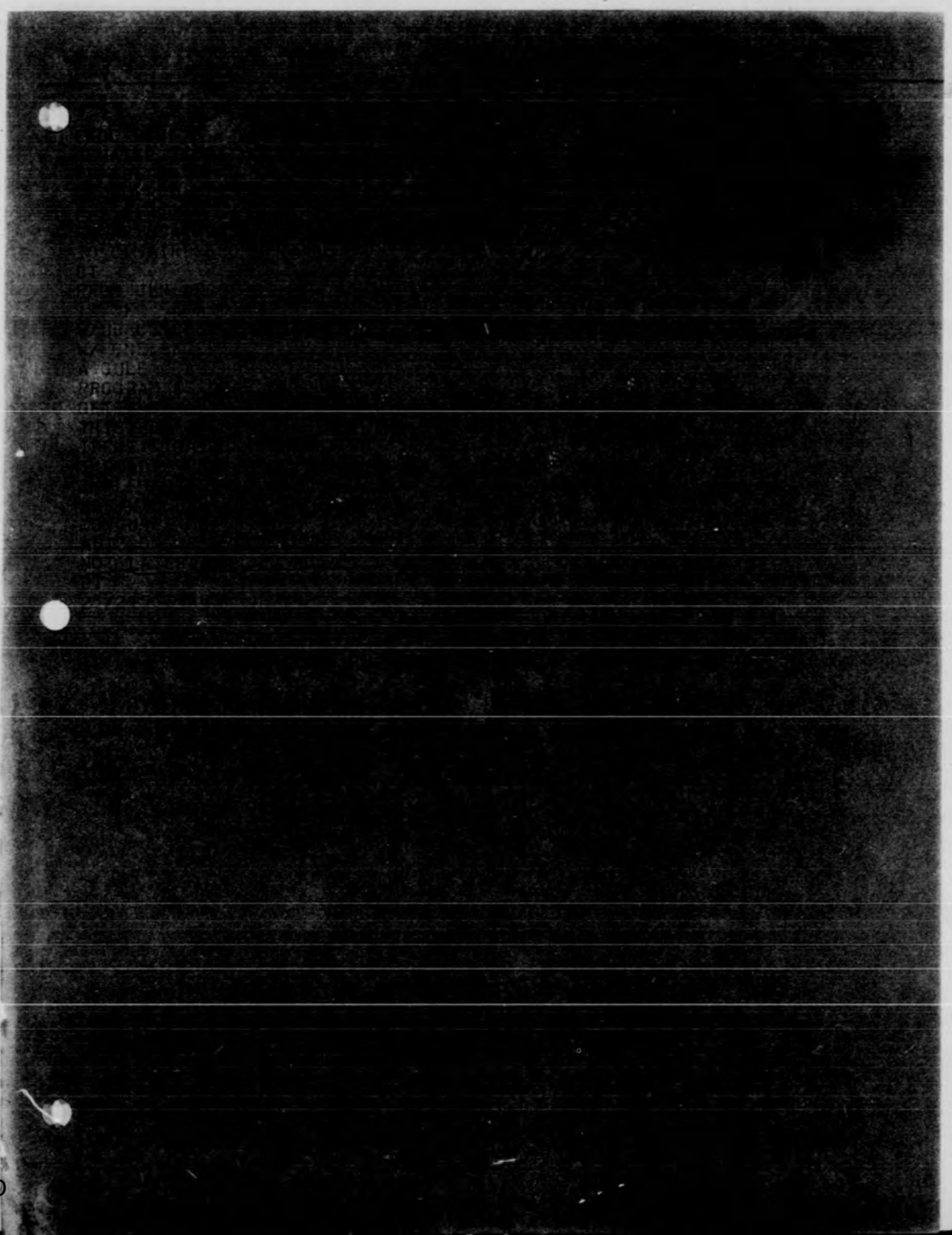
O+T

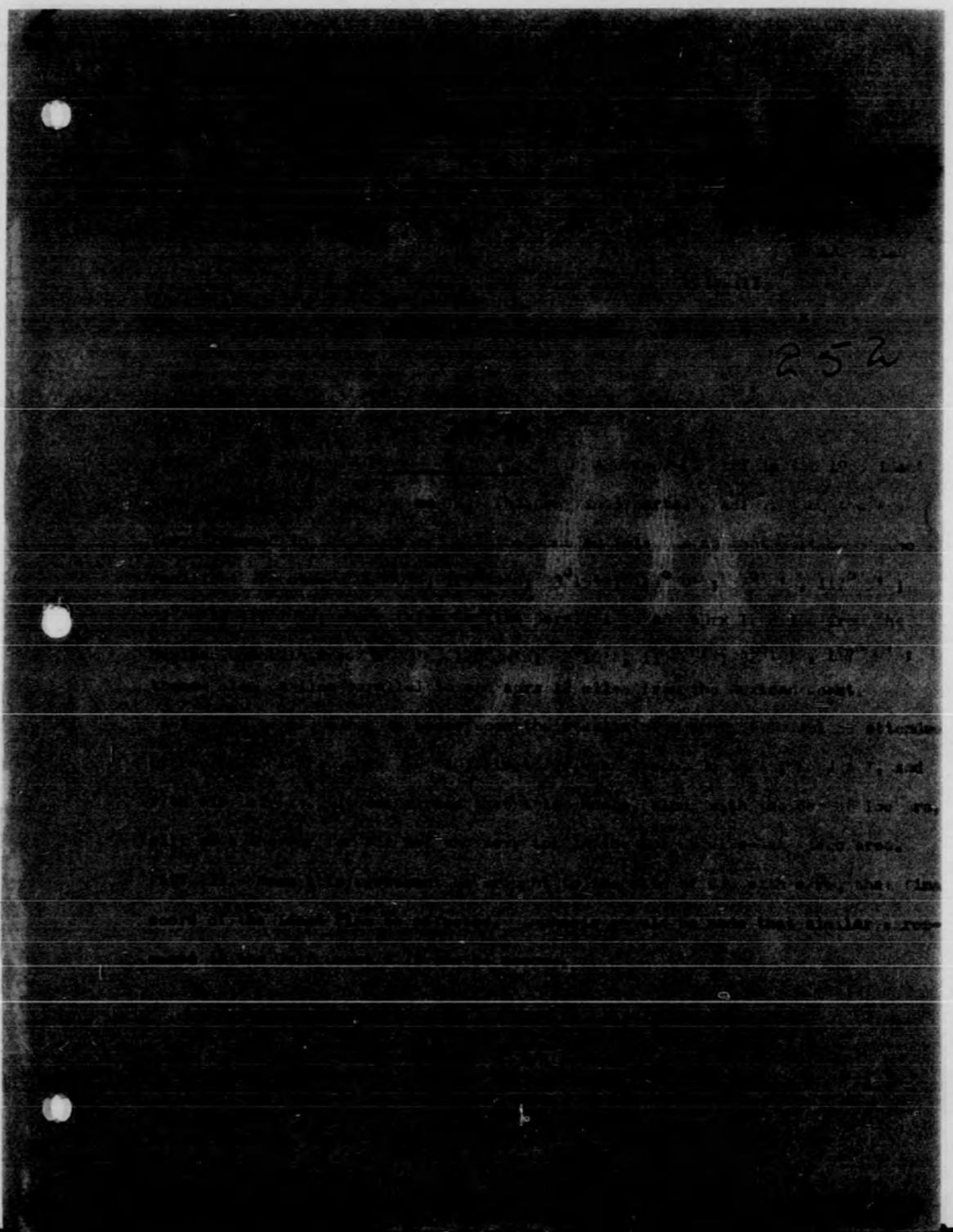
329

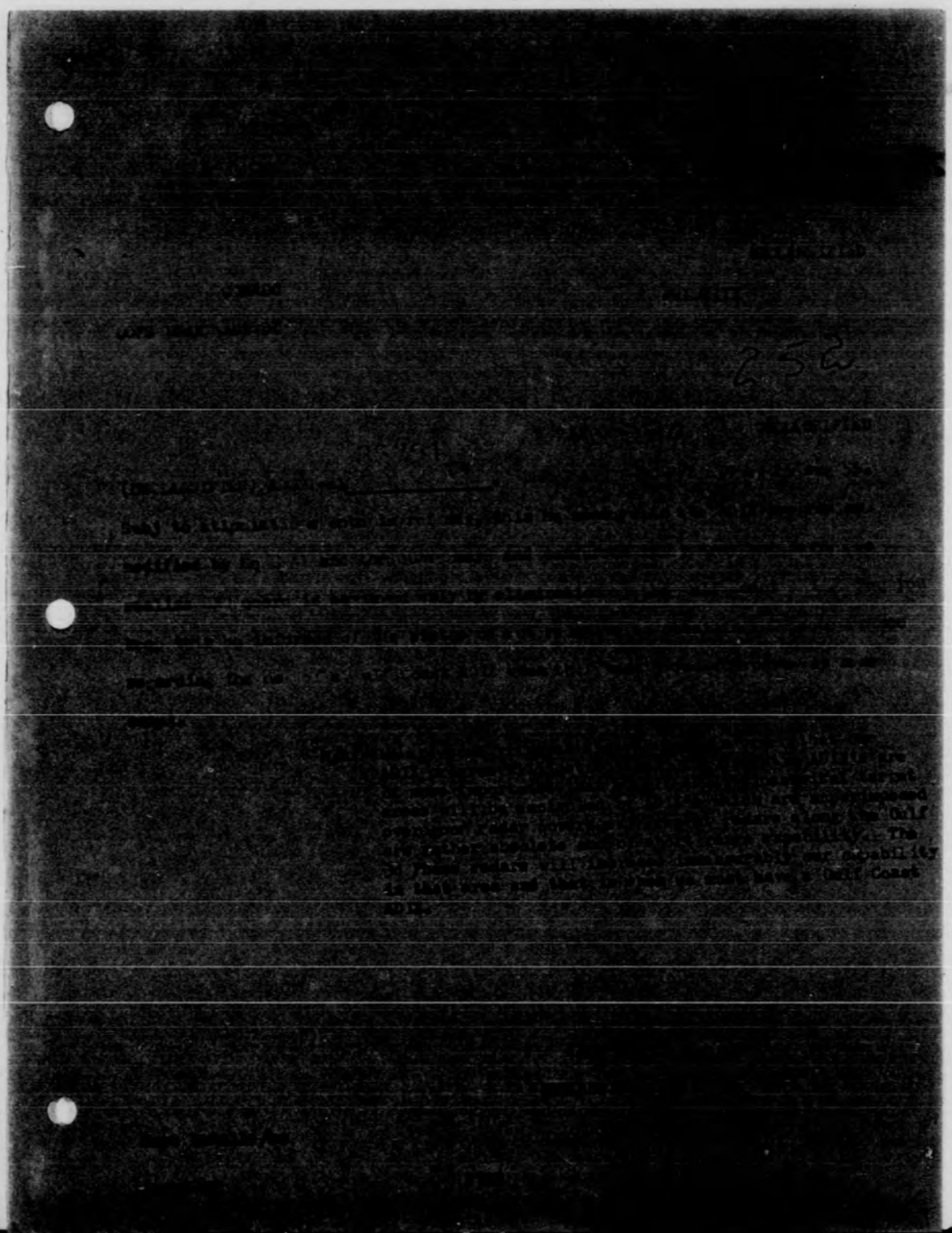
ADC B092 T ENG095 XYC160 XDD084 [illegible]
RR RJEDEN RBWDAC RBEPW RBWPI RJWPKL
DE RBHPB 119A
R 282202Z
FM ADMIN CINCPACFLT
TO RJEDEN/CINCONAD
INFO RBWDAC/COMAIRPAC
RBEPW/CNO
RBWPI/COMWESTSEAFRON
RBWDAC/COMFIRSTFLT
RJEDEN/COMNAVFORCONAD
RJWPKL/COMNAVFORWESTCONAD
NAVY GRNC
BT
COMAIRPAC 142347Z AND 161833Z X COMWESTSEAFRON 151805Z X COMFIRSTFLT
152221Z X ALL PASEP X REF MSGS DESCRIBE SITUATION WHERE NAVAL
OFFSHORE FLIGHTS ENGAGED IN TRAINING AND IN SUPPLYING SERVICES TO
PACFLT SHIPS ARE SEVERELY HAMPERED BY COASTAL ADIZ PROCEDURES X
THESE FLIGHTS ARE AN ESSENTIAL PART OF PACFLT TRAINING AND READINESS
AND MUST HAVE REASONABLE OPERATIONAL FREEDOM X PRESENT PROCEDURES
IMPOSE UNACCEPTABLE PENALTIES ON PACFLT TRAINING OPERATIONS AND IF
CONTINUED WOULD RESULT IN ACCELERATED REDUCTION COMBAT READINESS X
PARA X YOUR ASSISTANCE IS REQUESTED IN RESOLVING CURRENT IMPASSE
OVER OPS IN COASTAL ADIZ X COMWESTSEAFRON 192246Z PASEP INDICATES
CFN 142347Z 161833Z 151805Z 152221Z 192246Z

PAGE TWO RBHPB 119A
A TEMPORARY SOLUTION HAS BEEN REACHED AND YOUR ACTION IN THIS REGARD
IS GREATLY APPRECIATED X IN ORDER DEVELOP LONG TERM SOLUTION THIS
PROBLEM WHICH WILL BE ACCEPTABLE ALL CONCERNED SUGGEST EARLY
CONFERENCE BETWEEN YOUR DEIGNATED REPS AND THOSE OF CINCPACFLT AT
ANY LOCATION YOU PREFER
BT
28/2202Z JUL RBHPB









[redacted]

COPY

DEPARTMENT OF NATIONAL DEFENCE

334

Royal Canadian Air Force

St. Hubert, Que, 15 Jul 55

Commander-in-Chief
Continental Air Defense Command
Ent Air Force Base
Colorado Springs, Colo, U.S.A.

252

408X

Aircraft Control and Warning Operations
Surveillance - Identification

1. This headquarters is proposing to inaugurate changes in the CADIZ areas and regulations. These alternations are necessary to align the CADIZ's with the present day operational requirement.

2. The specific geographic co-ordinates are detailed in Appendix "A". In general the proposed changes include:

(a) Establishing "Domestic" and "Coastal" CADIZ's, and lowering the flight plan requirements to 3000' in the Domestic CADIZ, and to the surface in the Coastal CADIZ.

(b) Creating a new CADIZ in the Northeastern area to include all the NEAC stations except Thule.

(c) Realigning the Monoton CADIZ with the proposed NEAC CADIZ and the Atlantic ADIZ.

(d) Moving the Security Identification Zone from 46°20'N to 47°30'N.

(e) Deleting the CADIZ south of 46°00'North.

3. To allow the proper criteria to be established in appropriate areas and for east of reference, it is considered necessary to differentiate between a CADIZ over territorial land masses and waters, and a CADIZ over oceanic areas. To this end, it is proposed to designate a CADIZ over the territorial land mass and waters as a "Domestic" CADIZ, and a CADIZ over oceanic areas as a "Coastal" CADIZ, Aircraft operating in a Domestic CADIZ would be required to file flight plans for flights at 3000' or higher over the immediate terrain, and aircraft operating in a Coastal CADIZ would be required to file flight plans for operations at all altitudes.

4. At present there are two small CADIZ's in the NEAC area; the Gander CADIZ embracing Newfoundland, and the Goose CADIZ covering the area within 87 nautical miles of Goose Bay. Neither of these CADIZ's are adequate for the operational requirement. The establishment of a CADIZ to cover the NEAC area from Frobisher Bay to Newfoundland and the seaward approaches thereto, has been withheld pending the availability of navigational facilities.

[redacted]

[redacted]

334

Loran is now in operation in the area, and LF beacons will be installed and operating at the various sites during this summer.

5. To assist aircraft operators and traffic control agencies in the handling of flight movement data and to ease the load on identification sections, the Monoton CADIZ would be realigned to coincide with the seaward portion of the Atlantic ADIZ and the proposed Gander CADIZ.

6. The Security Identification Zone (SIZ) was placed in operation in September 1954 along 46°20'N between the Maine and Michigan borders. Although not in the most suitable location, it has proved its practicability in an area where the filing of flight plans is at times extremely difficult. Coincidental with the establishment of the SIZ the CADIZ was deleted south of 44°00'N and the International ADIZ was deleted south of 46°00' North. To further enforce the identification of aircraft in more needful areas, it is now proposed to move the SIZ northward to have its northern edge lie along 47°30'N between the northern tip of Maine and the Michigan border north west of Saulte Ste Marie. This position will place it in an area of better coverage and remove it from the immediate area of at least two busy airports. Simultaneously, it is proposed to delete that portion of the CADIZ in the Ontario and Quebec areas south of 46°00' North. There is very heavy traffic in this area and, for the most part, is designated as a "Q" area. The deletion of the CADIZ will allow greater emphasis to be placed on the identification of aircraft in more vital zones. Further, this will align southern limits of the United States and Canadian identification zones in this area along 46°00' North. Coincidental with these changes, you may wish to rescind the appropriate portions of the International ADIZ south of the northern edge of the Security Identification Zone.

7. The matter of the re-location of the SIZ and the deletion of the CADIZ south of 46°00'N has been discussed with Hq Eastern Air Defense Force. Attached as Appendix "B" is a copy of the correspondence originated by the 32nd Air Division (Def) and of the 1st endorsement by EADF. The enclosure referred to in para 2 of EADF's endorsement is a map pictorially displaying their proposal. The proposal in this case was to raise the SIZ to 48°20'N between 80°00'W and 83°00'W and thence westward along 48°20'N to the international boundary in the vicinity of 88°20' West. Subsequent discussions with Lt Col Aszman of your Hq resulted in the proposal in para 6 above.

8. Originally, it was intended to have these changes effective 1 Sept 55 in conjunction with the ADIZ changes proposed by your Hq. Informal information indicated that the United States alternations will not become effective until a later date. As some of the above proposals will have a bearing on the intended changes within the United States, may this command be advised as soon as possible of your concurrence, and of the expected date of implementation of the alternations by your Hq and by the Civil Aernautics Administration.

(P.A. Gilchrist) G/C
for AOC, ADC.

[redacted]

[redacted]

COPY

334

HEADQUARTERS
32D AIR DIVISION (DEFENSE)
Syracuse Air Force Station
Syracuse 6, New York

OOT-A 15 Jul 55

SUBJECT: Relocation of Security Identification Zone (SIZ)

TO: Commander
Eastern Air Defense Force
Stewart Air Force Base
Newburgh, New York

1. Reference minutes of conference to discuss EADF-RCAF ADC operational matters, 27 January 1955, the following recommendations concerning the relocation of the Security Identification Zone (SIZ) are forwarded:

a. It is recommended that the SIZ should be moved to the 48th parallel. The reasons for this recommendation are as follows:

(1) With the SIZ in a more northerly location, more time is available for tactical action following identification of hostilities. This is an important consideration due to the present high speed of jet bombers.

(2) Vital target areas in both Canada and the United States would be farther from the SIZ, providing more time to initiate passive defense plans.

(3) The SIZ would then extend from the Gulf of Saint Lawrence to Lake Superior covering major airways. This would facilitate identification by flight plan correlation by having the correlation line closer to the reporting points.

(4) There is more population along the 48th parallel than along the 47th. This would help to bolster the Ground Observer Corps within the SIZ. In addition, current radar coverage charts indicate much better coverage along the 48°N parallel than is available along either the 46° or 47° N parallels.

FOR THE COMMANDER:

/s/t/ ROBERT W. REINHOLD, 2 Lt
for EVERITT W. HOWE
Major, USAF
Adjutant

[redacted]

[redacted]

334

Hq 32d Air Div (Def) COT-A Subject: Relocation of Security Identification Zone (SIZ)

EAOOT-TS (1 Jun 55) 1st Ind

HEADQUARTERS EASTERN AIR DEFENSE FORCE, Stewart AFB, Newburgh, New York

TO: Air Officer Commanding, Air Defence Command, RCAF Station, St. Hubert, Quebec, Canada

1. Reference telephone conversation between S/L Evans, your headquarters, and S/L Ockenden, this headquarters. This headquarters concurs basically with the 32d Air Division's (Defense) recommendations contained in the basic letter.

2. The SIZ as shown on Enclosure 1 is recommended in lieu of the 48th parallel, as suggested by the 32d Air Division (Defense), as it is in an area of better radar coverage, is more adequately covered when one station is off the air, avoids PE patterns and is coincident with existing subsector boundaries (limiting the number of ADCC's involved in SIZ identification). The southern subsector boundaries of C-14, C-10, C-8, C-7 and C-1 would become the northern edge of the 20-minute-wide SIZ.

3. It is also recommended that consideration be given to moving the southern boundaries of the Montreal and Toronto CADIZ's from 44N to 46N. The present "Q" track area covers most of the area that would be deleted. This change in the CADIZ would align the southern Toronto and Montreal CADIZ boundaries with the southern Traverse City and Presque Isle ADIZ boundaries planned by Headquarters Air Defense Command to be implemented 1 September 1955.

4. This information is furnished upon the condition that it will not be released to another nation without specific authority of the Department of the Air Force of the United States, that it will be used for military purposes only, and that the information be provided substantially the same degree of security as afforded by the United States of America-Department of the Air Force.

5. This correspondence is classified Secret in accordance with paragraph 25c of Air Force Regulation 205-1.

FOR THE COMMANDER:

/s/t/ JAMES R. WORLINE
Captain, USAF
Asst Adjutant

[redacted]

[redacted]

Appendix "A"

334

GOOSE-GANDER DOMESTIC CADIZ

The area bounded by a line 52°30'N 65°00'W; 56°00'N 65°00'W; 63°00'N 71°30'W; 65°00'N 71°30'W; 65°00'N 66°00'W; 64°00'W 64°00'W; 61°00'N 64°00'W; 56°30'N 60°00'W; 53°30'N 55°00'W; 51°30'N 55°00'W; 48°00'N 52°30'W; 46°30'N 52°30'W; 46°30'N 58°00'W; 48°30'N 62°00'W; 51°00'N 63°00'W; 52°30'N 65°00W; the point of beginning.

GOOSE-GANDER COASTAL CADIZ

The area bounded by a line 61°00'N 69°32'W; 61°00'N 70°40'W; 63°00'N 73°00'W; 66°00'N 73°00'W; 66°00'N 66°00'W; 63°00'N 60°00'W; 48°00'N 48°00'W; 45°00'N 50°00'W; 43°50'N 53°15'W; 46°30'N 58°00'W; 46°30'N 52°30'W; 48°00'N 52°30'W; 51°30'N 55°00'W; 53°30'N 55°00'W; 56°30'N 60°00'W; 61°00'N 64°00'W; 64°00'N 64°00;W; 65°00'N 66°00'W; 65°00'N 71°30'W; 63°00'N 71°30'W; 61°00'N 69°32 W; the point of beginning.

NOTE: No attempt has been made to differentiate between the Goose CADIZs and Gander CADIZs until such time as the Department of Transport determines the boundaries between the Gander ATCC area of responsibility and the area of responsibility of the proposed Goose Air Traffic Control Center.

MONOTON DOMESTIC CADIZ

51°00'N 63°00'W;

The area bounded by a line 52°30'N 65°00'W,/48°30'N 62°00'W; 46°30'N 58°00'W; 43°00'N 65°47'W; 44°30'N 66°45'N 44°30'N 67°07'W; 44°46'36"N 66°54'11"W; along U.S.-Canada Boundary to 46°42'N 70°00'W; 51°00'N 70°00'W; 52°30'N 65°00'W; the point of beginning.

MONOTON COASTAL CADIZ

The area bounded by a line 46°30'N 58°00'W; 43°50'N 53°15'W; 39°30'N 63°45'W; 43°00'N 65°47'W; 46°30'N 58°00'W; the point of beginning.

MONTREAL DOMESTIC CADIZ

The area bounded by a line 51°00'N 70°00'W; 46°42'N 70°00'W; along the U.S.-Canada Boundary to 46°00'N 70°18'W; 46°00'N 77°50'W; 51°00'N 80°00'W; 51°00'N 70°00'W; the point of beginning.

TORONTO DOMESTIC CADIZ

The area bounded by a line 51°00'N 80°00'W; 46°00'N 77°50'W; 46°00'N 83°29'W; thence along the U.S.-Canada Boundary to 46°07'N 84°00'W; 51°00'N 80°00'W; the point of beginning.

VANCOUVER DOMESTIC CADIZ

The area bounded by a line 48°30'N 125°00'W; 50°30'N 129°00'W; 51°15'N 128°00'W; 53°23'N 130°22'W; 57°00'N 123°00'W; 49°00'N 116°00'W; along US-Canada Boundary to 48°29'38"N 124°43'35"W; 48°30'N 125°00'W; the point of beginning.

[redacted]

[redacted]

Appendix "A"
(continued)

334

VANCOUVER COASTAL CADIZ

The area bounded by a line 48°30'N 125°00'W; 48°30'N 132°10'W; 51°30'N 134°00'W; 53°23'N 130°22'W (approx); 51°15'N 128°00'W; 50°30'N 129°00'W; 48°30'N 125°00'W; the point of beginning.

SECURITY IDENTIFICATION ZONE

The area bounded by a line 47°25'N 69°14'W; along US-Canada Boundary to 47°10'N 69°32'W; 47°10'N 85°19'W; along US-Canada Boundary to 47°30'N 86°20'W; 47°30'N 70°00'W; 47°25'N 69°14'W; the point of beginning.

[redacted]

[illegible]
27 Aug 55

UNCLASSIFIED

COMADC

ROUTINE DEFERRED

COMS USAF WASH DC

[redacted]

ADC CANADIAN AIR [illegible] [illegible]

(UNCLASSIFIED) [illegible] 31331. FOR AF[illegible]. [illegible] (Unclas) Redng of ADIZ's and Incorp of the ADIZ Vertical Plane Concept in [illegible], 1[illegible] Dec 54. RCAF-ADC is proposing [illegible] of [illegible]'s and [illegible] and [illegible] of coastal [illegible]'s. To insure that such [illegible] coincide with U. S. ADIZ's, req you accomp the fol in para 2 of Incl [illegible] to ref ltr: 1) Change that portion of the Northern ADIZ which reads "...along the US-Canadian bdry to 46°20'N, 84°07'W; 46°00'N, 84°20'W; 46°51'N, 94°00'W; ..." to read: "...along the US-Canada bdry to 47°10'N, 85°10'W; 46°51'N, 94°00'W cont; 2) [illegible] - change to read: The area bounded by a line 47°25'N, 69°14'W; along the US-Canada bdry to 47°10'N, 69°38'W; 47°10'N, 85°10'W; along the US-Canada bdry to 47°30'N, 86°20'W; 47°30'N, 70°00'W; 47°25'N, 69°14'W (pt of beginning); 3) [illegible] ADIZ - delete 46°20'N, 70°12'W. [illegible] CAA be advised to effect coord with Dept of Trans of proposed ADIZ changes req in ref ltr in order that effective date of CADIZ and ADIZ changes are [illegible] the same time.

[illegible]

UNCLASSIFIED

Capt [illegible]

[illegible]

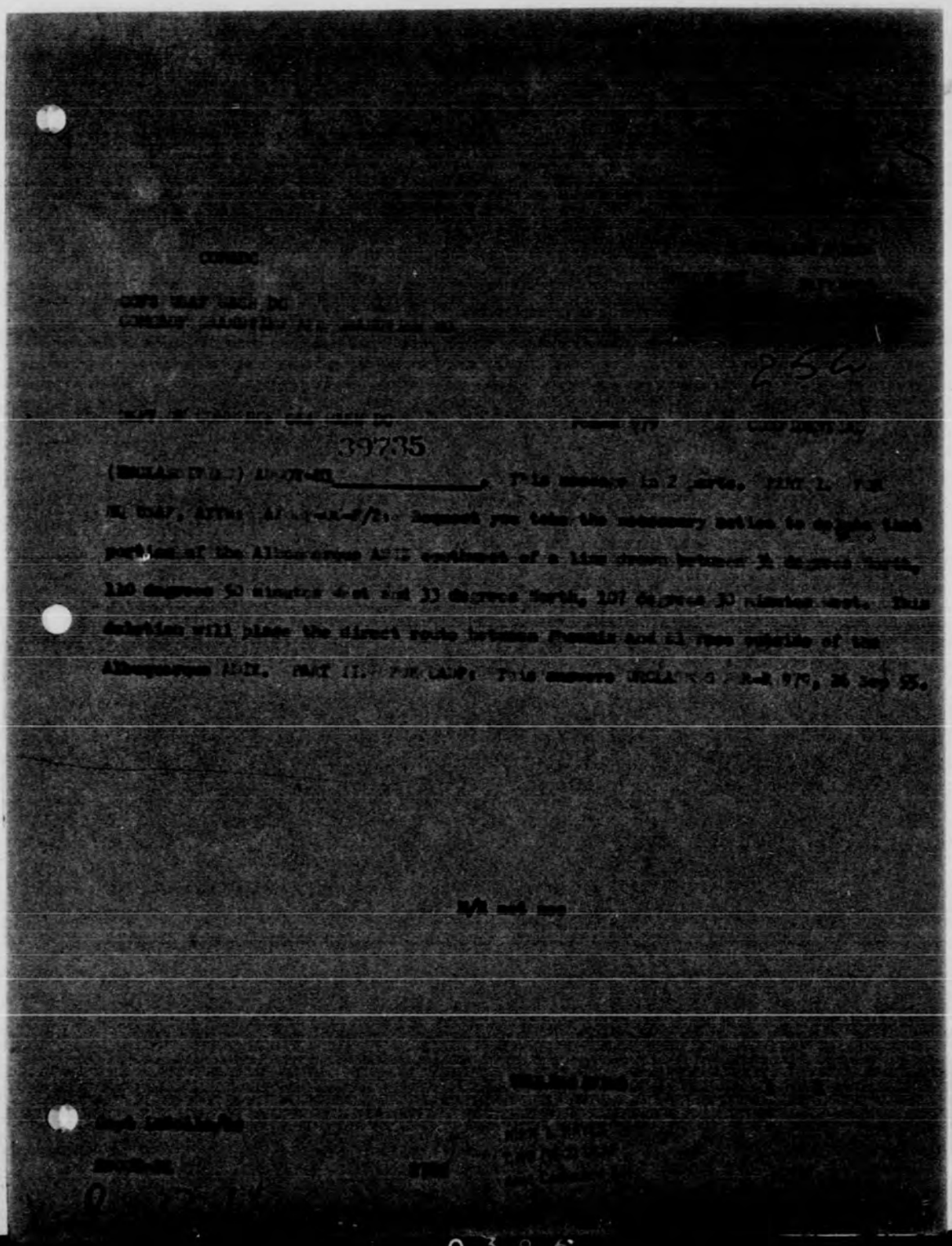
[redacted]

252

[redacted]

[redacted]

[redacted]



39735

[redacted]

COPY

338

From: COMDR ADC 29 Nov 55

To: COMDR WADF HAMILTON AFB CALIF

[redacted] ADOOT-B1 4556 . URMSG WDOTN-1 5011035, 16 Nov 55. This hq does not concur with your proposed method of accommodating loc flying for Luke, Williams, and Nellis AFB. Recm pro be as fol: All acft both civ and mil be rqr to comply with flt plan rqr of AFR 60-22, "Ident and Scty Con of Mil Acft," 24 Oct 55, and CAA Part 620. Exemptions for ATRC acft be placed in effect only during loc flying tng pd and only when these acft remain in their loc flying areas.

M/R: WADF proposal would in effect eliminate practically the whole ADIZ in that area. WADF proposal would make it impossible to detect and identify acft during the hours Training Command acft are not opr.

252

[redacted]

UNCLASSIFIED

CONAD

[illegible]

PRIORITY ROUTINE

X

252

31 OCT 55

[illegible] DEPUTY [illegible]
[illegible] FEDERAL [illegible]
DEPT OF COMMERCE WASH DC
[illegible] CALIF
[illegible] STEWART AFB [illegible] NY
[illegible] AFB [illegible]

(UNCLASSIFIED) [illegible] for AF [illegible]/2. Subj is Proposed AFR 60-22, "Identification and Security Control of Military Aircraft." This headquarters has no requirement for identifying aircraft proceeding from the central open area to the Florida open area provided the aircraft penetrate no ADIZ or any portion thereof other than that portion of the Eastern ADIZ which lies within the geographical boundaries of the State of Florida and while therein maintain a track outbound from the eastern defense area. Nor does a requirement exist for identifying aircraft which depart the central open area and traverse the northern ADIZ or the southern border ADIZ outbound provided the aircraft do not penetrate the Albuquerque western or eastern ADIZ's. This headquarters is notifying subordinate units in appropriate regulation that such aircraft will be identified as friendly. Request you take the necessary action to notify command and services concerned that operators of such flights need not comply with the provisions of the proposed AFR 60-22.

UNCLASSIFIED 1

Capt LaSalle/bs

[illegible] 2722

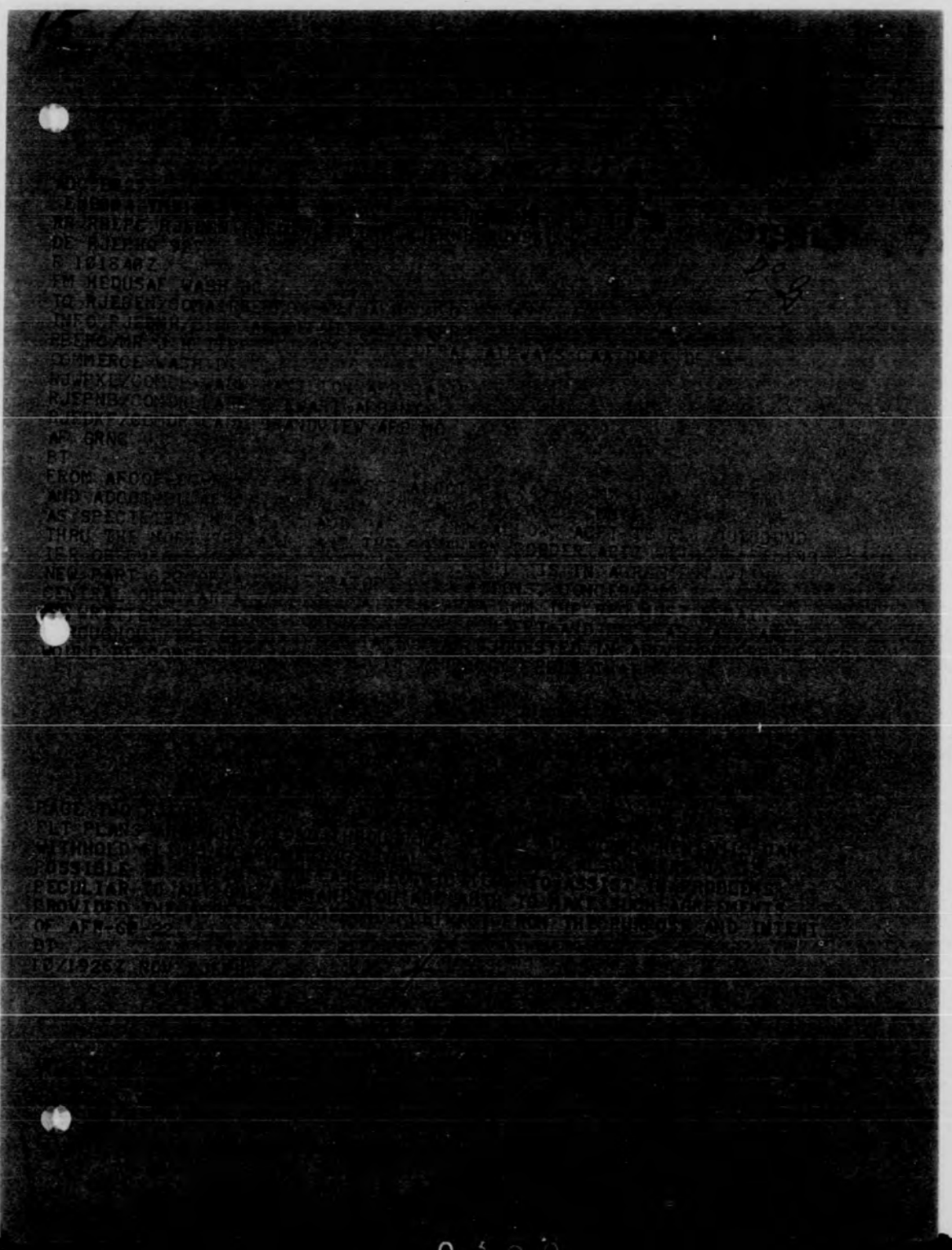
0 5 4 8

[redacted]

252

47328

[redacted]



[redacted]

342

ADOOT-B1

13 Dec 55

SUBJECT: (Unclassified) Proposed Redesignation of the Western ADIZ and the Vancouver and Lethbridge CADIZ's

TO: Air Officer Commanding
Air Defence Command, RCAF Station
St. Hubert, Province of Quebec
Canada

1. The Northern ADIZ which was designated 1 Dec 55 creates operational problems for the 25th Air Division (Defense). The tactical aspect of locating the ADIZ relatively close to a target complex is undesirable; further, the superimposition of the ADIZ over several air fields poses an identification problem due to the high volume of air traffic in that area.

2. To eliminate these problems we propose:

a. Deletion of that portion of the Northern ADIZ west of 115-00-W.

b. Redesignation of the northern portion of the Western ADIZ in order that the northern boundary will terminate at the U.S.-Canada boundary between 113-00-W and 115-00-W.

c. Deletion of those portions of the Vancouver and Lethbridge domestic CADIZ's which fall within [illegible], thence along the 50° parallel to the Vancouver coastal CADIZ.

d. Designation of an ADIZ extending from the surface upwards to infinity in that area bounded by the coordinates described in paragraph c and the following: 49-00-N, 115-00-W; along the U.S.-Canada boundary to 49-00-N, 113-00-W; 51-00-N, 113-00-W; thence along the 51 parallel to the Vancouver coastal CADIZ.

3. This recommendation will, in effect, make one continuous ADIZ which will be sufficiently far from target complexes to permit interception of unknown aircraft prior to bomb release line. In addition, this ADIZ will eliminate restrictions to flight within the present local

DEC

B-668-1

[redacted]

This correspondence is classified [redacted] accordance with Par [redacted], AFR 205-1, 15 Dec 53, or for the reason (s) stated.

[redacted]

342

16

ADOOT-SI Subj: (Unclas) Proposed Redesignation of the Western ADIZ and the Vancouver and Lethbridge CADIZ's (Cont)

flying areas and will ease the identification problem in the vicinity of Vancouver, B.C., Whidley NAS, Paine AFB, and in the Straits of Juan de Fuca.

4. If you concur in general with subject proposal, recommend representatives of this and your headquarters, 5 ADCC and Western Air Defense Force meet to accomplish final joint planning.

FOR THE COMMANDER:

C. F. HUMPHREYS
Major, USAF
Asst Command Adj

Info copy
ComWADF
Hq CAA
Ch, CCS

DEC 14 1955

B-668-2X

[redacted]

UNCLASSIFIED

19

[redacted]

SEE CRYPTO SECTION BEFORE
DECLASSIFYING
PARAPHRASE IS NOT REQUIRED

COPY OF INCOMING CLASSIFIED MESSAGE

X 408

ACTION COPY

AG 3
A-1-17
RJEDEN RJWPK
DE RFEMV 16/17
R 172025Z
FM CANAIRDEF
TO ZEN CANAIRVAN
INFO RJEDEN/CMDR ADC ENT AFB COLO
[redacted] FB CALIF
[redacted] C214 17 JAN
PARA 1 RECENT NEGOTIATIONS BETWEEN HQ ADC USAF AND THIS HQ REVEAL THAT CERTAIN CHANGES TO THE CADIZ AND ADIZ BOUNDARIES IN YOUR AREA MAY BE DESIRABLE PD THESE CHANGES ARE BASICALLY CENTRED ON THE UNDESIRABLE TACTICAL ASPECT OF THE PRESENT LOCATION OF THE CADIZ AND ADIZ TOGETHER WITH THE ASSOCIATED PROBLEMS OF IDENTIFICATION OF THE HIGH VOLUME OF AIR TRAFFIC PD TO ELIMINATE SOME OF THESE PROBLEMS IT IS PROPOSED TO
A DELETE THAT PORTION OF THE NORTHERN ADIZ WEST OF 115-00-W
B REDESIGNATE THE NORTHERN PORTION OF THE WESTERN ADIZ IN ORDER THAT THE NORTHERN BOUNDARY WILL TERMINATE AT THE US-CANADA BOUNDARY BETWEEN 113-00-W AND 115-00-W
C DELETE THOSE PORTIONS OF THE VANCOUVER AND LETHBRIDGE DOMESTIC CADIZ'S WHICH FALL WITHIN 49-00-N CMM 115-00-W CMM 50-00-N CMM 115-00-W CLN THENCE ALONG THE 50 DEGREE PARALLEL TO THE VANCOUVER COASTAL CADIZ
D DESIGNATE AN ADIZ EXTENDING FROM THE SURFACE UPWARDS TO INFINITY IN THAT AREA BOUNDED BY THE COORDINATES DESCRIBED IN PARA C AND THE FOLLOWING CLN 49-00-N CMM 115-00-W CLN ALONG THE US-CANADA BOUNDARY TO 49-00-N CMM 113-00-W CLN 51-00-N CMM 113-00-W CLN THENCE ALONG THE 51 DEGREE PARALLEL TO THE VANCOUVER COASTAL CADIZ PD
PARA 2 THIS RECOMMENDATION WILL CMM IN EFFECT CMM ARE ... [illegible]

Action: CHT
CG, IG
02300

FILE:

ACTION COPY

ACTION: NAK

SIGNATURE:

PAGE TWO OF RFEMV 16/17
ADIZ WHICH WILL BE SUFFICIENTLY FAR FROM TARGET COMPLEXES TO PERMIT INTERCEPTION OF UNKNOWN AIRCRAFT PRIOR TO BOMB RELEASE LINE PD IN ADDITION CMM THIS ADIZ WILL ELIMINATE RESTRICTIONS TO FLIGHT WITHIN THE PRESENT LOCAL FLYING AREAS AND WILL EASE THE IDENTIFICATION PROBLEM IN THE VICINITY OF VANCOUVER BC CMM WHIDBEY NAS CMM PAINE AFB CMM AND IN THE STRAITS OF JUAN DE FUCA PD
PARA THREE IN ORDER THAT FINAL JOINT PLANNING ON THIS MATTER MAY BE ACCOMPLISHED CMM IT IS PROPOSED TO HOLD A CONFERENCE AT YOUR HQ ON 21 AND 22 FEB WITH REPRESENTATIVES FROM YOUR HQ CMM HQ ADC USAF CMM HQ WADF AND THIS HQ PD IF YOUR HQ CONCURS WITH THIS ARRANGEMENT CMM IT IS REQUESTED THAT THIS HQ BE ADVISED ACCORDINGLY PD UPON RECEIPT OF YOUR REPLY CMM THE NAMES OF PERSONNEL ATTENDING TOGETHER WITH POSSIB ADDITIONAL AGENDA ITEMS WILL BE FORWARDED TO YOUR HQ
BT
18/0046Z JAN RFEMV

JAN 20 1950

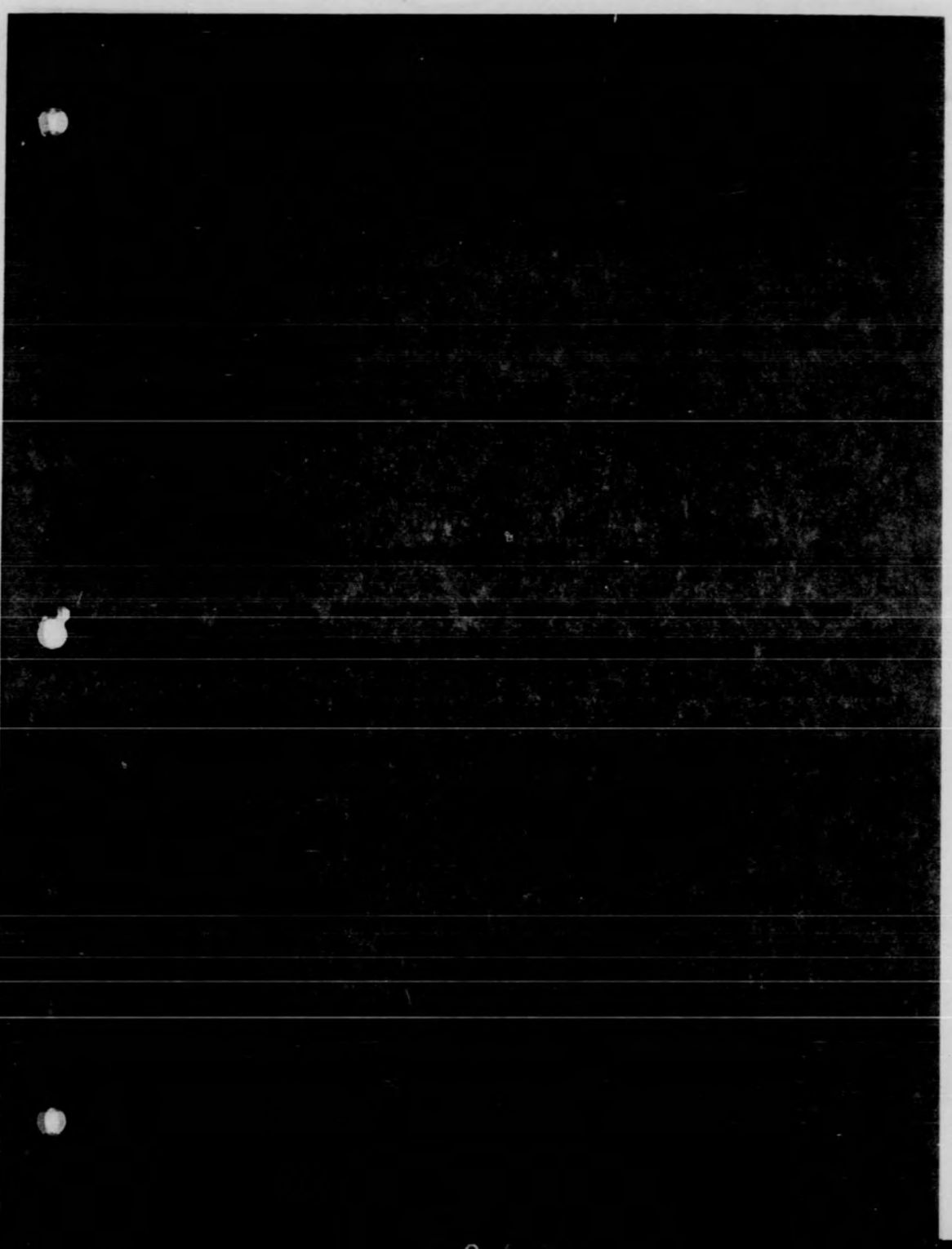
ADC HQ-0-AG-Form 22
9 April 51

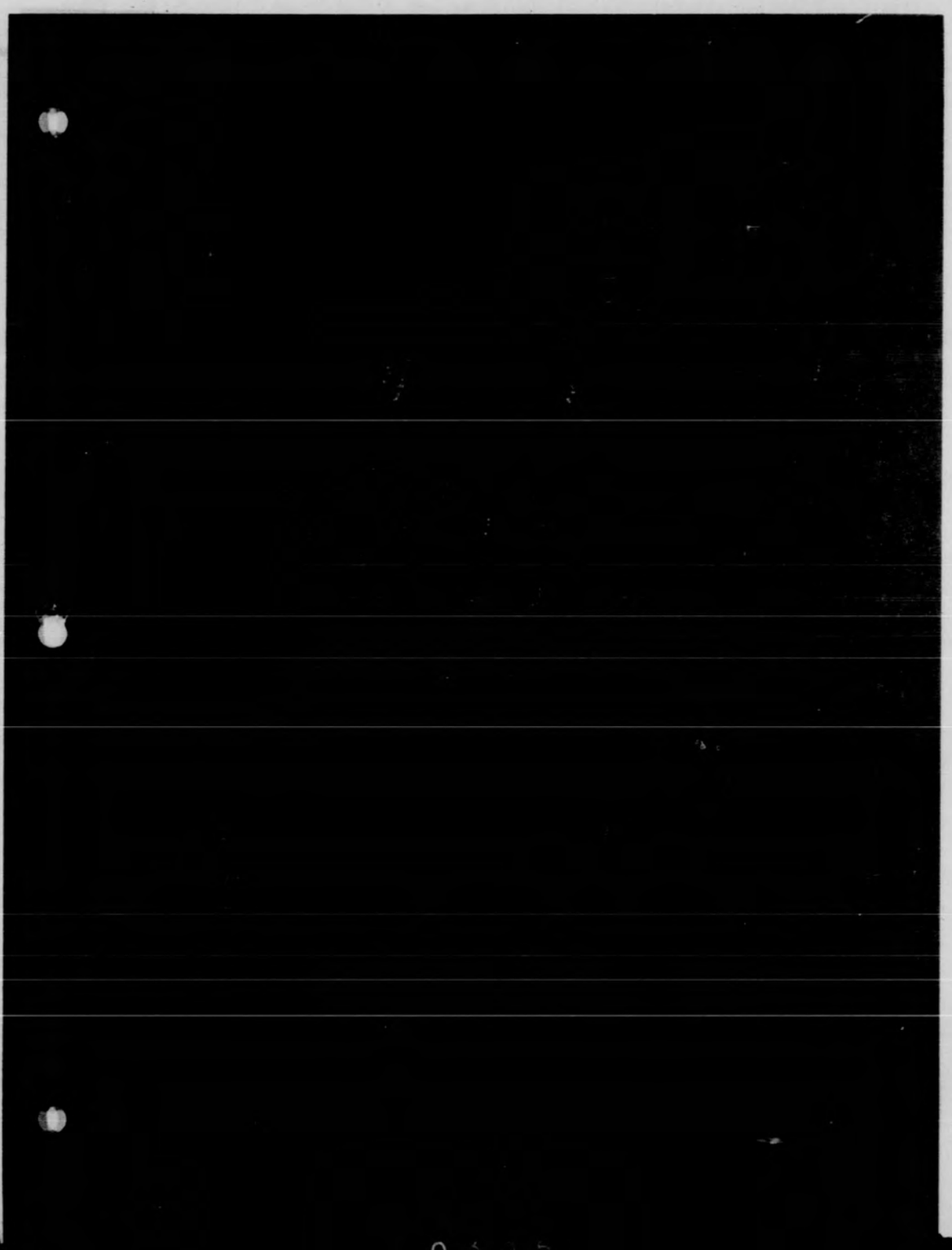
PARAPHRASE NOT REQUIRED EXCEPT ... CATEGORY B ENCRYPTION--
PHYSICALLY REMOVE ALL INTERNAL ... DATE-TIME GROUP ...

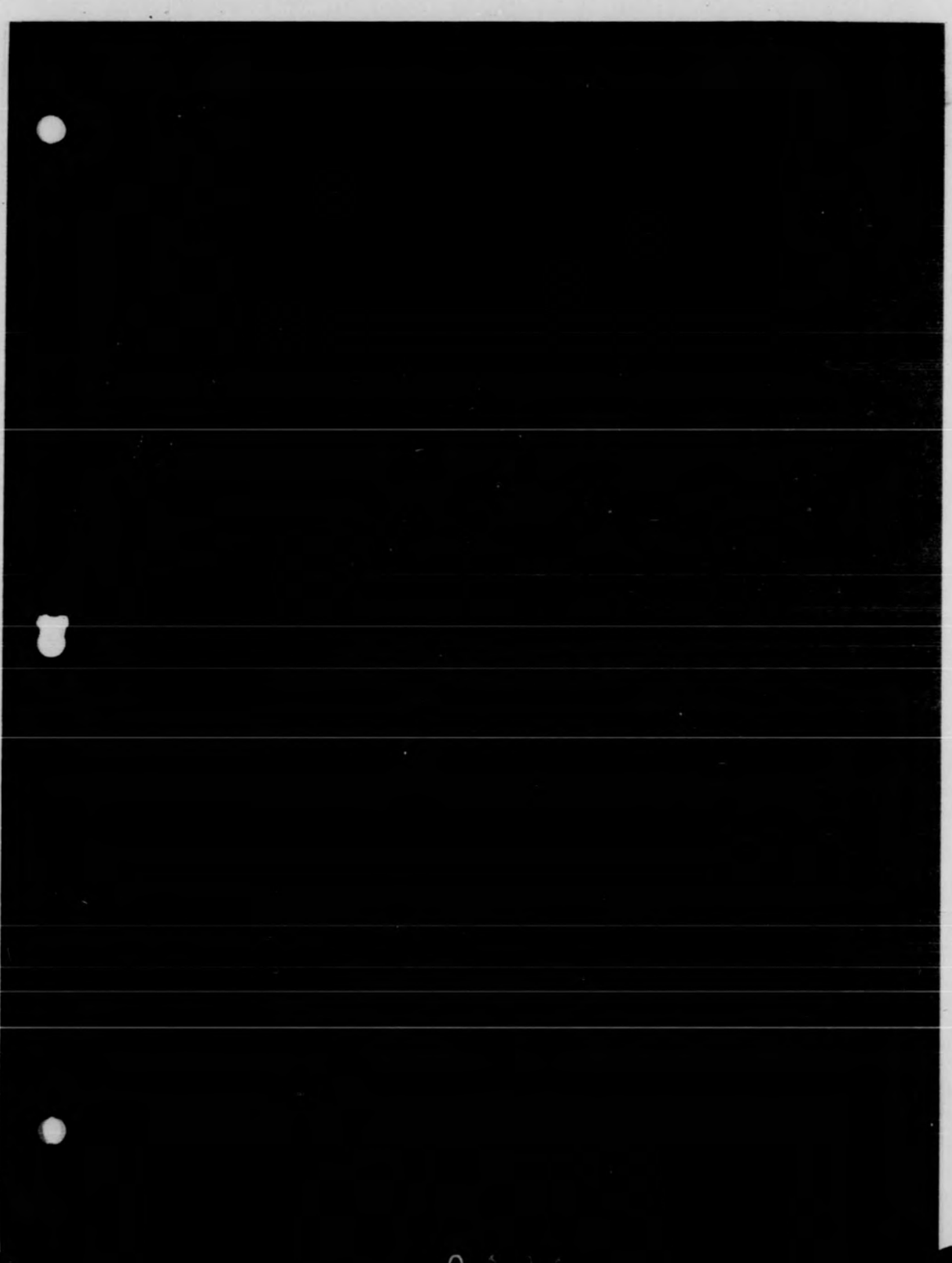
This document consists of ____ page
This is copy No. ____ of ____ copies

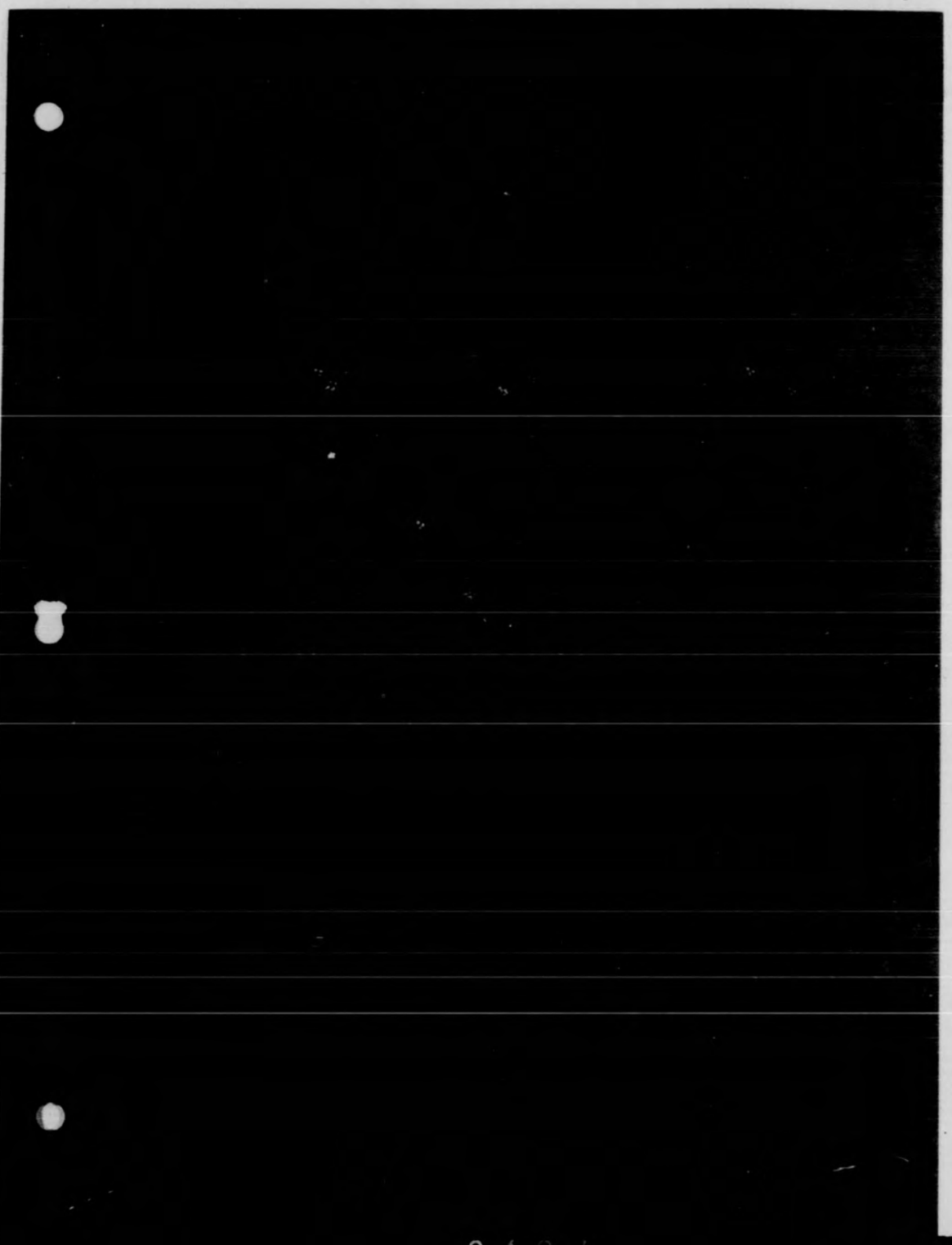
UNCLASSIFIED

0393









19

345

Civil Aeronautics Administration — U. S. Department of Commerce

REGULATIONS OF THE ADMINISTRATOR

PART 620

Security Control of Air Traffic

(Revised effective December 1, 1955)

Pursuant to section 1201 of the Civil Aeronautics Act of 1938, as amended (64 Stat. 825; 49 U. S. C. Supp 701), the President determined in Executive Order 10197 (published on December 22, 1950, in 15 F. R. 9180) that it is necessary in the interest of national security to establish security provisions for the use of aircraft in designated areas in the airspace above the United States, its Territories, and its Possessions (including areas of land or water administered by the United States under international agreement). In accordance with such determination and the authority delegated to me by the Secretary of Commerce (published on January 4, 1951, in 16 F. R. 99), Part 620 was adopted. This part, as amended, is revised herewith as recommended by the Board for Security Control of Air Traffic in Air Defense after coordination with the Department of Defense, the Civil Aeronautics Board, and representatives of the industry. The Air Defense Identification Zones in the Continental United States are generally reduced in area along the boundaries of the country. Two new ADIZ's are designated which enclose the northeastern area of the United States and the area west of the Continental Divide. These two areas are designated as the Eastern Defense Area and the Western Defense Area. Flights entering these areas or any ADIZ are required to comply with Part 620, but exceptions are made for flights departing these areas. Although the 4,000-foot exception has been removed, aircraft which maintain a true air speed of 110 knots or less and an altitude of 1,500 feet or less above the terrain are now exempt from the requirements of this Part. A military function of the United States is involved. Therefore, compliance with the notice, procedures, and effective date provisions of section 4 of the Administrative Procedure Act is not required. Part 620 is revised to read:

Subpart A—Introduction

AUTHORITY: §§ 620.1 to 620.23 issued under sec. 205, 52 Stat. 984; 49 U. S. C. 425. Interpret or apply secs. 1201–1204, 64 Stat. 825; 49 U. S. C. 701–704.

SUBPART A—INTRODUCTION

§ 620.1 *Basis and purpose*—(a) *Basis.* This part is issued pursuant to sections 205 and 1201–1204 of the Civil Aeronautics Act of 1938, as amended (52 Stat. 984, 64 Stat. 825; 49 U. S. C. and Sup. 425, 701–704); Executive Order 10197 (15 F. R. 9180); and Department of Commerce Order 86, Amendment 5 (16 F. R. 99).

(b) *Purpose.* This part establishes rules which have been found necessary in the interest of national security to identify, locate, and control United States and foreign aircraft operated within areas designated by the Administrator of Civil Aeronautics as Air Defense Identification Zones (ADIZ).

§ 620.2 *Definitions.* As used in this part, the following words shall mean:

(a) *Aircraft.* Any contrivance now known or hereafter invented, used or designed for navigation of or flight in the air.

(b) *Air Defense Identification Zone (ADIZ).* Airspace of defined dimensions designated by the Administrator of Civil Aeronautics within which the ready identification, location, and control of aircraft is required in the interest of the national security.

(1) *Domestic Air Defense Identification Zone.* An Air Defense Identification Zone within the United States or along an international boundary of the United States.

(2) *Coastal Air Defense Identification Zone.* An Air Defense Identification Zone over the coastal waters of the United States.

(c) *Open area.* An area within the Continental United States not designated as an ADIZ or Defense Area within which the flight of aircraft is restricted by the provisions of this part, only during an Air Defense Emergency.

(d) *Defense area.* Airspace of defined dimensions designated by the Administrator of Civil Aeronautics within which the ready control of aircraft is required in the interest of the national security during an Air Defense Emergency.

(e) *Air defense emergency.* Any state of events which indicates to Commander in Chief, Continental Air Defense Command, or higher authority that hostile action is in progress or is imminent or is sufficiently probable as to require, in the interest of national security, the implementation of any portion of approved plans and agreements for the defense of the United States.

(f) *Appropriate aeronautical facility.* The normal communications facility with which flight plans or position reports are filed.

(g) *CAA-Airways operations facility.* A Civil Aeronautics Administration control tower, air route traffic control center, or communications station.

(h) *Flight plan.* Specified information which is filed either verbally or in writing with an appropriate aeronautical facility relative to the intended flight of an aircraft.

(i) *Foreign aircraft.* An aircraft other than a United States aircraft defined in paragraph (o) of this section.

(j) *IFR flight.* A flight conducted under the instrument flight rules of the air traffic rules of Part 60 of this title.

(k) *Operate aircraft.* The use of aircraft, for the purpose of air navigation and includes the navigation of aircraft. Any person who causes or authorizes the operation of aircraft, whether with or without the right of legal control (in the capacity of owner, lessee, or otherwise) of the aircraft, shall be deemed to be engaged in the operation of aircraft.

(l) *Person.* Any individual, firm, copartnership, corporation, company, association, joint-stock association, or body politic; and includes any trustee, receiver, assignee, or other similar representative thereof.

(m) *Reporting point.* A geographical location in relation to which the position of an aircraft is reported.

For Sale by Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 5 cents.

(n) *United States.* The several States, the District of Columbia, and the several Territories and possessions of the United States (including areas of land or water administered by the United States under international agreement), including the Territorial waters and the overlying space thereof.

(o) *United States aircraft.* (1) An aircraft registered with the Administrator of Civil Aeronautics as a "civil aircraft of the United States",

(2) An aircraft of the national defense forces of the United States, or

(3) An aircraft of the Federal Government, or of a State, Territory or Possession of the United States, or the District of Columbia, or of any political subdivision thereof which has been registered with the Administrator of Civil Aeronautics.

(p) *VFR flight.* A flight conducted under the Visual Flight Rules of the air traffic rules of Part 60 of this title.

SUBPART B—OPERATING RULES

§ 620.10 *Scope.* Aircraft shall not be operated into or within and Air Defense Identification Zone (ADIZ) prescribed by the Administrator in Subpart C of this part in violation of the rules stated in this subpart.

NOTE: These Air Defense Identification Zones are depicted in CAA Flight Information Manual, Radio Facility Charts published by the Coast and Geodetic Survey, and USAF and Navy Radio Facility Charts.

§ 620.11 *Flight plans.* Unless otherwise authorized under § 620.13, prior to penetrating an ADIZ or prior to takeoff from a point within an ADIZ, a flight plan shall be filed with an appropriate aeronautical facility.

NOTE: Pilots are urged to file flight plans in person or by telephone prior to take-off. Within the Continental United States, a pilot unable to file in person may file a DVFR flight plan by placing a collect telephone call to the nearest CAA communications station or other CAA facility. (Standard procedures for making use of this service are published in the Airman's Guide and Flight Information Manual.)

(a) *IFR flights.* Unless an abbreviated flight plan is authorized by air traffic control, the flight plan shall contain the following information:

(1) Aircraft identification, and if necessary, radio call sigh;

(2) Type of aircraft, or in the case of a formation flight, the types and number of aircraft involved;

(3) Full name, address, and number of pilot certificate of pilot in command of the aircraft, or of the flight commander if a formation flight is involved;

(4) Point of departure;

(5) Cruising altitude, or altitudes, and the route to be followed;

(6) Point of first intended landing;

(7) Proposed true air speed at cruising altitude;

(8) Radio transmitting and receiving frequencies to be used;

(9) Proposed time of departure;

(10) Estimated elapsed time until arrival over the point of first intended landing;

(11) Alternate airport or airports;

(12) Amount of fuel on board expressed in hours;

(13) Any other information which the pilot in command of the aircraft, or air traffic control, deems necessary for air traffic control purposes;

(14) For international flights, the number of persons on board.

(b) *VFR flights.* Unless an abbreviated flight plan is authorized by air traffic control, the flight plan shall contain the information specified in paragraphs (a) (1) through (10) of this section. Such a flight plan shall be designated by the pilot in command as a Defense Visual Flight Rules (DVFR) flight plan.

(c) *Notification of arrival.* If a DVFR flight plan has been filed, or if an IFR flight plan has been filed for a flight for which an air traffic control clearance is not required, the pilot in command of the aircraft, upon landing or completion of the flight, shall file an arrival or completion notice with the nearest CAA communications station or control tower, unless the pilot in command states in the flight plan that no arrival notice will be filed.

NOTE: Pilots are urged to file flight plans either in person or by telephone. Flight plans filed by radio while in flight may result in interception of the aircraft to confirm its identity.

§ 620.12 *Reporting points.*—(a) *Flights within or penetrating a Domestic ADIZ.* Unless otherwise authorized under § 620.12:

(1) *IFR flights.*—(i) *Within control zones and areas.* Position reports shall be made as required by the Instrument Flight Rules of Part 60 of this title.

(ii) *Outside control zones and areas.* The reporting procedures specified for DVFR flights will apply.

(2) *DVFR flights.* The pilot in command of an aircraft shall not operate an aircraft into or within an ADIZ unless the aircraft is equipped with a functioning two-way radio and shall not enter an ADIZ until:

(i) He has reported to an appropriate aeronautical facility the time, position, and altitude at which the aircraft passed the last reporting point along the flight path of the aircraft prior to penetration of an ADIZ and his estimated time over the next reporting point along the intended flight path of the aircraft; or if it is not practicable to comply with this reporting procedure.

(ii) A report which contains the estimated time, position, and altitude at which he will penetrate the ADIZ has been made to an appropriate aeronautical facility at least fifteen minutes prior to penetration.

NOTE: A pilot of an aircraft departing from an airport too close to an ADIZ boundary to reach cruising altitude before entering the ADIZ or to report an estimated time and place of penetration at least 15 minutes prior to penetration will be considered to have complied with 620.12 and 620.14:

Provided, He reports immediately after takeoff the departure time with an estimate at the first reporting point along the flight path.

(b) *Aircraft entering the United States through a Coastal ADIZ.*—(1) *United States aircraft.* The reports prescribed in paragraph (a) of this section are required.

(2) *Foreign aircraft.* The pilot in command of a foreign aircraft shall not operate an aircraft into the United States without:

(i) Making position reports as prescribed for United States aircraft in subparagraph (1) of this paragraph, or

(ii) Reporting to an appropriate aeronautical facility when the aircraft is not less than one hour and not more than two hours average cruising distance via the most direct route, from the United States. Thereafter, reports shall be made as instructed by the facility receiving the original report.

NOTE: Operators of foreign aircraft who exercise the optional position reporting method described in subdivision (ii) of this subparagraph are cautioned that this procedure does not eliminate the position reporting requirements prescribed for the control of air traffic.

§ 620.13 *Authorized exceptions.* The provisions of this subpart except for § 620.17 are not applicable to the following aircraft operations:

(a) *Speeds excepted.* Aircraft operating into or within an ADIZ at true air speeds of 110 knots or less if the flight is conducted at an altitude of 1,500 feet or less above the terrain.

(b) *Altitudes excepted.*—(1) *Hawaiian ADIZ.* Aircraft operating within the Hawaiian ADIZ on inter-Hawaiian Island flights on Red Civil Airway No. 87 southeast of the Island of Oahu, below seven thousand (7,000) feet MSL.

(2) *Alaskan Domestic ADIZ.* Aircraft operating within the Alaskan Domestic ADIZ on a VFR flight originating from within the Alaskan Domestic ADIZ if:

(i) The flight is confined to altitudes of 4,000 feet or less above the immediate terrain; and

(ii) The aircraft is flown no closer than 500 feet to any other aircraft.

(c) *Areas or routes excepted.*—(1) *General.* Flights exempted by a CAA air route traffic control center. Such flights shall be operated in accordance with the instructions, if any, issued at the time the exemption is granted.

NOTE: Flights which may be exempted, after approval has been obtained from appropriate military commanders, are (a) flights wholly within the boundaries of an ADIZ, (b) flights not currently of significance to the air defense system, or (c) military flights which are conducted in accordance with special procedures prescribed by appropriate military authorities.

(2) *Continental United States.* (i) A flight originating within the Eastern Defense Area which maintains an outbound track into or through the Eastern ADIZ, Northern ADIZ, Presque Isle ADIZ, or Southern Border ADIZ without penetrating the Albuquerque ADIZ, Western ADIZ, or a Coastal ADIZ.

(ii) A flight originating within the Western Defense Area which maintains an outbound track into or through the Western ADIZ, Northern ADIZ, or Southern Border ADIZ without penetating the Albuquerque ADIZ, Eastern ADIZ, or a Coastal ADIZ.

(iii) A flight originating within the Central Open Area which maintains an outbound track into or through the Northern ADIZ or Southern Border ADIZ without pentrating the Albuquerque ADIZ, Eastern ADIZ, or Western ADIZ.

(iv) A flight originating in the Albuquerque ADIZ proceeding outbound into the Central Open Area without penetrating the Eastern or Western ADIZ: *Provided,* The route of flight passes no closer to Albuquerque or Los Alamos, New Mexico, than the point of departure.

(v) A local flight within ten (10) miles of the point of departure.

(vi) *Exception from requirement for two-way radio.* Aircraft without two-way radio may enter and operate within an ADIZ: *Provided,* That the pilot adheres to a filed DVFR flight plan which includes the route, altitude, point of penetration and estimated elapsed time to the point of penetration. Aircraft without two-way radio may operate entirely within an ADIZ: *Provided,* That the pilot adheres to a filed DVFR flight plan which includes the route and altitude within the ADIZ and he departs within five minutes of his estimated time of departure.

NOTE: The tolerances outlined in the under § 620.14 (b) will apply to exemption.

(3) *Hawaiian ADIZ.* Aircraft op ing within the Hawaiian ADIZ ove island or within three miles of the line of any island.

(4) *Guam ADIZ.* Within the ADIZ, the exceptions of subpara (1) of this paragraph may be grant the aeronautical facility exercisi curity control. The instructions at the time authorization is grant an intra-zone VFR flight shall i the requirement that the aircr equipped with a functioning t radio and that a listening wat maintained on the appropriate frequency.

§ 620.14 *Adherence to flight pl air traffic clearances.*—(a) *IFR fli* (1) *Within control zones and area* deviation shall be made from traffic clearance unless an am clearance is obtained from CAA air control. In case emergency autho used to deviate from the provision air traffic clearance, the pilot in mand shall notify air traffic cont soon as possible and, if necessary, an amended clearance. However ing in this paragraph shall pre pilot, operating on an IFR traffic ance, from notifying air traffic that he is canceling his IFR flig and proceeding under VFR: *Pr* That he is operating in VFR conditions when he takes such a

NOTE: A pilot who cancels an IF plan should not neglect to file a DVF plan if any of the remainder of th will be conducted in an Air Defense fication Zone.

(2) *Outside control zones an* When a flight is conducted in acc with IFR within or into an ADIZ an air traffic clearance is not requ the Civil Air Regulations, no de from the flight plan, as filed, made unless prior notification is an appropriate aeronautical fa

(b) *DVFR flights.* No deviati be made from a DVFR flight pla prior notification is given to an priate aeronautical facility.

NOTE: The requirements of the ai of the United States make it impera pilots adhere to their flight pla traffic clearances within the follow distance, and altitude tolerances. meet these requirements may jeop effective identification of aircraft by the national defense effort which are operated in excess of th ances may be subject to intercept

(a) Five minutes from an estima over a reporting point or point of tion of an ADIZ; or, in the case originating within an ADIZ, five from the proposed time of depart fied in the flight plan, unless the of departure is reported to the ap aeronautical facility.

(b) Ten miles from the centerl route of flight if the flight is enter erating within a Domestic ADIZ from the centerline of the route if the flight is entering or operati a Coastal ADIZ.

(c) A pilot in command of when on a DVFR flight plan or plan for which air traffic clearan quired should not deviate from altitude specified in the flight prior notification is given to an aeronautical facility, except that gin descent from the altitude spe flight path within reasonable destination without reporting altitude.

§ 620.15 *Emergency situa* emergency situations which re mediate decision and actio

…thod described in subdivision (ii) of this …paragraph are cautioned that this pro…ure does not eliminate the position re…rting requirements prescribed for the con… of air traffic.

§ 620.13 *Authorized exceptions.* The …visions of this subpart except for …20.17 are not applicable to the follow… aircraft operations:

(a) *Speeds excepted.* Aircraft operat… into or within an ADIZ at true air …eeds of 110 knots or less if the flight …conducted at an altitude of 1,500 feet …less above the terrain.

(b) *Altitudes excepted*—(1) *Hawaiian …IZ.* Aircraft operating within the …awaiian ADIZ on inter-Hawaiian …and flights on Red Civil Airway No. 87 …theast of the Island of Oahu, below …en thousand (7,000) feet MSL.

(2) *Alaskan Domestic ADIZ.* Air… …ft operating within the Alaskan …mestic ADIZ on a VFR flight originat… …from within the Alaskan Domestic …IZ if:

(i) The flight is confined to altitudes …,000 feet or less above the immediate …rain; and

(ii) The aircraft is flown no closer …n 500 feet to any other aircraft.

(c) *Areas or routes excepted*—(1) *…eral.* Flights exempted by a CAA air …ce traffic control center. Such flights …ll be operated in accordance with the …tructions, if any, issued at the time …exemption is granted.

…ote: Flights which may be exempted, …r approval has been obtained from appro…te military commanders, are (a) flights …ly within the boundaries of an ADIZ, …flights not currently of significance to …air defense system, or (c) military flights …ch are conducted in accordance with …ial procedures prescribed by appropriate …tary authorities.

(2) *Continental United States.* (i) A …t originating within the Eastern …ense Area which maintains an out…nd track into or through the Eastern …IZ, Northern ADIZ, Presque Isle …IZ, or Southern Border ADIZ without …etrating the Albuquerque ADIZ, …stern ADIZ, or a Coastal ADIZ.

(ii) A flight originating within the …tern Defense Area which maintains …utbound track into or through the …stern ADIZ, Northern ADIZ, or South… Border ADIZ without penetating the …querque ADIZ, Eastern ADIZ, or a …tal ADIZ.

(iii) A flight originating within the …tral Open Area which maintains an …ound track into or through the …hern ADIZ or Southern Border ADIZ …out pentrating the Albuquerque …IZ, Eastern ADIZ, or Western ADIZ.

(iv) A flight originating in the Albu…que ADIZ proceeding outbound into …Central Open Area without penetrat… …he Eastern or Western ADIZ: *Pro…*, The route of flight passes no closer …lbuquerque or Los Alamos, New …co, than the point of departure.

(v) A local flight within ten (10) miles …e point of departure.

(d) *Exception from requirement for …way radio.* Aircraft without two… …adio may enter and operate within …DIZ: *Provided*, That the pilot ad… …s to a filed DVFR flight plan which …des the route, altitude, point of pen…ion and estimated elapsed time to …oint of penetration. Aircraft with… …wo-way radio may operate entirely …n an ADIZ: *Provided*, That the pilot …as to a filed DVFR flight plan which …des the route and altitude within …DIZ and he departs within five …es of his estimated time of …ture.

Note: The tolerances outlined in the note under § 620.14 (b) will apply to this exemption.

(3) *Hawaiian ADIZ.* Aircraft operating within the Hawaiian ADIZ over any island or within three miles of the coastline of any island.

(4) *Guam ADIZ.* Within the Guam ADIZ, the exceptions of subparagraph (1) of this paragraph may be granted by the aeronautical facility exercising security control. The instructions issued at the time authorization is granted for an intra-zone VFR flight shall include the requirement that the aircraft be equipped with a functioning two-way radio and that a listening watch be maintained on the appropriate radio frequency.

§ 620.14 *Adherence to flight plans or air traffic clearances*—(a) *IFR flights*—(1) *Within control zones and areas.* No deviation shall be made from an air traffic clearance unless an amended clearance is obtained from CAA air traffic control. In case emergency authority is used to deviate from the provision of an air traffic clearance, the pilot in command shall notify air traffic control as soon as possible and, if necessary, obtain an amended clearance. However, nothing in this paragraph shall prevent a pilot, operating on an IFR traffic clearance, from notifying air traffic control that he is canceling his IFR flight plan and proceeding under VFR: *Provided*, That he is operating in VFR weather conditions when he takes such action.

Note: A pilot who cancels an IFR flight plan should not neglect to file a DVFR flight plan if any of the remainder of the flight will be conducted in an Air Defense Identification Zone.

(2) *Outside control zones and areas.* When a flight is conducted in accordance with IFR within or into an ADIZ where an air traffic clearance is not required by the Civil Air Regulations, no deviation from the flight plan, as filed, shall be made unless prior notification is given to an appropriate aeronautical facility.

(b) *DVFR flights.* No deviation shall be made from a DVFR flight plan unless prior notification is given to an appropriate aeronautical facility.

Note: The requirements of the air defense of the United States make it imperative that pilots adhere to their flight plans or air traffic clearances within the following time distance, and altitude tolerances. Failure to meet these requirements may jeopardize the effective identification of aircraft and thereby the national defense effort. Flights which are operated in excess of these tolerances may be subject to interception:

(a) Five minutes from an estimated time over a reporting point or point of penetration of an ADIZ; or, in the case of a flight originating within an ADIZ, five minutes from the proposed time of departure specified in the flight plan, unless the actual time of departure is reported to the appropriate aeronautical facility.

(b) Ten miles from the centerline of the route of flight if the flight is entering or operating within a Domestic ADIZ or 20 miles from the centerline of the route of flight if the flight is entering or operating within a Coastal ADIZ.

(c) A pilot in command of an aircraft when on a DVFR flight plan or an IFR flight plan for which air traffic clearance is not required should not deviate from the cruising altitude specified in the flight plan unless prior notification is given to an appropriate aeronautical facility, except that he may begin descent from the altitude specified in the flight path within reasonable distance of destination without reporting change of altitude.

§ 620.15 *Emergency situations.* In emergency situations which require immediate decision and action for the safety of the flight, the pilot in command of the aircraft may deviate from the provisions of this part to the extent required for such emergency. When a deviation is exercised, the pilot in command shall report such deviation and the reasons therefor, as soon as practicable to an appropriate aeronautical facility.

§ 620.16 *Radio failure*—(a) *IFR flights.* If unable to maintain two-way radio communications, the pilot in command of the aircraft shall:

(1) If operating under VFR conditions, proceed under VFR and land as soon as practicable, or

(2) Proceed according to the latest air traffic clearance to the radio facility serving the airport of intended landing, maintaining the minimum safe altitude or the last acknowledged assigned altitude whichever is higher. Descent shall start at the expected approach time last authorized or, if not received and acknowledged, at the estimated time of arrival indicated by the elapsed time specified in the flight plan.

Note: Detailed procedures to be followed by the pilot are contained in the CAA Flight Information Manual, for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

(b) *DVFR flights.* In case of the failure of two-way radio communications the flight may proceed in accordance with the original DVFR flight plan, and the pilot in command of the aircraft shall make a report of such failure, as soon as possible, to an appropriate aeronautical facility.

§ 620.17 *Air defense security instructions.* Under emergency air defense conditions which may involve the national security, aircraft shall be operated into or within an ADIZ in accordance with such additional special security instructions as may be issued by the Administrator. Such instructions will be consistent with the provisions of the "Plan for the Security Control of Air Traffic During a Military Emergency," as approved 15 July 1952, or as subsequently amended.

§ 620.18 *Violations.* In addition to the penalties otherwise provided for by the Civil Aeronautics Act of 1938, as amended, any person who knowingly or willfully violates any provision prescribed in this part, or any order issued thereunder shall be deemed guilty of a misdemeanor and upon conviction thereof, shall be subject to a fine of not exceeding $10,000 or to imprisonment not exceeding one year, or to both such fine and imprisonment.

SUBPART C—DESIGNATED AIR DEFENSE IDENTIFICATION ZONES AND DEFENSE AREAS

§ 620.20 *General.* Airspace above the following described areas is established by the Administrator of Civil Aeronautics as Domestic or Coastal Air Defense Identification Zones of Defense Areas.

§ 620.21 *Domestic ADIZ's*—(a) *Northern (Domestic) ADIZ.* The area bounded by a line 48°29'38" N., 124°43'35" W.; eastward along U. S.-Canadian Border to 47°10' N., 95°31' W.; 46°51' N., 94°00' W.; 47°10' N., 96°17' W.; 48°00' N., 99°00' W.; to 48°00' N., 125°15' W.; 48°29'38" N., 124°43'35" W. (point of beginning).

(b) *Presque Isle (Domestic) ADIZ.* The area bounded by a line 46°00' N., 69°38' W.; 46°00' N., 70°18' W.; northward and eastward along U. S.-Canadian Border to 44°46'36" N., 66°54'11" W.; 44°30' N., 67°07' W.; 44°19' N., 67°53' W.; 46°00' N., 69°38' W. (point of beginning).

(c) *Eastern (Domestic) ADIZ.* The area bounded by a line 46°51' N., 94°00' W.; 42°00' N., 96°45' W.; 39°20' N., 95°10' W.; 38°23' N., 95°08' W.; 37°30' N., 94°15' W.; 37°30' N., 92°00' W.; 36°00' N., 87°15' W.; 35°45' N., 86°30' W.; 35°00' N., 85°30' W.; 33°30' N., 84°50' W.; 30°50' N., 82°20' W.; 30°50' N., 80°54' W.; 30°05' N., 81°07' W.; 28°45' N., 80°00' W.; 27°30' N., 82°56' W.; 27°47' N., 83°08' W.; 28°45' N., 82°57' W.; 29°50' N., 84°00' W.; 30°10' N., 83°30' W.; 31°45' N., 84°00' W.; 34°55' N., 87°50' W.; 35°15' N., 89°08' W.; 35°40' N., 91°15' W.; 36°00' N., 93°20' W.; 36°00' N., 95°15' W.; 41°30' N., 98°00' W.; 43°50' N., 98°00' W.; 47°10' N., 96°17' W.; 46°51' N., 94°00' W. (point of beginning).

(d) *Albuquerque (Domestic) ADIZ.* The area bounded by a line 37°02' N., 110°52' W.; 38°45' N., 108°30' W.; 38°14' N., 104°50' W.; 37°15' N., 104°30' W.; 37°15' N., 104°14' W.; 35°10' N., 104°00' W.; 34°00' N., 104°00' W.; 33°00' N., 105°30' W.; 33°00' N., 107°30' W.; 34°00' N., 110°50' W.; 35°00' N., 110°50' W.; 37°02' N., 110°52' W. (point of beginning).

(e) *Western (Domestic) ADIZ.* The area bounded by a line 48°00' N., 117°00' W.; 48°00' N., 115°00' W.; 46°30' N., 115°00' W.; 44°45' N., 117°15' W.; 38°00' N., 117°00' W.; 36°00' N., 113°32' W.; 32°10' N., 113°45' W.; westward along U. S.-Mexican Border to 32°43' N., 114°45' W.; 33°08' N., 114°55' W.; 33°30' N., 115°15' W.; 34°30' N., 116°00' W.; 35°31' N., 116°22' W.; 36°00' N., 117°05' W.; 36°00' N., 118°48' W.; 39°15' N., 121°00' W.; 44°15' N., 121°00' W.; 45°20' N., 118°15' W.; 48°00' N., 117°00' W. (point of beginning).

(f) *Southern Border (Domestic) ADIZ.* A line extending from 32°16' N., 117°08' W.; 32°30' N., 117°20' W.; 32°32'03" N., 117°07'25" W.; eastward along the U. S.-Mexican Border to 25°58' N., 97°07' W.

(g) *Alaskan (Domestic) ADIZ.* The area bounded by a line 69°50' N., 141°00' W.; 60°18' N., 141°00' W.; easterly along the International Boundary line to 60°20' N., 139°30' W.; 59°30' N., 139°30' W.; 59°28' N., 146°18' W.; 56°34' N., 154°10' W.; 58°39' N., 162°03' W.; 63°17' N., 168°42' W.; 68°53' N., 166°16' W.; 71°18' N., 156°44' W.; 69°50' N, 141°00' W. (point of beginning).

§ 620.22 *Coastal ADIZ's*—(a) *Pacific (Coastal) ADIZ.* The area bounded by a line 48°29'38" N., 124°43'35" W.; 48°00' N., 125°15' W.; 46°15' N., 124°30' W.; 43°00' N., 124°40' W.; 40°00' N., 124°35' W.; 38°50' N., 124°00' W.; 34°50' N., 121°10' W.; 34°00' N., 120°30' W.; 32°16' N., 118°25' W.; 32°16' N., 117°08' W.; along line parallel to and approximately 12 miles from the Mexican Coast to 29°00' N., 114°51' W.; 28°00' N., 123°10' W.; 37°42' N., 130°40' W.; 48°30' N., 132°10' W.; 48°30' N., 125°00' W.; 48°29'38" N., 124°43'35" W. (point of beginning).

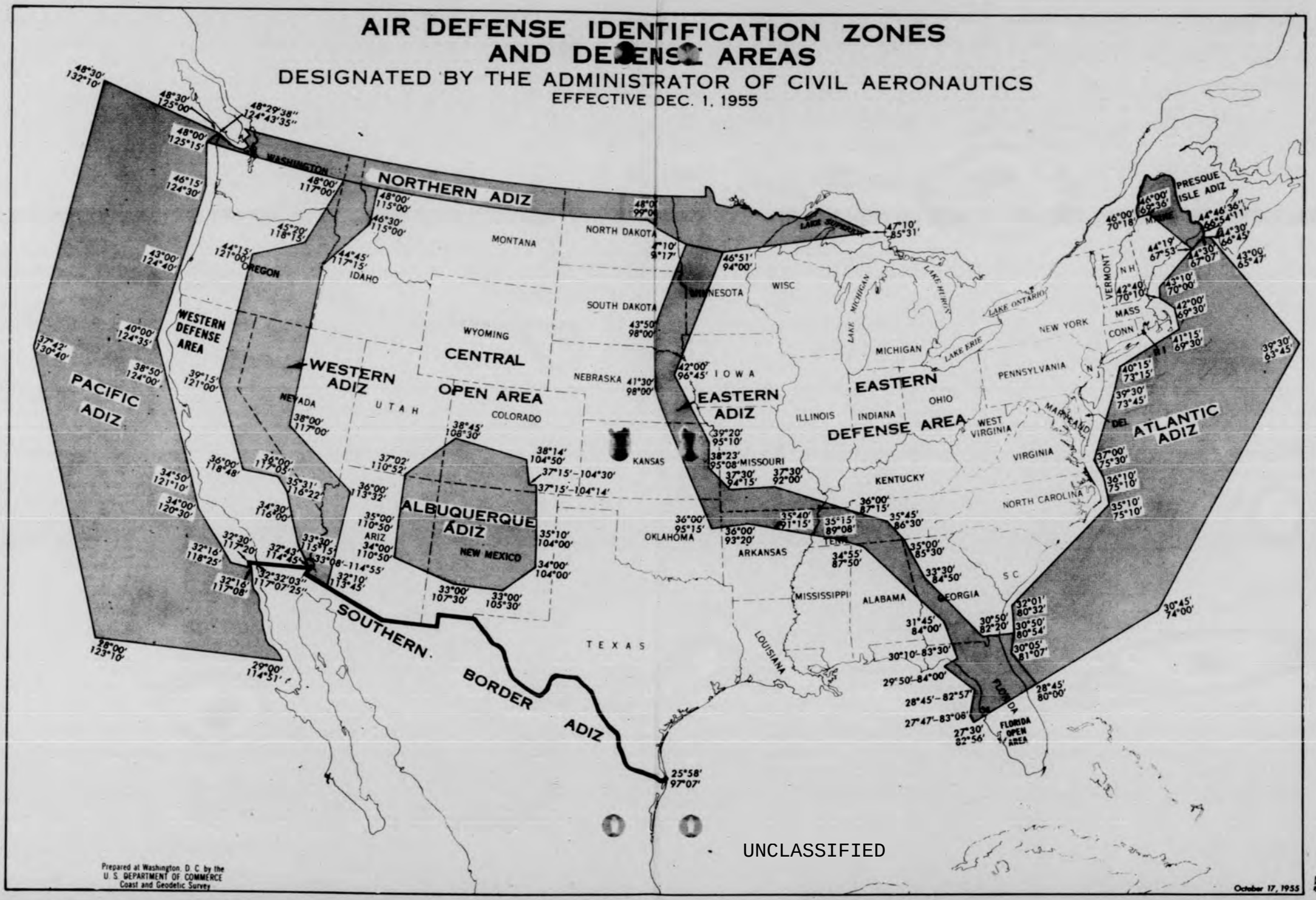
(b) *Atlantic (Coastal) ADIZ.* The area bounded by a line 44°30' N., 66°45' W.; 43°00' N., 65°47' W.; 39°30' N., 63° 45' W.; 30°45' N., 74°00' W.; 28°35' N., 80°00' W.; 30°05' N., 81°07' W.; 30°50' N., 80°54' W.; 32°01' N., 80°32' W.; 35° 10' N., 75°10' W.; 36°10' N., 75°10' W.; 37°00' N., 75°30' W.; 39°30' N., 73°45' W.; 40°15' N., 73°15' W.; 41°15' N., 69° 30' W.; 42°00' N., 69°30' W.; 42°40' N., 70°10' W.; 43°10' N., 70°00' W.; 44°19' N., 67°53' W.; 44°30' N., 67°07' W.; 44° 30' N., 66°45' W. (point of beginning).

(Continued on p. 6)

AIR DEFENSE IDENTIFICATION ZONES AND DEFENSE AREAS

DESIGNATED BY THE ADMINISTRATOR OF CIVIL AERONAUTICS

EFFECTIVE DEC. 1, 1955



Prepared at Washington, D. C. by the
U. S. DEPARTMENT OF COMMERCE
Coast and Geodetic Survey

October 17, 1955

UNCLASSIFIED

(c) *Hawaiian (Coastal) ADIZ.* The area bounded by a line 24°15′ N., 158°00′ W.; 22°30′ N., 155°30′ W.; 19°45′ N., 153°30′ W.; 19°00′ N., 155°00′ W.; 18°15′ N., 158°00′ W.; 20°00′ N., 161°00′ W.; 22°30′ N., 161°00′ W.; 24°15′ N., 158°00′ W. (point of beginning).

(d) *Guam (Coastal) ADIZ.* The area bounded by a circle with a radius of 200 nautical miles centered at the Guam Radio Range Station. (Latitude 13°32′ 41″ N., Longitude 144°50′30″ E.)

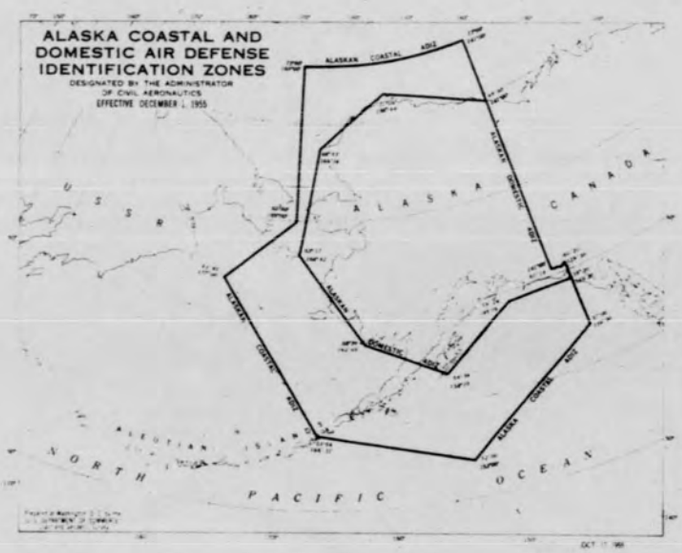
(e) *Alaskan (Coastal) ADIZ.* The area bounded by a line 73°00′ N., 141°00′ W.; 69°50′ N., 141°00′ W.; 71°18′ N., 156°44′ W.; 68°53′ N., 166°16′ W.; 63°17′ N., 168°42′ W.; 58°39′ N., 162°03′ W.; 56°34′ N., 154°10′ W.; 59°28′ N., 146°18′ W.; 59°30′ N., 139°30′ W.; 57°00′ N., 139°30′ W.; 52°00′ N., 153°00′ W.; 53°54′ N., 166°31′ W.; 61°45′ N., 177°00′ W.; 65°00′ N., 169°00′ W.; 73°00′ N., 169°00′ W.; 73°00′ N., 141°00′ W. (point of beginning).

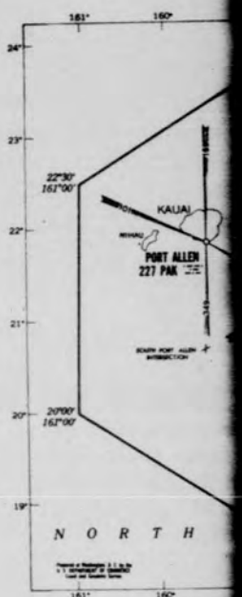
§ 620.23 *Defense areas*—(a) *Eastern Defense Area.* The area bounded by a line 46°51′ N., 94°00′ W.; 47°10′ N., 85°31′ W.; eastward along the U. S.-Canadian Border to 46°00′ N., 70°18′ W.; 46°00′ N., 69°36′ W.; 44°19′ N., 67°53′ W.; 43°10′ N., 70°00′ W.; 42°40′ N., 70°10′ W.; 42°00′ N., 69°30′ W.; 41°15′ N., 69°30′ W.; 40°15′ N., 73°15′ W.; 39°30′ N., 73°45′ W.; 37°00′ N., 75°30′ W.; 36°10′ N., 75°10′ W.; 35°10′ N., 75°10′ W.; 32°01′ N., 80°32′ W.; 30°50′ N., 80°54′ W.; 30°50′ N., 82°20′ W.; 33°30′ N., 84°50′ W.; 35°00′ N., 85°30′ W.; 35°45′ N., 86°30′ W.; 36°00′ N., 87°15′ W.; 37°30′ N., 92°00′ W.; 37°30′ N., 94°15′ W.; 38°23′ N., 95°08′ W.; 39°20′ N., 95°10′ W.; 42°00′ N., 96°45′ W.; 46°51′ N., 94°00′ W. (point of beginning).

(b) *Western Defense Area.* The area bounded by a line 48°00′ N., 125°15′ W.; 48°00′ N., 117°00′ W.; 45°20′ N., 118°15′ W.; 44°15′ N., 121°00′ W.; 39°15′ N., 121°00′ W.; 36°00′ N., 118°48′ W.; 36°00′ N., 117°05′ W.; 35°31′ N., 116°22′ W.; 34°30′ N., 116°00′ W.; 33°30′ N., 115°15′ W.; 33°08′ N., 114°55′ W.; 32°43′ N., 114°45′ W.; westward along U. S.-Mexican Border to 32°32′03″ N., 117°07′25″ W.; 32°30′ N., 117°20′ W.; 32°16′ N., 117°08′ W.; 32°16′ N., 118°25′ W.; 34°00′ N., 120°30′ W.; 34°50′ N., 121°10′ W.; 38°50′ N., 124°00′ W.; 40°00′ N., 124°35′ W.; 43°00′ N., 124°40′ W.; 46°15′ N., 124°30′ W.; 48°00′ N., 125°15′ W. (point of beginning).

NOTE: Unless specifically stated otherwise, the lines between points herein described are great circles except those lines between adjacent points on the same parallel of latitude. In this latter case, the lines are rhumb lines.

This part shall become effective 0001 e. s. t. December 1, 1955.

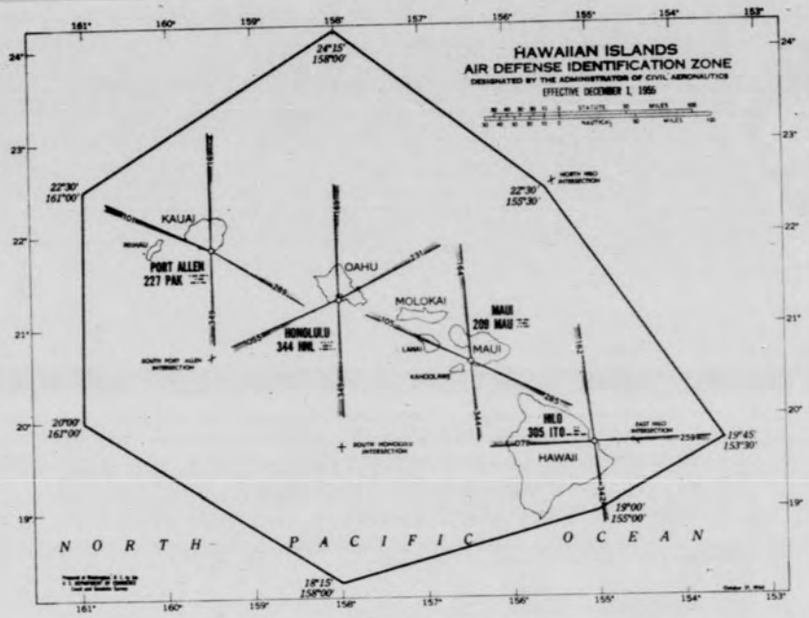


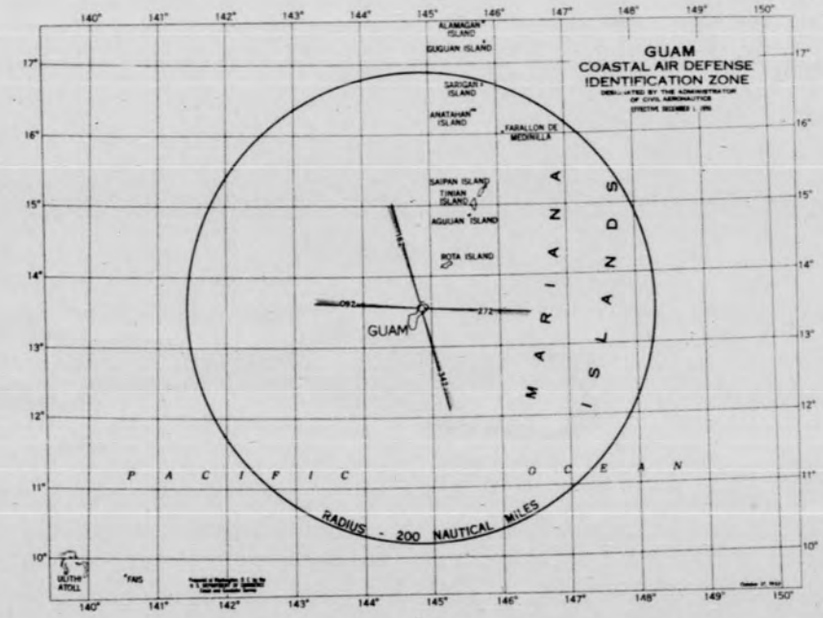


121°00′ W.; 36°00′ N., 118°48′ W.; 36°00′ N., 117°05′ W.; 35°31′ N., 116°22′ W.; 34°30′ N., 116°00′ W.; 33°30′ N., 115°15′ W.; 33°08′ N., 114°55′ W.; 32°43′ N., 114°45′ W.; westward along U. S.-Mexican Border to 32°32′03″ N., 117°07′25″ W.; 32°30′ N., 117°20′ W.; 32°16′ N., 117°08′ W.; 32°16′ N., 118°25′ W.; 34°00′ N., 120°30′ W.; 34°50′ N., 121°10′ W.; 38°50′ N., 124°00′ W.; 40°00′ N., 124°35′ W.; 43°00′ N., 124°40′ W.; 46°15′ N., 124°30′ W.; 48°00′ N., 125°15′ W. (point of beginning).

NOTE. Unless specifically stated otherwise, the lines between points herein described are great circles except those lines between adjacent points on the same parallel of latitude. In this latter case, the lines are rhumb lines.

This part shall become effective 0001 e. s. t. December 1, 1955.





A complete list of the Regulations of the Administrator is obtainable, without charge, from Office of Aviation Information, CAA, Washington 25, D. C. Information concerning amendments and their availability also is obtainable from the same source.

AVIATION INFORMATION

*U. S. GOVERNMENT PRINTING OFFICE: 1955 O - 366436

*AFR 60–22
*AR 95–110
*OPNAV Instruction 3722.5A
1–3

AIR FORCE REGULATION
NO. 60–22
ARMY REGULATIONS
NO. 95–110
OPNAV INSTRUCTION
NO. 3722.5A

DEPARTMENTS OF THE AIR FORCE,
THE ARMY, AND THE NAVY
WASHINGTON, *24 OCTOBER 1955*

346

FLYING

Identification and Security Control of Military Aircraft

(Effective 0001 EST, 1 December 1955)

SECTION A—GENERAL

1. Purpose and Scope. These regulations prescribe the rules and procedures which are considered necessary in the interest of national security to identify, locate, and control military air traffic in designated air defense identification zones in the United States and the coastal approaches thereto.

2. Responsibility. Commanders of all echelons will insure that military pilots are cognizant of the provisions of these regulations.

3. Definitions. For the purpose of these regulations, the following definitions will apply:

a. *Air Defense Identification Zone (ADIZ)*—Airspace of defined dimensions designated by the Administrator of Civil Aeronautics within which the ready identification, location and control of aircraft is required in the interest of national security. (These zones are delineated in Radio Facility Charts or other appropriate military regulations.)

(1) *Domestic Air Defense Identification Zone*—An air defense identification zone within the United States or along an international boundary of the United States.

(2) *Coastal Air Defense Identification Zone*—An air defense identification zone over the coastal waters of the United States.

b. *Open Area*—That portion of the United States not designated as an ADIZ or Defense Area in which the flight of aircraft is restricted by provisions of the Civil Aeronautics Administrator's regulations only during an Air Defense Emergency.

c. *Defense Area*—Airspace of defined dimensions, designated by the Administrator of Civil Aeronautics, within which the ready control of aircraft is required in the interest of the national security during an Air Defense Emergency.

d. *Security Identification Zone*—An airspace of defined dimensions, designated by the Department of Transport, Canada, extending upwards from the surface of the earth to a specified altitude within which southbound flights must be conducted in accordance with certain rules designed to facilitate ready identification of the aircraft.

e. *United States*—The District of Columbia, the several States, and the coastal approaches thereto.

f. *Local Flying*—Flights within established local flying areas and between parent bases and auxiliary bases of the parent base, and between

***These regulations supersede AFR 60–22, 26 January 1953, including Change 60–22A, 20 November 1953; AR 95–210, 26 January 1953, including C 1, AR 95–210, 20 November 1953; and OPNav Instruction 3722.5, 26 January 1953, including Ch. 1, OPNav Instruction 3722.5, 20 November 1953.**

such auxiliary bases, provided that no landings are to be made at other than the parent or auxiliary bases. (The term "bases" includes airfields, seadromes, and aircraft carriers or other vessels tending a[illegible]t.)

g. *Defense Visual Flight Rules (DVFR)*—Visual flight rules (VFR) applicable to flights which originate within, operate within, or penetrate an air defense identification zone toward a Defense Area or originate within, operate within or penetrate a coastal ADIZ.

h. *Flight Plan*—Specified information which is filed either verbally or in writing with an appropriate clearing agency relative to the intended flight of aircraft.

i. *Appropriate Aeronautical Facility*—The normal communications facility with which flight plans or position reports are filed.

j. *Reporting Point*—A geographical location in relation to which the position of an aircraft is reported.

k. *Position Report*—Information transmitted to an appropriate aeronautical facility in accordance with applicable regulations.

4. Violations. Reports of violations of Air Defense Identification Zones will be processed in accordance with the provisions of AFR 62–5/SR 95–145–1/OPNAV Instruction 3760.1.

5. Communications. Direct communications between all agencies and/or units is authorized for the purpose of coordinating the procedures outlined herein.

SECTION B—OPERATION OF MILITARY AIRCRAFT IN DESIGNATED AIR DEFENSE IDENTIFICATION ZONES

6. General. Pilots of aircraft will file either a DVFR or IFR flight plan prior to take-off, in writing or by telephone with an appropriate aeronautical facility when the flight:

a. Originates outside of the United States and penetrates a domestic ADIZ toward the United States.

b. Penetrates or operates within a coastal ADIZ.

c. Penetrates the Eastern or Western ADIZ toward a Defense Area or operates within subject ADIZ. (Flights originating in a Defense Area flying into or through the Eastern or Western ADIZ toward an open area to terminate in subject ADIZ or the open area but will not penetrate the Albuquerque ADIZ or Northern ADIZ are exempt from the provisions of these regulations.)

d. Penetrates or operates within the Albuquerque ADIZ. (Flights originating within the Albuquerque ADIZ which maintain a track away from the Los Alamos prohibited area are exempt from the provisions of these regulations while within the Albuquerque ADIZ. This includes flights departing Albuquerque eastbound on civil airways.)

e. Originates in the Northern ADIZ or the Presque Isle ADIZ or penetrates the Northern ADIZ or the Presque Isle ADIZ toward the United States.

NOTE: Aircraft flying at a TAS of 110 knots or less at an altitude of 1,500 feet or less above terrain are exempt from the provisions of these regulations with the exception of paragraph 12 which deals with security instructions in time of emergency.

7. Flight Plans:

a. *In Flight.* Flight plans will not be submitted in flight to provide for flights listed in paragraph 6.

b. *DVFR Flight Plans.* DVFR flight plans will include the route and altitude for penetration and/or operation while within an ADIZ.

c. *IFR Flights.* Flights conducted under instrument flight rules (IFR) will be as follows:

(1) *Within Air Traffic Control Areas*—Present IFR procedures will apply.

(2) *Outside Air Traffic Control Areas*—The reporting procedures specified for DVFR flights in d(2) below will apply.

d. *VFR Flights.* VFR flight plans filed for the category of flights specified in paragraph 6 will be preceded by the letter "D" (DVFR) and the following procedures will apply:

(1) *DVFR Flights Without Two-Way Radio Communication*—These flights may file DVFR provided that the aircraft commander adheres to a filed flight plan which will include the route, altitude, point of penetration and estimated elapsed time to the point of penetration.

(2) *DVFR Flights With Two-Way Radio Communication*—The pilot in command of an aircraft with functioning two-way radio communications will not enter or operate within an ADIZ at any altitude, until:

(a) He has r
aeronauti
tion and
craft pas
along the
prior to
and his
next repo
tended fli
This posi
while ove
or as soo

(b) A report
appropria
which co
position
will pene
(a) abov
position
sooner th
later than
tration.
made at
within an
AFR 60–1
ate OPNA
frequently
When pra
porting po

e. *Local Flying:*

(1) *Local IFR F*
cedures, incl
and emergen

(2) *Local VFR*
flights condu
within an A
a manner co
cation. Proc
fication of fli
prescribed by
commanding
after coordin
sion (Defens

f. *Mass Flights.* F
regulations, recurring ma
other than close formati
specified in pertinent re
the major command inv
mand, and Civil Aero

**8. Adherence to Flig
Clearance:**

a. *IFR Flights:*

(1) *Within Contr*
deviation wil
traffic clearan

visions of these regula-

erates within the Albu-
s originating within the
h maintain a track away
hibited area are exempt
these regulations while
ADIZ. This includes
erque eastbound on civil

Northern ADIZ or the
penetrates the Northern
Isle ADIZ toward the

t a TAS of 110 knots or
,500 feet or less above
the provisions of these
eption of paragraph 12
ty instructions in time

t plans will not be sub-
ide for flights listed in

ans. DVFR flight plans
d altitude for penetra-
hile within an ADIZ.

ghts conducted under in-
FR) will be as follows:
Traffic Control Areas—
procedures will apply.
Traffic Control Areas—
procedures specified for
s in d(2) below will

VFR flight plans filed
s specified in paragraph
he letter "D" (DVFR)
dures will apply:
hts Without Two-Way
unication—These flights
VFR provided that the
nander adheres to a filed
which will include the
e, point of penetration
d elapsed time to the
tration.
ts With Two-Way Radio
ion—The pilot in com-
aircraft with functioning
io communications will
operate within an ADIZ
de, until:

(a) He has reported to an appropriate aeronautical facility the time, position and altitude at which the aircraft passed the last reporting point along the flight path of the aircraft prior to penetration of an ADIZ and his estimated time over the next reporting point along the intended flight path of the aircraft. This position report will be made while over the last reporting point or as soon thereafter as possible.

(b) A report has been made to an appropriate aeronautical facility which contains the estimated time, position and altitude at which he will penetrate, if compliance with (a) above is impracticable. This position report will be made no sooner than 30 minutes and not later than 15 minutes prior to penetration. Position reports will be made at least once an hour while within an ADIZ as required by AFR 60–16, AR 95–8, or appropriate OPNAV instructions, or more frequently as may be required. When practicable, established reporting points will be used.

e. *Local Flying:*

(1) *Local IFR Flights*—Normal IFR procedures, including present reporting and emergency procedures will apply.

(2) *Local VFR Flights*—Local VFR flights conducted wholly or partially within an ADIZ will be performed in a manner conducive to ready identification. Procedures relative to identification of flights of this nature will be prescribed by the local commander, or commanding officers, as appropriate, after coordination with the Air Division (Defense) commander concerned.

f. *Mass Flights.* For the purpose of these regulations, recurring mass flights, when flown in other than close formation, will be conducted as specified in pertinent regulations as agreed to by the major command involved, Air Defense Command, and Civil Aeronautics Administration.

8. Adherence to Flight Plans or Air Traffic Clearance:

a. *IFR Flights:*

(1) *Within Control Zones and Areas.* No deviation will be made from an air traffic clearance unless an amended clearance is obtained from CAA air traffic control.

(2) *Outside Control Zones and Areas.* When a flight is conducted in accordance with IFR within or into an ADIZ where an air traffic clearance is not required by the Civil Air Regulations or appropriate military regulations, no deviation from the flight plan, as filed, will be made unless prior notification is given to an appropriate aeronautical facility.

b. *DVFR Flights.* No deviation will be made from a DVFR flight plan unless prior notification is given to an appropriate aeronautical facility.

c. *Time, Distance, and Altitude Tolerances.* To adhere to a flight plan, or an air traffic clearance, a pilot in command of an aircraft will not exceed the following tolerances:

(1) *Time.* Plus or minus 5 minutes from an estimate over a reporting point or point of penetration. Pilots departing from an airfield which has no tower facility will be required to make good a departure time within plus or minus 5 minutes of that proposed in the flight plan.

(2) *Distance.* Ten nautical miles from the center line of the route of flight if the flight is entering or operating within a domestic ADIZ or 20 nautical miles from the center line of the route of flight if the flight is entering or operating within a coastal ADIZ.

(3) *Altitude Deviation.* A pilot in command of an aircraft when on a DVFR flight plan or an IFR flight plan for which air traffic clearance is not required will not deviate from the cruising altitude specified in the flight plan unless prior notification is given to an appropriate aeronautical facility, except that he may begin descent from the altitude specified in the flight plan within reasonable distance of destination without reporting change of altitude.

d. *Revision of Flight Plan.* The pilot in command of an aircraft will immediately transmit corrected information to an appropriate aeronautical facility when it becomes evident that a previously filed estimated time over a reporting point or point of penetration of an ADIZ is in

error in excess of the time and distance tolerances indicated in c(1) and (2) above.

e. *Change of Flight Plan from IFR to DVFR.* Aircraft commanders of IFR flights subject to the provisions of these regulations who desire to change to a VFR flight plan in the air before the ADIZ portion of the flight is completed, will request the change to be made as DVFR instead of VFR.

9. Coastal Air Operations. In coastal ADIZs, when compliance with the provisions of this section is impracticable, identification and reporting procedures will be as prescribed and mutually agreed to by the appropriate Air Defense Force commander(s) and Sea Frontier commander(s), Fleet commander(s), Coast Guard commander(s), and/or other military and civil agencies concerned.

10. Emergency Procedures. In emergency situations which require immediate decisions and action for the safety of the flight, the pilot in command of the aircraft may deviate from the provisions of these regulations to the extent required for such emergency. When a deviation is exercised the pilot in command will report such deviation, and the reasons therefor, as soon as practicable to military Flight Service.

11. Radio Failure:

a. *IFR Flights*—In case of the failure of two-way radio communications, the pilot in command of the aircraft will proceed as prescribed by appropriate regulations for such situations.

b. *DVFR Flights*—In case of failure of two-way radio communications, the flight may proceed in accordance with the original DVFR flight plan and the pilot in command of the aircraft will make a report of such failure, as soon as possible, to an appropriate aeronautical facility.

12. Air Defense Security Instructions. Under emergency air defense conditions which may involve the national security, aircraft will be operated in accordance with such additional special security instructions as may be issued. These instructions will be consistent with the provisions of the "Plan for the Security Control of Air Traffic during a Military Emergency (SCAT)" 15 July 1952, as approved.

BY ORDER OF THE SECRETARIES OF THE AIR FORCE, THE ARMY, AND THE NAVY:

OFFICIAL:

E. E. TORO
Colonel, USAF
Air Adjutant General

N. F. TWINING
Chief of Staff, United States Air Force

OFFICIAL:

JOHN A. KLEIN
Major General, United States Army
The Adjutant General

MAXWELL D. TAYLOR
General, United States Army
Chief of Staff

OFFICIAL:

G. L. RUSSELL
Rear Admiral, United States Navy
Deputy Chief of Naval Operations
(Administration)

ARLEIGH BURKE
Chief of Naval Operations

DISTRIBUTION:

Air Force:
S

Army:
Active Army: B
To be distributed on a need-to-know basis to all units and headquarters down to and including separate battalions (administrative) and to units and headquarters of comparable size and responsibility.

NG: State AG (3)
USAR: None

☆ U. S. GOVERNMENT PRINTING OFFICE: 1955

[redacted]

IBM CD NO. 904-1637
COPY NO. 15

This report consists of 84 total pages including text, figures, and tables.

347

AN/FSQ-7

ENGINEERING PROGRESS REPORT

CONTRACT NO. AF 30(635)-1404

DECEMBER 1, 1955

PROJECT HIGH

MILITARY PRODUCTS DIVISION

INTERNATIONAL BUSINESS MACHINES CORPORATION

POUGHKEEPSIE, NEW YORK

KINGSTON, NEW YORK

[redacted]

347

CONTENTS

CONTENTS (Cont'd)

347

CONTENTS (Cont'd)

ILLUSTRATIONS

ILLUSTRATIONS (Cont'd)

TABLES

347

CHAPTER 1
INTRODUCTION

This document is the ninth quarterly progress report to be published in accordance with the provisions of Contract AF 30 (635)-1404 between the U. S. Air Force and the International Business Machines Corporation. The report covers the period from September 1, 1955, to November 30, 1955.

1.1 CONTRACTUAL AGREEMENTS, OCTOBER, 1952, TO AUGUST, 1953.

Initial design of the AN/FSQ-7 Combat Direction Central (XD-1) began when IBM was awarded Subcontract No. 20 from Lincoln Laboratory of the Massachusetts Institute of Technology in October, 1952. At that time, Lincoln Laboratory was performing under Prime Contract AF 19 (122)-458 in agreement with the Rome Air Force Depot.

Under Subcontract No. 20, which covered work accomplished by IBM between October 27, 1952, and April 27, 1953, IBM agreed to assist Lincoln Laboratory by studying the data processing and control requirements of the U. S. Air Defense System, by evaluating these requirements in order to determine a type of digital computer system capable of fulfilling air defense needs, and by formulating a preliminary design approach for fabricating this equipment. Subcontract No. 20 expired in April, 1953, and was superseded by Prime Contract AF 19 (604)-727.

From April, 1953, to August, 1953, IBM performed under Prime Contract AF 19 (604)-727 from the Air Force Cambridge Research Center (AFCRC). Work under this contract was primarily concerned with research and development studies for formulating equipment specifications. Additional work included design of circuit logic and the preparation of logical drawings, systems planning and the establishment of standards and specifications for both computer circuits and computer components. Contract AF 19 (604)-727 expired in August, 1953, and was superseded by Letter Contract AF 30 (635)-1404.

1.2 CONTRACT AF 30 (635)-1404

Contract AF 30 (635)-1404 was issued by the Rome Air Force Depot to IBM as a letter contract on September 1, 1953. Its provisions called for IBM to design, manufacture, install, and maintain two prototype Combat Direction Centrals, AN/FSQ-7 (XD-1, XD-2). On February 25, 1955, it became a definitive contract, and since that time has been amended by Supplemental Agreement No. 2. This amendment provided for an increase in the scope of the work described in engineering exhibit AFCRC 1-A. Engineering exhibit AFCRC 1-A, which outlines the general requirements and the performance requirements for the prototype machines, superseded exhibit AFCRC 1 and amendments thereto.

Contract change notifications (CCN's) made on contract AF 30 (635)-1404 which have been issued by the Rome Air Force Depot to date are listed in table 1-1.

The table shows that by the end of this reporting period the Air Force had issued eight CCN's on definitive contract AF 30 (635)-1404. Contract change notifications are comprised of one or more approved ECP's or amendments to the contract engineering exhibit.

The six additional auxiliary drums for XD-1 which were authorized by CCN 1 have been installed, and unit testing of unit 20, which houses the drums, has started. In addition, marginal checking and distribution (MCD) unit 46, which is used for marginal checking the auxiliary drum circuitry, has been installed. The Command Post room requirements called for in CCN 2 will be completed in January, 1956. Installation and testing of the two additional index registers added to the program unit of XD-1, as called for in

TABLE 1-1. CCN'S TO CONTRACT AF 30 (635)-1404

CCN No.	Description	Date Received From Air Force
1	Auxiliary Drums (XD-1)	April 4, 1955
2	Command Post Digital Display Consoles, Console for Projection Display, and Command Post Room Alteration (XD-1)	July 18, 1955
3	Additional Index Registers for Program Unit (XD-1)	July 18, 1955
4	Investigation of Display System Changes (XD-1)	August 10, 1955
5	Accomplish Display System Changes (XD-1)	August 24, 1955
6	Incorporate Engineering Change Proposals (ECP's) 0001, 0002, 0003, 0005, 0006, and 0007	November 9, 1955
7	Incorporate ECP 0009	November 8, 1955
8	Incorporate ECP's 0004 and 0008	November 18, 1955

CCN 3, have been successfully completed. The Display System changes authorized by CCN 4 and CCN 5 will not be completed until February, 1956.

Engineering change proposals 0001, 0002, 0003, 0006, and 0007, which are authorized by CCN 6, call for relatively small changes to the XD-1 Central Computer System. Engineering change proposal 0005, which is also contained in CCN 6, provides for an increase of the XD-1 digital display capacity. Contract change notification 7 authorized ECP 0009 which calls for increasing the number of XD-1 teletype lines from 5 to 25. Engineering change proposals 0004 and 0008, which deal with XD-1 card machine changes and the addition of a core memory assignment switch to the XD-1 Central Computer System, respectively, are authorized by CCN 8.

Figure 1-1 is a composite chart which shows the status of contract AF 30 (635)-1404 as it existed at the close of this reporting period.

1.3 LETTER CONTRACT DESIGNATED SUPPLEMENTAL AGREEMENT NO. 1 TO AF 30 (635)-1404

A letter contract designated Supplemental Agreement No. 1 to AF 30 (635)-1404 was granted to IBM by the Rome Air Force Depot on January 19, 1954. This letter contract called for the design, manufacture, installation, and maintenance of two production type AN/FSQ-7 (DC-1, DC-2) Combat Direction Centrals. In addition, the contract stipulated that design and fabrication of the production Combat Direction Centrals must be accomplished in accordance with the requirements given in engineering exhibit AFCRC-17. To date, the Rome Air Force Depot has approved six amendments to this letter contract.

Amendments 1 and 2 authorize certain allowable costs. The third amendment provides for an increase in contract funds. Amendment 4 provides for the addition of auxiliary drums

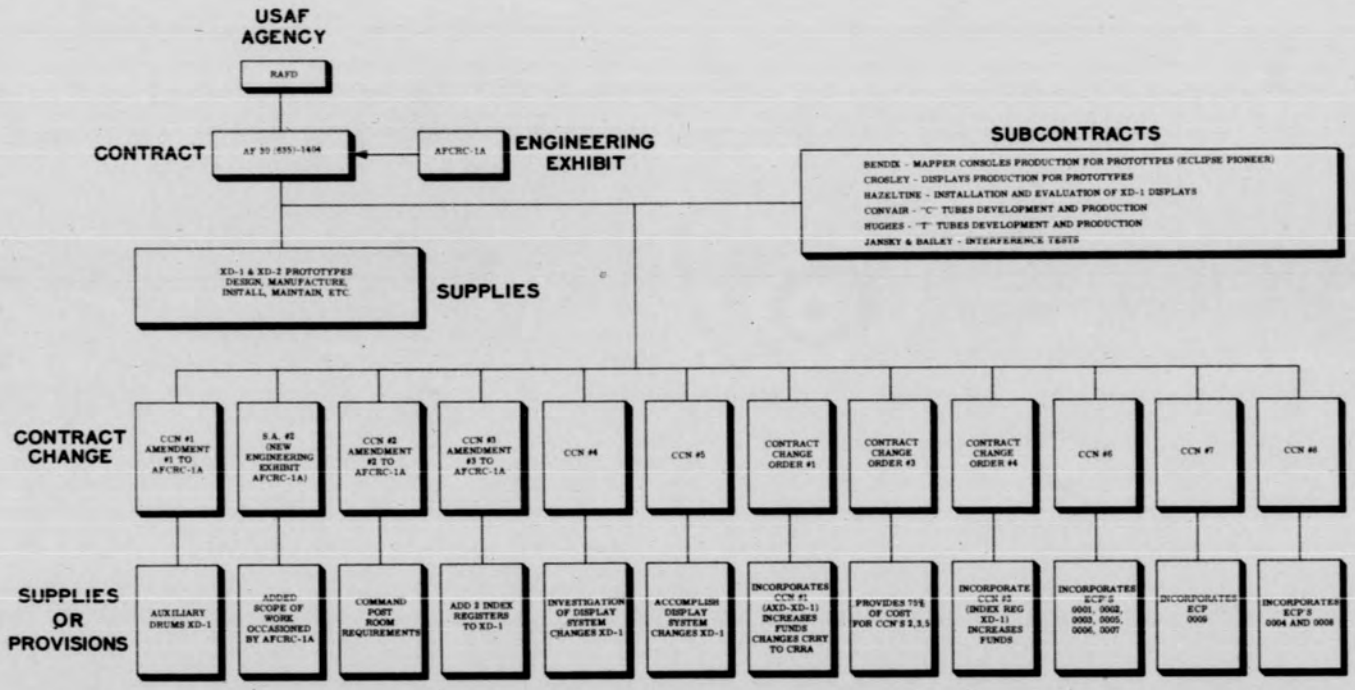


FIGURE 1-1. CONTRACT AF 30 (635)-1404

[redacted]

to the first two production machines (DC-1 and DC-2). IBM received final Air Force approval to amendment 5 on October 26, 1955. This amendment stipulates that manufacture, installation, and maintenance of all production Combat Direction Centrals would be performed under Letter Contract AF 30 (635)-3130 and not under the letter contract which is designated Supplemental Agreement No. 1 to AF 30 (635)-1404. Consequently, the letter contract designated Supplemental Agreement No. 1 to AF 30 (635)-1404 is now exclusively concerned with the design of production Combat Direction Centrals.

Amendment 6 adjusts the funds comitted under the letter contract. In addition, the amendment adds the design of the AN/FSQ-8 Combat Control Central and the design of special tools and test equipment to the scope of work. General requirements and performance requirements for designing the AN/FSQ-8 are given in engineering exhibit AFCRC-55-18.

A composite chart showing all amendments to the letter contract designated Supplemental Agreement No. 1 to AF 30 (635)-1404 is shown in figure 1-2.

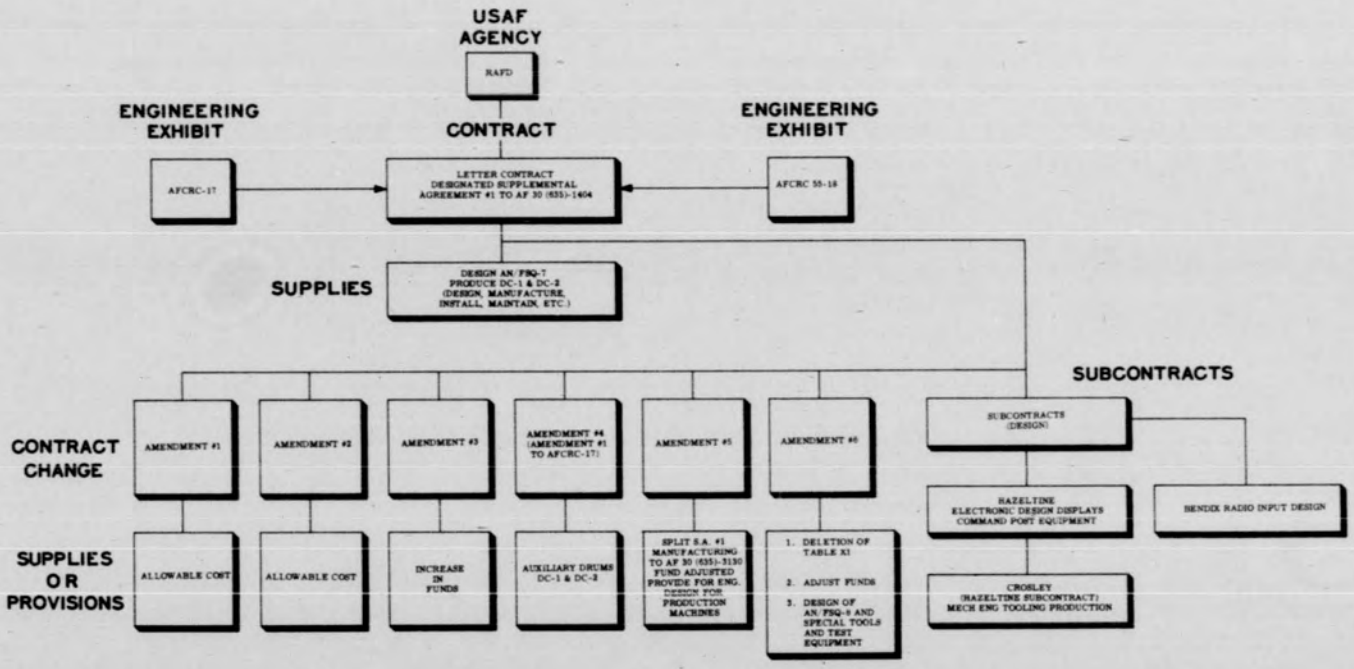


FIGURE 1-2. LETTER CONTRACT DESIGNATED SUPPLEMENTAL AGREEMENT NO. 1 TO AF 30 (635)-1404

347

CHAPTER 2
PROJECT SUMMARY

In October, 1952, under the provisions of Subcontract No. 20 with the MIT Lincoln Laboratory, IBM, in close collaboration with Lincoln Laboratory, undertook the task of evolving preliminary design approaches leading to the manufacture of a large-scale, versatile, electronic control and data processing system capable of becoming the nucleus of each of the Semi-Automatic Ground Environmental (SAGE) System subsectors which will comprise the nation's air defense network.

A subsequent contract between the U. S. Air Force Air Materiel Command and IBM called for IBM to design, fabricate, install, and maintain two prototype machines designated AN/FSQ-7 Combat Direction Centrals XD-1 and XD-2. Performance specifications called for the Combat Direction Centrals to receive and process data relevant to air defense, to present displays, to compute and transmit weapons orders to defensive weapons, and to communicate with other Centrals in adjacent sectors.

The basic prototype equipment consisted of a large, high-speed, general-purpose, real-time digital computer with extensive storage capacities, and of the associated accessory units required to adapt the computer to the unique requirements of the U. S. Air Defense System. The digital computer in this system is a binary single-address machine which employs parallel operation.

In November, 1953, it was decided to adopt the concept of duplex Combat Direction Centrals. The basic philosophy of the duplex central consists of duplicating, at one location, all common electronic units whose failure could put the Central out of operation. Work on the production AN/FSQ-7 Combat Direction Centrals has included planning and major design modification of prototype equipment to accommodate the philosophies of duplexing.

To begin work on the prototype Combat Direction Central, engineering personnel were drawn from the staff of the IBM Engineering Laboratory in Poughkeepsie. Their experience was primarily with electronic digital computers.

During the summer of 1953, arrangements were made to provide space in the IBM Poughkeepsie plant for construction of the prototype equipment. Work on the prototypes included planning, design, development, manufacturing, and testing at the IBM facilities in Poughkeepsie. It has also included the development of maintenance techniques such as marginal checking and diagnostic and reliability programming, a comprehensive standards program, and the establishment of multiple sources of supply for critical components.

Shipment of the AN/FSQ-7 (XD-1) from Poughkeepsie to its installation site in Building F at Lincoln Laboratory began in November, 1954. All AN/FSQ-7 (XD-1) equipment, with the exception of some consoles of the Display System, has now been delivered to Lexington.

System testing of AN/FSQ-7 (XD-1) is virtually completed. Tests still to be performed concern Display System consoles and their associated manual input equipment. During this quarter, the connecting of external equipment to the prototype machine was begun. Test patterns were obtained over telephone lines from the South Truro radar site, and test data was successfully transmitted over the output teletype system to the Montauk Point radar site.

Early in this reporting period, AN/FSQ-7 (XD-2) was moved from Poughkeepsie and successfully installed at the IBM Military Products Division center in Kingston, N. Y. By the end of the quarter, system testing was successfully completed on the Central Computer System and begun on the Drum System.

[redacted]

By the end of this quarter, bills of material for all IBM-designed units for AN/FSQ-7 had been released to production and plans for system testing the machine were being made. In addition to duplexing, prototype design modifications were made to increase the reliability and the operational capacity of production AN/FSQ-7 Combat Direction Centrals over that of prototype machines. Also, manufacturing goals were established which call for IBM to produce one Direction Central per month. Construction has begun on test equipment that is to be located at the field sites. This equipment is scheduled for delivery to the Air Force with the AN/FSQ-7 (DC-1). Work has also progressed on IBM-directed component improvement programs (on a subcontract basis) to insure availability of highly reliable components for production machines.

[redacted]

CHAPTER 3
PROJECT ORGANIZATIONAL STATUS

On October 20, 1955, a new IBM division to be known as the IBM Military Products Division was established. The Military Products Division will be responsible for all military projects assigned to IBM, including those in process at the time of its inception. Administrative offices of the new division will be at IBM World Headquarters in New York City. Engineering and manufacturing facilities will be located in two general areas in New York State. One will be in the Kingston-Poughkeepsie area, with the center of operation at IBM Kingston. This center has cognizance of definitive contract AF 30 (635)-1404 and letter contract designated Supplemental Agreement No. 1 to AF 30 (635)-1404. The second area will be at the IBM Airborne Computer Laboratory now located at Vestal, New York. The organizational structure of the Military Products Division, Kingston, is shown in figure 3-1.

3.1 PERSONNEL

Table 3-1 gives the total and division of personnel engaged in work relating to definitive contract AF 30 (635)-1404 and letter contract designated Supplemental Agreement No. 1 to AF 30 (635)-1404.

Forty-eight percent of the man-hours spent by project personnel has been charged to definitive contract AF 30 (635)-1404 and 52 percent to letter contract designated Supplemental Agreement No. 1 to AF 30 (635)-1404.

TABLE 3-1. PROJECT PERSONNEL

Department	No. of Personnel
Development Engineering	742
Product Engineering	523
Subcontractors (on premises)	34
Manufacturing (prototype)	9
Total	1308

3.2 FLOOR SPACE

Table 3-2 lists current floor space allotments for work on definitive contract AF 30 (635)-1404 and letter contract designated Supplemental Agreement No. 1 to AF 30 (635)-1404.

TABLE 3-2. PROJECT FLOOR SPACE

Location	Area (Square Feet)
Poughkeepsie	44,500
Kingston	53,300*
Lexington	15,200**
Total	113,000

* Includes 12,560 square feet for AN/FSQ-7 (XD-2) equipment.

**Includes 10,000 square feet for AN/FSQ-7 (XD-1) equipment.

MILITARY PRODUCTS DIVISION KINGSTON

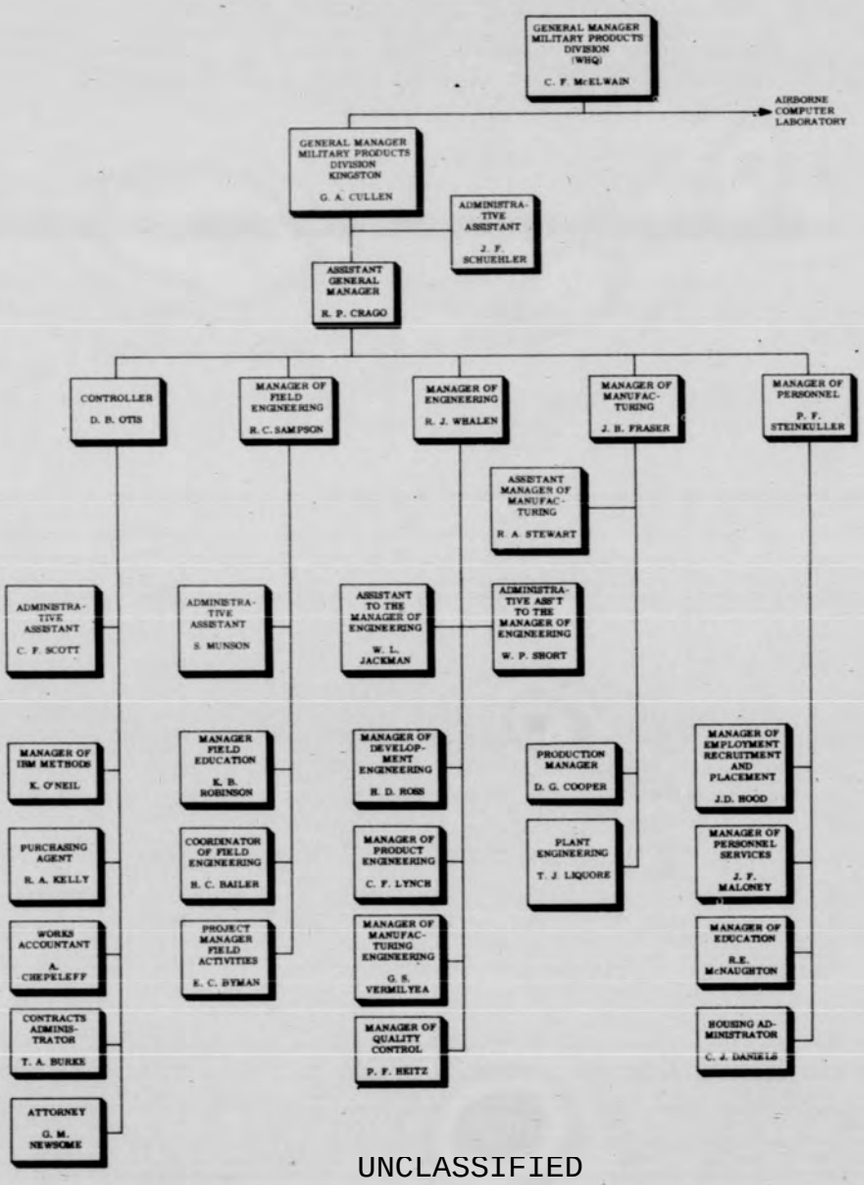


FIGURE 3-1. ORGANIZATIONAL STRUCTURE, MILITARY PRODUCTS DIVISION, KINGSTON

CHAPTER 4
AN/FSQ-7 (XD-1, XD-2) ENGINEERING

Engineering of the AN/FSQ-7 (XD-1, XD-2) prototype Combat Direction Centrals has included planning, design, manufacture, monitoring of subcontract activities, installation, testing, and establishing of maintenance methods and a spare parts policy.

The AN/FSQ-7 (XD-1) Combat Direction Central is now nearly completely installed in Building F of the Lincoln Laboratory of MIT at Lexington, Mass., and will be used to test operational programs, tactical procedures, and equipment performance prior to operation of the SAGE Defense System. The main concentration of effort on the XD-1 during this quarter has been on the completion of system testing of the Input and Output Systems, installation and testing of consoles of the Display System, incorporation of the CCN's listed in table 1-1, and on maintenance activities.

The AN/FSQ-7 (XD-2) Combat Direction Central was moved to its installation site in IBM's Military Products Center at Kingston at the beginning of this reporting period, and installation of the major portion of the equipment has been completed. The basic purpose of the XD-2 is to support production and field machines with engineering evaluation of any changes, modifications, or new developments. More specifically, the XD-2 will be used for the following purposes:

a. Engineering change evaluation

b. Development of maintenance programs and techniques

c. Training of maintenance personnel

d. Simulation of problems encountered in the field so that these problems can be studied without interrupting field equipment operation.

4.1 PLANNING

Although the original planning for the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals has long since been completed, changes and additions to equipment specifications are being made as operational requirements become more clearly defined and as a result of experience gained in equipment testing. All changes or additions to equipment specifications are concurred upon by IBM and Lincoln Laboratory. Implementation of these changes and additions requires prior Air Force approval by means of engineering change proposals.

Lincoln Laboratory memorandum 6M-3851-1, Master Reference List of Equipment Specifications for XD-1, lists the documents that formed the equipment specifications for the AN/FSQ-7 (XD-1) as of October 11, 1955. This listing will be brought up to date as necessary.

During this quarter, concurrence was reached on a specification which will increase the number of output teletype lines from 5 to 10, and eventually to 25, with the changes to accommodate 25 lines being made now. The Air Force gave approval to this proposal in CCN 7. Concurrence was also realized on a specification whereby three LRI monitor consoles will be provided for operation with the XD-1 breadboard LRI monitor unit. This was considered important in the evaluation of the LRI monitor equipment.

An additional specification concurred upon calls for making the complement of manual input pushbuttons, neons, alarms, and label layouts on the consoles of the AN/FSQ-7 (XD-2) compatible with their counterparts in the AN/FSQ-7 (XD-1).

4.2 DESIGN

Original design of the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals was completed

in May, 1955. However, testing has since indicated certain areas where equipment performance can be improved by redesign. Among the more important of these areas are:

a. The core current drivers (CCD's) and flux amplifiers (FA's) which are connected to the ferrite core storage arrays of the Output System

b. Overcoming the incompatibility of the search times and start-read pulses of the Drum System

c. Certain core memory circuits

Redesign work on a and b is described in this chapter since this work is directly applicable to the prototype equipment. It will, however, also affect the production equipment. Work on c is more directly applicable to the production equipment and is therefore described in Chapter 5.

Additional design work performed during this quarter includes that on the Command Post of the AN/FSQ-7 (XD-1) and on special test equipment for the AN/FSQ-7 (XD-1).

4.2.1 Drum System

During the running of XD-1 Output System tests at Lexington, occasional non-search alarms occurred which were caused by an error in drum logic. These alarms were generated when information in the first 36 registers of the drum field selected for read-out by the first field switching pulse was lost due to precession of the start-read pulses on the three output buffer (OB) drum fields.

Intermittent or sporadic alarms occurred because the 36 registers, which were missed only during read-out, did not always contain information or because search time and start-read pulses were coincident or nearly coincident. When the registers contained no information, alarms were not generated; when the registers contained information, and when search time and start-read pulses were coincident or nearly coincident, again no alarms were generated. However, when information was contained in the 36 registers and when start-read pulses and search time were non-coincident, all or part of the information was lost and alarms were generated.

The problem was solved by a revision in drum logic. Field switching is now accomplished by the drum index pulse instead of by a 2,060 counter. The drum index pulse does not precess during field switching, but always occurs at the same time position on each drum field. The index pulse also resets a scale-of-12 counter which generates the start-read pulse 120 microseconds after the drum index pulse. This delay is necessary to allow switching transients in the read amplifiers to subside.

The revised drum logic makes it mandatory that the 12-register section between the field switching pulse and the start-read pulse of each OB drum field never be written into or read from. Although this effects a 36-register reduction in drum capacity, it has been calculated that the remaining 6,108 registers will probably be adequate for central computer requirements. The change in logic was accomplished by replacing four pluggable units in the Drum System with three other pluggable units of existing types. No changes were required in the Output System.

4.2.2 Output System

During unit testing of the XD-1, the operating margins of the output storage element were found to be insufficient. This deficiency was caused by deterioration of the half-write currents supplied by the CCD's as well as by the loading due to the FA circuits at the time of writing information into the ferrite core arrays. It became necessary to modify the CCD's to provide better half-write current regulation and to change the FA so that it would present a minimum load at writing time. The objective of these changes was not to redesign in order to produce an optimum circuit, but rather to obtain a circuit capable of producing good results with a minimum of changes in the shortest possible time.

4.2.2.1 Core Current Driver Modifications

An attempt was made to improve the CCD by adding inductance and capacitance, but only minor improvement resulted. It then became necessary to change the basic design. However, it was felt that the largest available tape core should be used in order to save the time

347

necessary to design a new one, and that the original circuits of the core drivers (both set drivers and reset-inhibit drivers) should be retained in their original form as far as possible. The two areas remaining in which complete changes could be made were the windings on the CCD's and the value of the terminating resistor. The form of the original CCD is shown in figure 4-1.

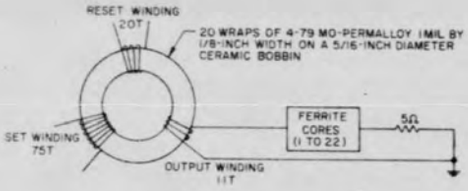


FIGURE 4-1. ORIGINAL TAPE CORE CONFIGURATION

The output waveforms of this circuit are shown in figure 4-2.

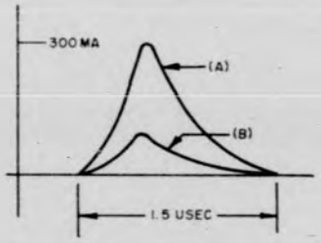


FIGURE 4-2. OUTPUT WAVEFORM OF ORIGINAL CORE CURRENT DRIVER

In figure 4-2, curve (a) represents the output with light load, and curve (b) represents the output with heavy load (many cores). These peaked waveforms were not ideal; the desired pulse would have a level of 240 milliamperes for a period longer than 1.5 microseconds.

Investigation showed that increasing the value of the terminating resistor produced much better output half-write current regulation, but that the number of turns of the output winding had to be increased in order to maintain the desired value of output pulse width. Increasing output winding turns necessitated an increase in reset winding turns to produce the desired output current with a given reset current. In addition, the set driver was not completely switching the core, and the number of turns of the set winding had to be increased to insure that the core was completely switched during the allotted time.

Figure 4-3 shows the redesigned CCD. In addition to changing the number of turns of the various windings, the location of the windings on the core bobbin was also changed in order to take into account the effects of the leakage inductance.

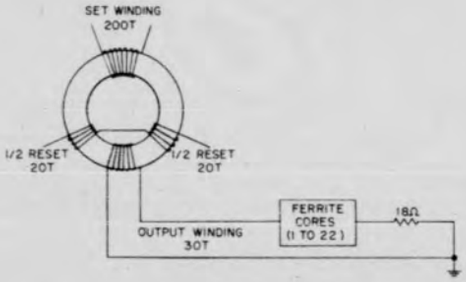


FIGURE 4-3. REDESIGNED CORE CURRENT DRIVER

The output waveform for this circuit is shown in figure 4-4, which is a more desirable

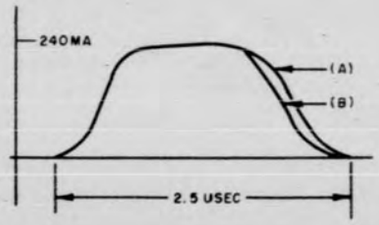


FIGURE 4-4. OUTPUT WAVEFORM OF REDESIGNED CORE CURRENT DRIVER

form. Curve (a) represents the output with a light load, and curve (b) represents the output with a heavy load. The regulation is now within 10 percent.

Because of the changes made in the CCD, some changes have also been made in the reset inhibit driver (RID). As yet, margins have not been run on the new RID, but preliminary tests are favorable. The new circuit is shown in figure 4-5. At the present time, three such RID's are being used for each array, but it is felt that this new circuit will make it possible to return to using only one RID for each array.

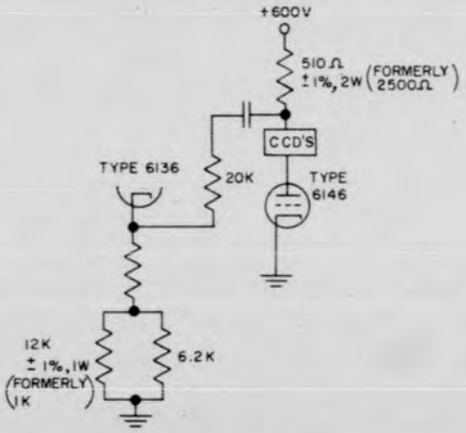


FIGURE 4-5. DESIGN CHANGES TO RESET INHIBIT DRIVER

4.2.2.2 Flux Amplifier Redesign

During testing of the AN/FSQ-7 (XD-1) at Poughkeepsie, it was found that undesired 1's were being passed by the FA's because of input signals arriving at the grid of the FA at improper times. A tentative gating circuit was developed and was being wired in when the equipment was shipped to Lexington. Following installation of the equipment at Lexington, the work of applying gating was completed and testing was begun. These tests were run successfully, but noise was still present in the FA output. This difficulty was overcome by changing the grounding system. Better clipping level margins also were obtained. As testing continued, it was found that the tentative gating circuit, in which the FA's were gated directly by the output of an inverter, did not operate as expected. In this circuit, each inverter was connected to drive nine FA's and operation was successful when only one FA was pulsed; when all nine were pulsed, the inverter was loaded down and the gate became ineffective. To remedy this trouble, two type B cathode followers were added to the circuit between the inverter and each of the nine FA's, as shown in figure 4-6. The FA clipping levels for the G/G section then compared favorably with those for the ungated G/A section.

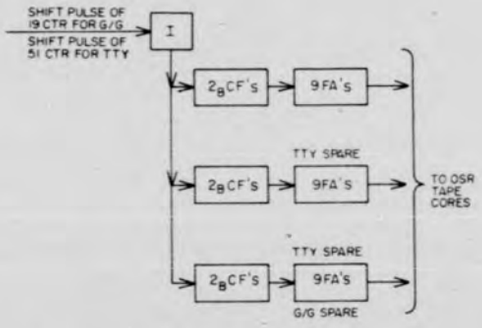


FIGURE 4-6. REVISED FLUX AMPLIFIER GATING FOR G/G AND TTY

Tests run to determine the FA clipping level ranges for all three sections of the output storage element disclosed that clipping levels were good for the G/G and TTY sections but unsatisfactory for the G/A section. After additional tests and further study of the problem, gating of the G/A flux amplifiers was found necessary in order to avoid unwanted busy bits in the G/A cores. Gating improved the G/A flux amplifier clipping level margins.

In a test which consisted of reading into one G/A address 25 times in one search period, it was found that a word could be read into the G/A array during the 10-microsecond reset time of the 25 and 13 counters and cause a large noise pulse at the G/A flux amplifier input. A change

was made in the G/A flux amplifier gating to limit it to non-search (read-out) time only. The final G/A flux amplifier gating circuit is shown in figure 4-7. This circuit is the same as the G/G and TTY gating circuit except that an AND circuit, conditioned by the shift pulse of the 25 counter and the non-search level, and a cathode follower were added between the core storage and the inverter.

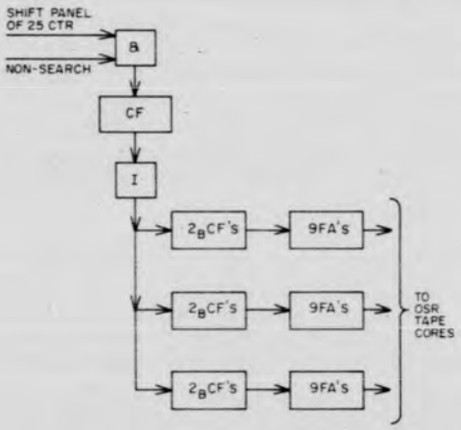


FIGURE 4-7. FINAL FLUX AMPLIFIER GATING FOR G/A

The changes in the grounding system and the gating circuits eliminated the difficulties that were encountered in the operation of the FA's.

4.2.3 Display System

Considerable effort was expended during this quarter toward completion of the design work necessary for the XD-1 Command Post area. The XD-1 Command Post called for by CCN 2 is an area in which the subsector commander and his staff will sit at desks from which they can view a screen containing a large scale image of a situation display. There will be two manually operated status boards, one at either side of the screen. The screen and status boards will present a summary of the overall defense system to the subsector commander and his staff. The Command Post for the XD-1 will be located in room P of the second floor at Building F of the Lincoln Laboratory. A floor layout of this second floor is shown in figure 4-8, foldout.

IBM is responsible for the Command Post desks, the screen, the two status boards, the situation display console, and the unit for controlling the camera which photographs the displays on a situation display console. Lincoln Laboratory is responsible for the camera and projection system.

An artist's conception of the Command Post desks is shown in figure 4-9, foldout. These desks provide the following facilities to the subsector commander and his staff:

a. Digital displays

b. Manual input switches

c. Warning lights

d. Audible alarms

e. Telephone equipment

f. Light pointers

Design of the Command Post desks has included mechanical design of the desk frames, packaging of the Typotrons, and provision of the necessary digital display circuits. Internal and external cabling has also been designed. Design of the Command Post desks is essentially complete, and fabrication is underway. The desks are scheduled to be delivered to Building F at Lincoln Laboratory in January, 1956.

4.2.4 Special Test Equipment (XD-1)

Three pieces of test equipment used for checking vacuum tubes in the AN/FSQ-7 (XD-1) Combat Direction Central have been consolidated into a single unit to comprise a tube tester console. This console performs static and dynamic tests on the most commonly used electron tubes in the AN/FSQ-7 (XD-1) Combat Direction Central. The tester is not designed for detailed analysis of tube operation; its sole purpose is to determine whether electron tube characteristics are within specified limits. The equipment em-

ploys three distinct tests in achieving its purpose: a pulse current test, a d-c characteristics test, and a cathode interface test.

The tube tester console is approximately 5 feet high and 6 feet long. It includes drawer and cabinet space, utility outlets, and a preheater for tubes to be tested. Figure 4-10 shows the tester as it appeared at the close of this quarter. Some minor modifications in the pulse current tester and d-c characteristics tester circuit will be incorporated into the equipment.

The pulse current tester, which comprises the center panel of the console, includes a Teletronics Pulse Generator Model PG-200AA and a Dumont Model 304H oscilloscope for calibration of the signal input in addition to actual tester circuitry. The d-c characteristics tester, which is located in the right panel of the console, consists of a modified Weston Model 686 Type 10A Dynamic Tube Analyzer. Modifications include installation of additional tube sockets, measuring devices (meters), and jumper adapters. An auxiliary power supply for furnishing screen and plate voltages for the tester is located behind the console drawers and is controlled at the front panel of the tester by flexible cables. The cathode interface tester uses an rf bridge circuit and signal sources of 60 cycles, 100 kilocycles, and 10 megacycles for determining the interface impedance of various XD-1 tubes. The measuring devices for the cathode interface test are located on the front panel.

Power for the tube tester is obtained from the maintenance room power supply. The specific voltages required are: 117 volts ac at 15 amperes, +250 volts dc, +150 volts dc, -150 volts dc, and 6.3 volts ac.

4.2.4.1 Pulse Current Tester

The pulse current test of the tube tester is used to check operating characteristics of gate and flip-flop electron tubes when they receive pulse inputs. To perform this test, all d-c supply voltages are adjusted to their correct value and a positive pulse is applied to the control grid of the tube undergoing the test. Under these conditions, the pulse current is measured in each of the tube elements with the exception of the control grid.

The input to the control grid is a 10-volt, 10-microsecond pulse with a frequency of 1 kilocycle. The signal pulse is calibrated by either or both of two methods. The first method uses an oscilloscope to compare the pulse to a +10-volt reference level; the second method employs a peak reading diode detector and a microammeter.

The supply voltages applied to the tube under test are +150 volts for the plate, +90 volts for the screen grid, and +10 volts for the suppressor grid. The pulse current in each tube element is averaged by a 1-microfarad capacitor which is connected between the element at the tube socket and ground. The average current is then read on d-c ammeters which are connected in series with each of the tube elements. If this current is not above a predetermined minimum standard, the tube is considered to be unsatisfactory for use. Figure 4-11 is a simplified block diagram of the pulse current tester.

4.2.4.2 Cathode Interface Tester

In digital computers, flip-flop and gate tubes are operated for extended periods of time under cutoff conditions and with no plate current flowing when filaments are heated. Under these conditions, cathode interface may develop. Cathode interface is an impedance which is caused by chemical action of the cathode base metal and its oxide coating. It causes the same effects that occur when a cathode resistor is partially bypassed with a capacitor. To show interface in an equivalent circuit, a parallel RC circuit with a time constant of approximately 0.1 microsecond should be connected into the cathode circuit of the tube.

Basically, the cathode interface tester consists of a single-ended signal source of three frequencies: 10 megacycles, 100 kilocycles, and 60 cycles, in addition to a bridge circuit with a null balance detector. The tube under test is diode connected and is plugged into a socket in one of the arms of the bridge. The diode-connected tube is then made to conduct by applying a 5-volt a-c signal to the bridge. Figure 4-12 is a simplified diagram of the cathode interface tester circuit.

The equation which describes the condition when there is no input to the null balance

FIGURE 4-10. TUBE TESTER CONSOLE

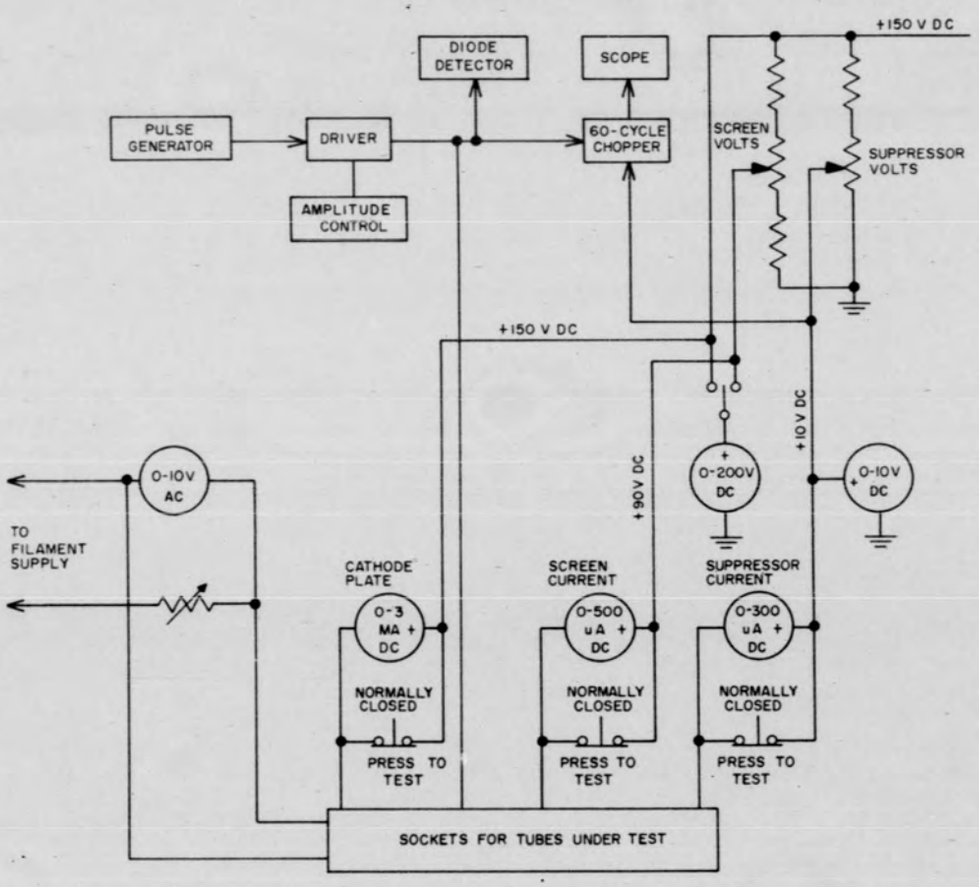


FIGURE 4-11. PULSE CURRENT TESTER, SIMPLIFIED BLOCK DIAGRAM

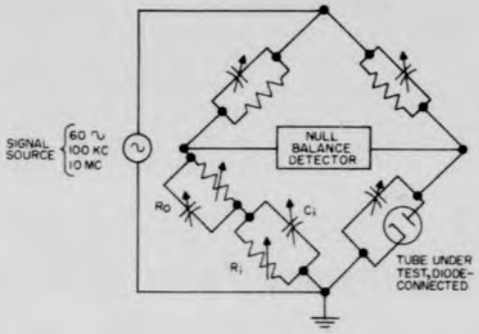


FIGURE 4-12. CATHODE INTERFACE TESTER, SIMPLIFIED BLOCK DIAGRAM

detector of figure 4-12 is:

$$R_o + \frac{R_i (1 - j\omega C_i R_i)}{1 + \omega^2 C_i^2 R_i^2} = rp + \frac{R (1 - j\omega CR)}{1 + \omega^2 C^2 R^2}$$

In this equation, the interface impedance is represented by the plate resistance of the diode (r_p) which is in series with the parallel interface combination of C and R.

The values for C and R are obtained by balancing this circuit at the three frequencies given previously. At 10 megacycles, the term $\omega CR >> 1$ and balance is obtained by adjustment of R_o so that $R_o = rp$. The circuit is next energized at 60 cycles; now $\omega CR >> 1$ and balance is restored by adjusting R_i so that $R = R_i$. The additional resistance added to balance the bridge at this low frequency equals the interface resistance R_i. Finally, at 100 kilocycles, the term $\omega CR = 1$, and balance is achieved so that $C = C_i$. Thus, if R_i and C_i are decade units, the value of the interface impedance can be read directly in ohms and microfarads.

A future modification of the cathode interface tester proposes replacing the decade resistors and capacitors with a direct reading helipot so that the interface impedance can be read directly in ohms. Consequently, the need for the intermediate frequency of 100 kilocycles is obviated, and its circuitry can be removed from the tester. Vacuum tubes whose interface impedance exceeds 20 ohms will not be suitable for use in the AN/FSQ-7 (XD-1) Combat Direction Central.

4.2.4.3 D-C Characteristics Tester

The d-c characteristics tester is a Weston Model 686 Type 10A True Mutual Conductance Vacuum Tube Analyzer. This tester has eight mutual conductance ranges with full scale readings ranging from 300 to 30,000 micromhos. Instruments are provided for accurately measuring all electrode voltages and for reading electrode currents including minute grid currents.

A modification made on this tester involves the addition of an auxiliary power supply for supplying better regulated plate and screen voltages to tubes under test than the voltages which were available from the tester power supply.

Tube sockets are mounted on a removable socket panel across the bottom front section of the tester. These sockets in turn connect through short-test switches to patch cord jacks which are marked with RMA pin numbers and are used with patch cards for various electrode connections. Complete connector flexibility and complete voltage control make it possible to plot static characteristics and to measure transconductance under various potential applications.

4.3 MANUFACTURING

Manufacturing of the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals has been carried on mainly by IBM, with certain specialized equipment being manufactured by subcontractors. IBM has completed its manufacturing activity on the AN/FSQ-7 (XD-1, XD-2) except for manufacture of the Command Post desks. These desks are scheduled to be delivered to Building F at the Lincoln Laboratory in January, 1956.

Delivery of power supply equipment and of GFI mapping consoles has been completed by subcontractors. The consoles of the Display System, and the Charactron and Typotron display tubes are still being delivered by subcontractors. The detailed status of these items is given in 4.4, Subcontract Engineering.

4.4 SUBCONTRACT ENGINEERING

To expedite the successful completion of its contractual obligations, IBM has subcontracted specialized activities to outside organizations. These activities are followed closely by IBM's Subcontract Engineering office, and assistance is given to the subcontractor whereever possible.

4.4.1 Display System Consoles (Crosley Division of the AVCO Manufacturing Corporation)

The display consoles for AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals are being manufactured by Crosley. Sixty-eight of the 74 situation display consoles and 37 of the 46 auxiliary consoles required for the AN/FSQ-7 (XD-1) have been delivered to the installation site. The delivery of display consoles for the XD-1 should be completed early in the next quarterly period.

4.4.2 Charactron Tubes (Stromberg-Carlson Company)

The subcontract for the development of Charactron tubes was originally let to the Convair Division of the General Dynamics Corporation. However, General Dynamics has recently obtained controlling interest in the Stromberg-Carlson Company and has since assigned responsibility of the Charactron project to Stromberg-Carlson.

Of an order for 156 Charactrons, 141 acceptable tubes have been received, to date. The remaining Charactrons should be delivered in December, 1955.

4.4.3 Typotron Tubes (Hughes Aircraft Company)

During the month of October, Hughes was unable to ship any Typotron tubes because of difficulty encountered by one of its vendors in the manufacture of storage meshes. Hughes has indicated that this problem appears to have been solved, and has recently delivered 20 tubes which are being tested for acceptance. Twenty-six additional tubes are now under shipment. It is estimated that the order for 208 Typotron tubes should be completed by January, 1956.

Prior to their difficulty with storage meshes, Hughes had delivered 93 acceptable Typotrons. This quantity is sufficient to prevent any delay in Display System testing of the XD-1.

4.4.4 Radio Interference Elimination (Jansky and Bailey, Inc.)

On July 11, 1955, a subcontract was let to Jansky and Bailey, Inc. to make a study of radio interference created by the AN/FSQ-7 (XD-1) and to determine the effect of heavy electronic equipment near the site on the performance of the AN/FSQ-7 (XD-1).

As a result of initial studies, Jansky and Bailey issued two reports on August 22, 1955. The first, Radio Interference Measurements, Methods, and Limits for the AN/FSQ-7 (XD-1) Computer, is a specification covering methods for use in measurement of radio interference in the frequency range from 14 kilocycles to 1,600 megacycles produced by the XD-1. It also provides limits for radio interference, where applicable, in this frequency range.

The second report, Plan for Testing the AN/FSQ-7 (XD-1) Computer for Susceptibility to External Sources of Radiation, describes the results of preliminary susceptibility tests on the XD-1 computer and proposes a program for further tests and investigations.

On September 16, 1955, an addendum was issued to the specifications in the first report. This addendum contains a description of the measuring instruments, and presents a discussion of the thoughts and reasoning which led to the various definitions and limits established in the specification.

On October 21, 1955, the Air Force gave approval to these reports, and Jansky and Bailey began measurements at the XD-1 site on November 7, 1955.

4.5 INSTALLATION

Installation, as used in this report, means the physical setting up of the equipment at its permanent site and provision of the required environmental conditions.

347

4.5.1 AN/FSQ-7 (XD-1) Installation

Building F at the Lincoln Laboratory of MIT, the installation site for the XD-1, was built by the Air Force at the request of MIT. As supplied by the Air Force, it was a concrete shell of three floors with a total area of 43,160 square feet. IBM and MIT worked together to provide detailed building requirements to the consulting engineering firm of Cleverdon, Varney, and Pike, and the building was modified to provide the prototype equipment with the proper environment; e.g., air conditioning, electrical and lighting facilities, and hanging ceilings. Installation of XD-1 equipment in Building F began in November, 1954, and all major building modifications have been completed.

4.5.1.1 Central Computer System

The two additional index registers in the computer program unit called for by CCN 3 were installed and put into operating condition early in this quarterly period. To accommodate this addition, one 9-tube module was added to the program unit and designated module A. Eighteen pluggable units were installed in this module, 16 containing the two additional index registers. Module A, and module B which contains the original index registers, each contain the same number and type of pluggable units. The back-panel wiring of both modules is identical.

Incorporation of the additional index registers into the system logic required the replacement of one pluggable unit in the instruction control unit with a new type, as well as the addition of three other pluggable units to the instruction control unit. This required extensive back-panel wiring changes to modules E and G of the instruction control unit.

4.5.1.2 Drum System

The auxiliary drum unit (unit 20) shown in figure 4-13 and the accompanying MCD unit (unit 46) called for by CCN 1 were shipped to Building F and installed during this quarterly period. The auxiliary drum unit is required in order to meet the anticipated storage requirements of the operational program. Installation of these two units required provision of the necessary air-conditioning facilities and cabling, and also necessitated minor rework on the maintenance console, the selection control unit, and the arithmetic unit.

FIGURE 4-13. XD-1 AUXILIARY DRUM UNIT (UNIT 20)

4.5.1.3 Display and Manual Input System

A major effort was expended during this quarterly period to install approximately 45 of the 112 consoles of the XD-1 Display System and have them operable by November 21 in order to meet MIT's requirements. This deadline was met. Installation work is reported herein; the testing procedure used to make the consoles operative is described in 4.6, Testing.

Figure 4-8 shows the location of the consoles on the second floor of Building F and indicates the titles of the operators at the various console positions. It also indicates the units which were installed and operating on November 21.

The initial installation of the consoles of the Display System includes making mechan-

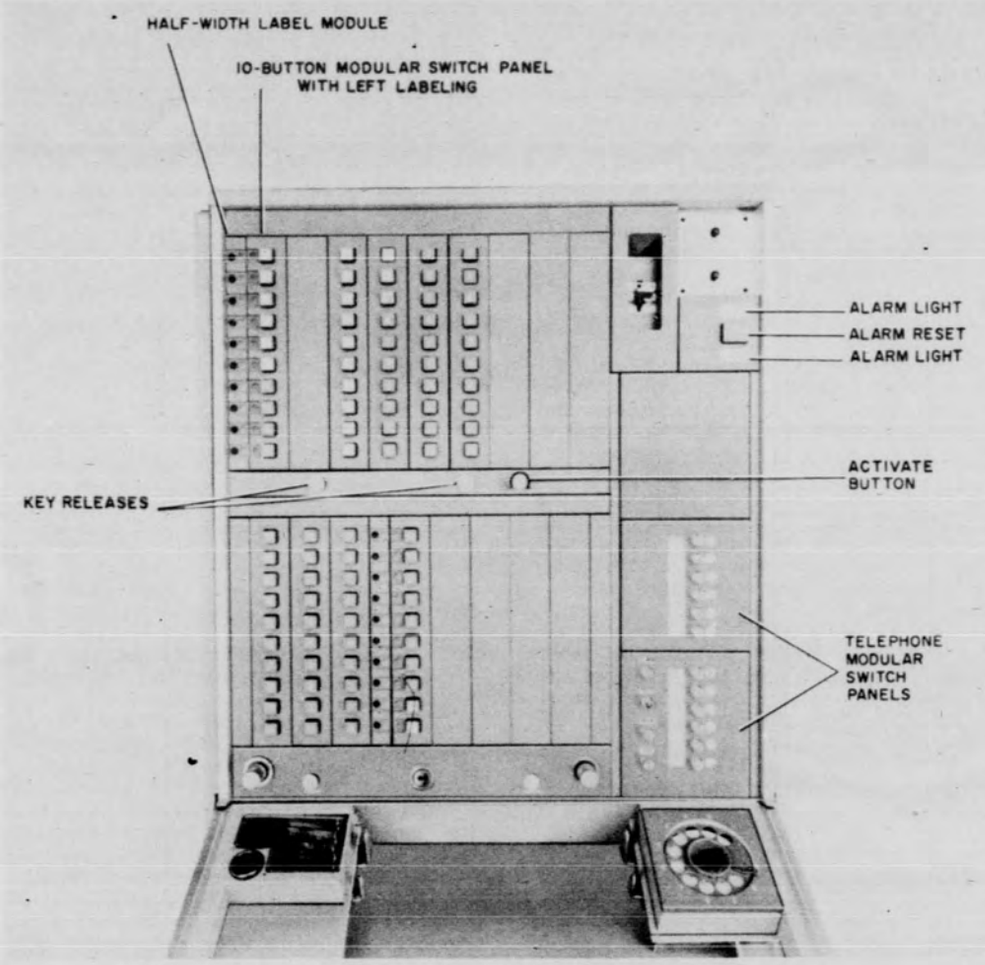


FIGURE 4-14. TYPE B AUXILIARY CONSOLE, FRONT PANEL

[redacted]

347

ical changes, the installation of pluggable units, installation and adjustment of Charactron and Typotron tubes, and changes to the modular switch panels located on the auxiliary consoles and on the wing units of situation display consoles. These switch panel changes are called for by CCN 5. This CCN was occasioned by IBM-MIT concurrence on Lincoln Laboratory memorandums 6M-3582 through 6M-3587 and supplement No. 1 to each of these memorandums. The changes are being made at the installation site in order to expedite delivery of the consoles from the vendor.

The facilities that will be at each operating console position are specified in Lincoln Laboratory memorandums 6M-3582 through 6M-3587 and their supplements; i.e., they denote the number, type, mounting, and labeling of manual input switch panels, audible alarms, and indicator lights, as well as certain other console facilities such as telephone and radio switch panels, light guns, activate buttons, key releases, and digital displays.

The modular switch panels for manual inputs are located on the front panels of auxiliary consoles and on wing units attached to situation display consoles. Figure 4-14 presents the front panel of a type B auxiliary console, and figure 4-15 shows a situation display console with a left wing unit. The labeling which has not yet been put on the modular switch panels shown in figure 4-14 is provided by plastic caps which are inserted into the space provided.

Table 4-1 provides a listing of the various types of modular panels used on the auxiliary consoles and on the wing units of situation display consoles.

TABLE 4-1. MODULAR SWITCH PANELS MOUNTED ON AUXILIARY CONSOLES AND ON WING UNITS OF SITUATION DISPLAY CONSOLES

Nomenclature	Type of Panel
AA	Special audible alarm panel
1-1/2 B	Blank, standard width module; 1-1/2 inches wide
3/4 B	Blank, half-width module; 3/4 inches wide
10 IND	Ten-light neon module; binary coding using 10 bits; 1-1/2 inches wide
HS	Heading and speed module containing a five-button interlocked-release switch plus an eight-position rotary switch indexed at 45 degree positions with no stops; octal coding using three bits each for both rotary and five-button switches
15PB	Fifteen-button interlocked-release pushbotton module; sexadecimal coding using four bits; 1-1/2 inches wide
10A-PB	Ten-button interlocked-release pushbutton module; sexadecimal coding using four bits; 1-1/2 inches wide
10B-PB	Ten-button module having nine buttons with an interlocked release and a tenth button with a common release; binary coding using nine bits; 1-1/2 inches wide
10C-PB	Special 10-key module, each button having independent on-off action; binary coding using 10 bits; 1-1/2 inches wide; individual keys are either rotary or pushbutton type
2 x 5 PB	Two 5-button interlocked-release pushbutton switches on one module; octal coding using three bits in each section; 1-1/2 inches wide
5PB	A 5-button interlocked-release pushbutton module; octal coding using three bits; 1-1/2 inches wide

[redacted]

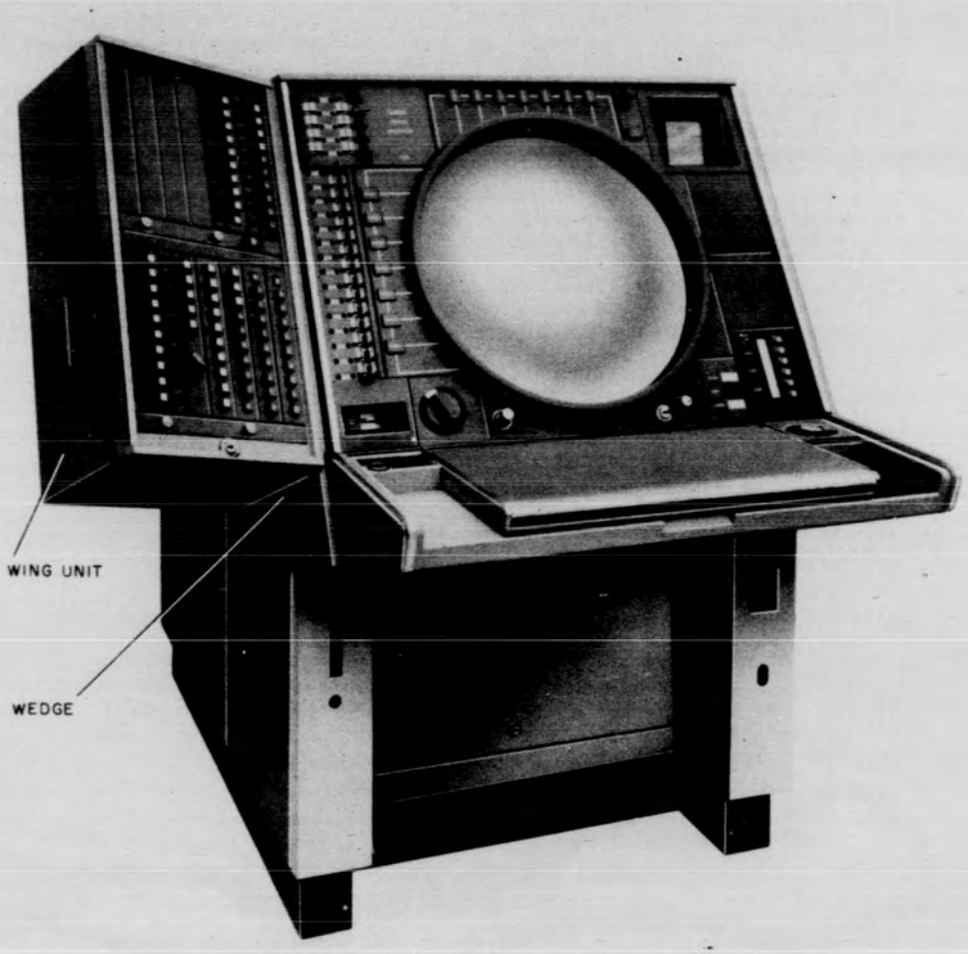


FIGURE 4-15. SITUATION DISPLAY CONSOLE WITH LEFT WING UNIT

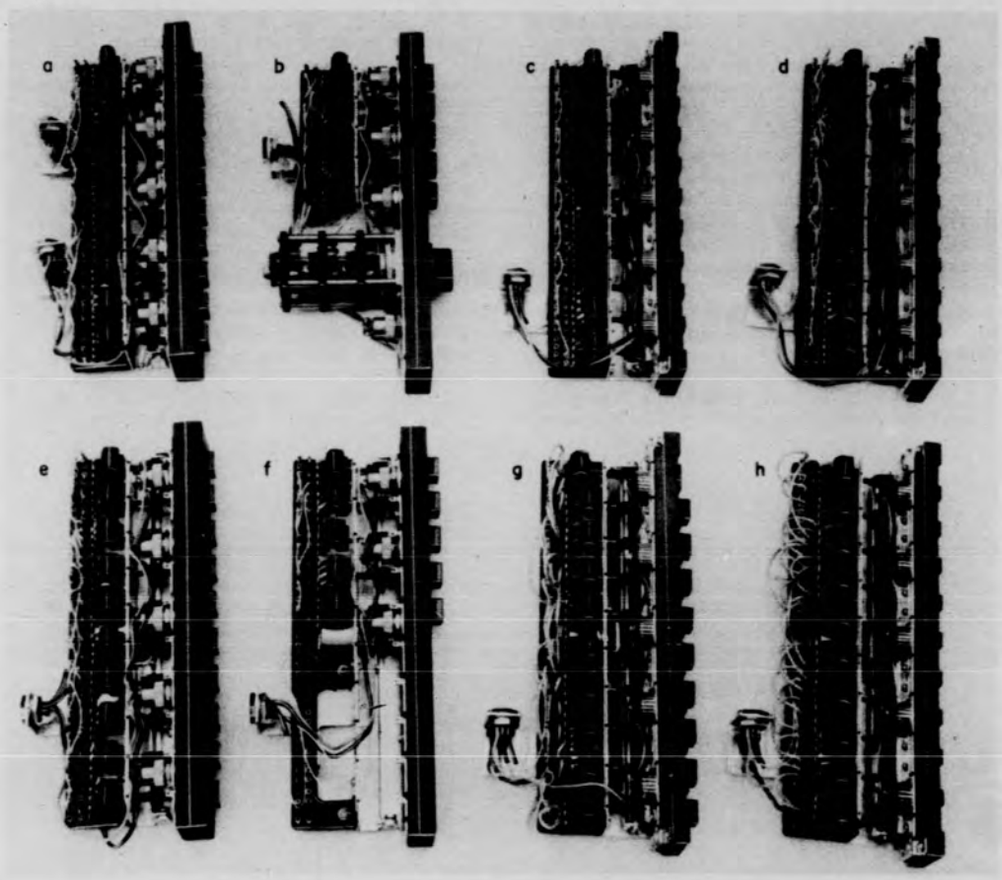


FIGURE 4-16. MODULAR SWITCH PANELS

Figure 4-16 presents a side view of some of the types of modular switches listed in table 4-1.

4.5.2 AN/FSQ-7 (XD-2) Installation

Moving of the AN/FSQ-7 (XD-2) from IBM's Poughkeepsie plant to its permanent installation site at IBM's Kingston Military Products Center began on August 26, 1955. By September 5, all moved units were in place at the installation site.

The AN/FSQ-7 (XD-2) is installed at Kingston on a 100 by 120-foot floor which is raised 4 feet above the building floor. Figure 4-17 (foldout) presents the layout of the XD-2 equipment on the raised floor area and indicates which units are not yet in place. Two of the major missing units are unit 24, the situation display generator element, and unit 25, the digital display generator element. These units are presently being used by the Hazeltine Electronics Corporation to assist in their development work

for the production AN/FSQ-7 Combat Direction Centrals, and will be returned to Kingston in February, 1956. Hazeltine also has on loan three situation display consoles and one auxiliary console which are XD-2 equipment.

Installation work has included provision of cabling, air conditioning, and telephone facilities. Power was applied to the central computer units on October 4, and had been applied to all units, including MCD units, by the time this quarterly period ended.

An overall view of the XD-2 area, with the maintenance console in the foreground, is presented in figure 4-18.

During this quarter a quick-disconnect device was constructed which enables Memory I to be quickly connected to the central computer or to the memory tester, as desired.

4.6 TESTING

The term testing, as used here, refers to formal unit and system testing procedures which are used to check the correctness of circuitry and logic, but give no evaluation of tactical performance. After successful completion of system testing, the units are turned over to maintenance groups.

The equipment of each logical system of a prototype is physically broken down into units. The majority of units are modular in construction, and each module is composed of pluggable units. The purpose of unit testing is to test the overall logic of the unit to the maxi-

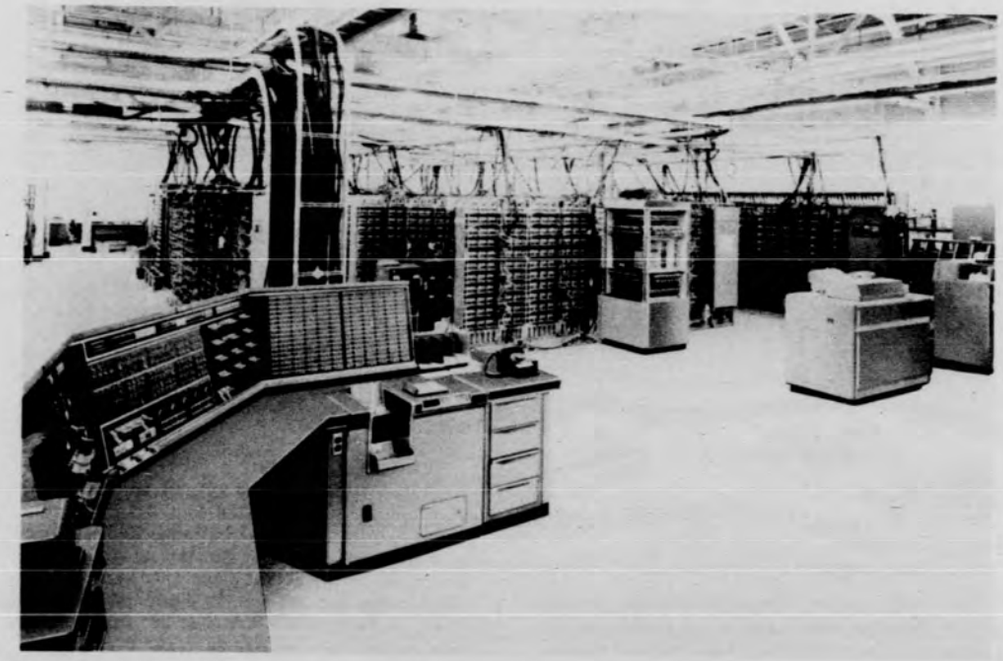


FIGURE 4-18. AN/FSQ-7 (XD-2) AT KINGSTON

mum extent possible prior to its connection with other units. System testing is conducted by connecting the units of a system to each other and to the other systems of the equipment. If some systems are not available, simulation equipment is used. System testing is performed in steps or phases. As the individually tested prototype equipment units become available, they are joined together in successively larger groups. Special programs are written to system test each successive group. Any errors revealed are corrected to assure that those units under test are individually and collectively error-free.

At the AN/FSQ-7 (XD-1) site, the equipment which has been successfully system tested is available to MIT personnel for preparation of the master program and integration of external equipment.

In addition to the unit and system testing described previously, a program of system tests for acceptance on the AN/FSQ-7 (XD-1) equipment is being conducted at Lexington. These tests, which fulfill a contractual obligation, are designed to permit evaluation of system logic and reliability in order to determine whether there is any serious fault that would prevent meeting design specifications.

4.6.1 AN/FSQ-7 (XD-1) Tests

Testing of the AN/FSQ-7 (XD-1) began in January, 1955, and when this quarter began all equipment had been system tested except the tape units of the Central Computer System, the consoles of the Display System, and the units of the Input and Output Systems. System testing of the tape units was completed early in this quarterly reporting period.

4.6.1.1 Drum System

Unit testing of unit 20, the auxiliary drum unit, which was shipped to Lexington on October 20, began on November 4. Unit and system testing of this unit are scheduled to be complete by February, 1956.

4.6.1.2 Input System

System testing of the LRI, GFI, and XTL elements of the Input System was completed during September, 1955. The LRI and GFI elements have since been successfully used to receive test data from radar sites.

System testing of the MI element is being conducted as the auxiliary consoles and wing units on situation display consoles are being installed.

4.6.1.3 Output System

Though system testing of the output units has been essentially completed, formal testing while using the newly developed CCD's and FA's, discussed in 4.2.2.1 and 4.2.2.2, remains to be completed. During this quarter, TTY section test patterns were successfully transmitted to Montauk Point.

4.6.1.4 Display System

System testing of the situation display generator element, the digital display generator element, and the display tester element had all been completed when this quarter began. During this quarter, system testing has been conducted on those consoles whose initial installation was completed. It has been decided to test the consoles in small groups as they became available, rather than to test the consoles as a complete set after all have been installed. This procedure permits qualified personnel to exercise thorough testing procedures on all consoles.

It should be noted that area discriminators, light guns, and manual data input switches are not part of the Display System, but belong to the Input System. The testing described herein applies only to those features of consoles operated under control of signals from the situation display generator element and the digital display generator element.

The manner of testing consoles, in general, consists of loading display drum fields with information which causes specific test patterns to be displayed on consoles. Each of these test patterns had specific applicability to determining the correctness of certain controls, adjustments, or wiring.

Figure 4-19 presents a test pattern which appeared on the Charactron tube of a situation display console being tested. This pattern is used for an overall test of display quality and is produced by program RDR 09.

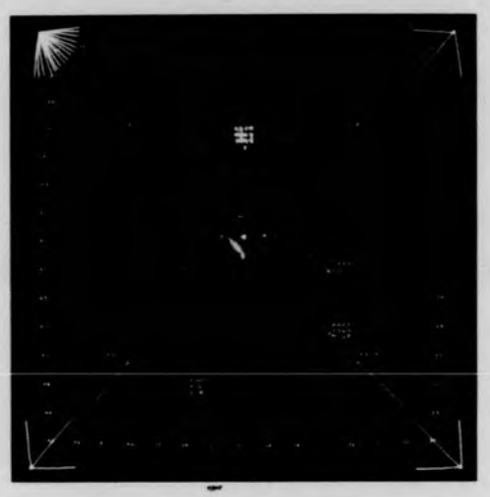


FIGURE 4-19. SITUATION DISPLAY CONSOLE TEST PATTERN

The numbers which form the perimeter of the pattern indicate that the display assignment bit lines are operating properly. The fact that the vectors which form the corners of the test pattern are located at the extremities of the display area indicates that the magnetic deflection circuits are properly adjusted. The group of vectors in the upper left-hand corner indicate that the vector generator can provide the necessary angular displacement. Linearity of the vector generator is denoted when the vectors which bisect the corners of the test pattern are aligned with adjacent vectors. Certain groups of characters in the figure are for testing feature selection logic and circuits.

The display tester element may be used in lieu of the Drum System to supply signals to the display generator. The display tester element consists of four sections: the test control section, the word sequence section, the word output section, and the display tester console section. With the exception of the display tester console, these display tester sections are located in unit 25. The display tester console, unit 199, is shown in figure 4-20 and is located near the central computer maintenance console.

The display tester element is capable of simulating any of the drum messages for the Display System, and therefore a thorough test of all Display System circuits can be made. The display tester console contains toggle switches (2) for selecting the various bits for the composition of test displays, and neon light indicators (1) which reveal the operating condition of specific circuits in the situation display generator or the digital display generator. The bottom row of switches (3) are used for selecting the mode of operation of the display tester element.

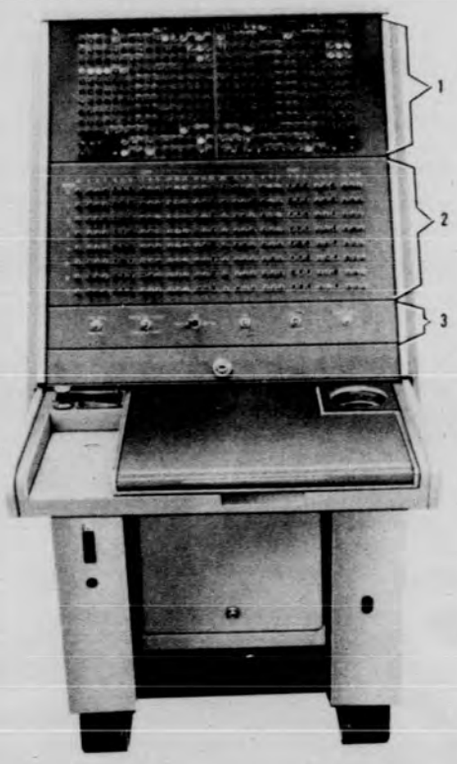


FIGURE 4-20. DISPLAY TESTER CONSOLE (UNIT 199)

4.6.1.5 System Tests for Acceptance

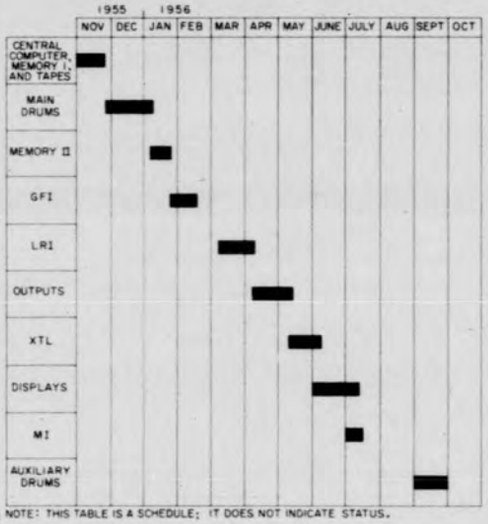
A program of system tests for acceptance has been underway at the AN/FSQ-7 (XD-1) site since June, 1955. These tests are a contractual requirement and are sufficiently comprehensive to determine that system performance meets all requirements of engineering exhibit AFCRC-1A. IBM conducts these tests (in accordance with system test descriptions submitted to and approved by AFCRC) with AFCRC observers present. The data obtained is evaluated by AFCRC and MIT personnel to determine whether basic requirements are met.

These tests are being conducted as a series of phases of system testing. Table 4-2 is a list of these phases and the status of each. The final phase of these systems tests for acceptance will be a summary test. The initial draft of this test has been prepared.

4.6.2 AN/FSQ-7 (XD-2) Tests

Power has been supplied to all units at the AN/FSQ-7 (XD-2) installation site and unit testing has been started. Table 4-3 is a tentative schedule for system testing AN/FSQ-7 (XD-2).

TABLE 4-3. AN/FSQ-7 (XD-2) TENTATIVE SYSTEM TESTING SCHEDULE



NOTE: THIS TABLE IS A SCHEDULE; IT DOES NOT INDICATE STATUS.

TABLE 4-2. SYSTEMS TESTS FOR ACCEPTANCE

Phase		Status
1	Central computer	Test demonstration completed
2	Auxiliary memory drum fields and tapes	Test demonstration completed
3	Displays (units 24 and 25)	Test plans approved by AFCRC
3c	Display consoles	Test plans approved by AFCRC
4	GFI	Test demonstration completed
5	LRI	Test demonstration completed
6	XTL	Test demonstration completed
7	MI (units 23 and 28)	Test procedure being prepared
7c	MI switches and light guns	Test procedure being prepared
8	Outputs	Test procedure being prepared
9	Warning lights	Test procedure being prepared

System testing of the central computer has been completed. System testing of drums began on November 21 and is being continued.

4.7 MAINTENANCE METHODS

As formal system testing is completed on the various units of the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals, these units become part of the prototype machines being maintained by IBM. Maintenance activities are largely based on marginal checking, either manual or calculator-controlled, and on running reliability and diagnostic programs.

4.7.1 Maintenance Programming

The Maintenance Methods Group at IBM is concerned with providing maintenance programs designed to detect computer faults and to determine the reliability of the equipment.

Maintenance programs consist of the following two major types:

a. Reliability, which indicate whether or not equipment is operative.

b. Diagnostic, which are used in locating malfunctions.

Each of these two types of programs may be used with or without marginal checking. Table 4-4 presents the status of maintenance programs for the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals.

The term first pass refers to initial program writing and debugging. All reliability and diagnostic programs must be subjected to a second pass wherein modifications and improvements are made. The program is considered to have completed a third pass when experience shows that it performs its intended function.

TABLE 4-4. STATUS OF MAINTENANCE PROGRAMS FOR AN/FSQ-7 (XD-1, XD-2)

	Reliability Non-MC	Reliability MC	Diagnostic Non-MC	Diagnostic MC
Central computer	X	X	S	O
Core memory	X	X	S	O
Drums	X	S	X	O
Displays	X	S	S	O
Outputs	X	S	X	O
LRI, XTL	X	X	X	S
MI	X	S	X	O
GFI	X	X	X	S
Magnetic tapes	X	X	X	S

Non-MC	Non-marginal checking
MC	Marginal checking
X	All or most programs complete for first pass
S	Program work started
O	No work started

Although these maintenance programs have been prepared for prototype equipment, they are easily converted for use with production equipment. In certain cases, this has already been done and additional maintenance programs have been prepared specifically for production equipment.

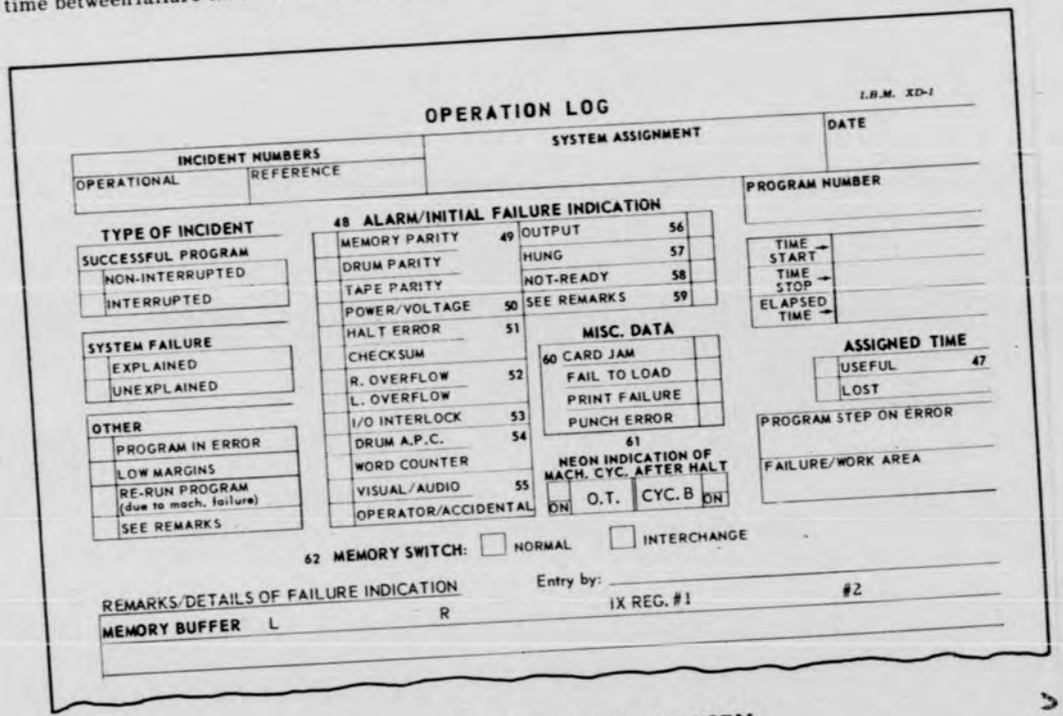
4.7.2 AN/FSQ-7 (XD-1) Maintenance Activity

At the end of this quarter, approximately 45 personnel from IBM were engaged in maintaining the AN/FSQ-7 (XD-1). Maintenance records for the period from August, 1955, to mid-November, 1955, show that the XD-1 has operated without failure during 89.6 percent of the time it has been allotted to MIT personnel for work on external equipment integration and on the master program. The average mean good time between failure indications was 3.15 hours.

The keeping of records is essential to proper maintenance of equipment of the size and complexity of the AN/FSQ-7 (XD-1). These records assist in pointing out areas where trouble is most likely to occur, and provide the data for statistical analyses which can be used to assist in determining future design and maintenance practices.

Basic to the maintenance of records for the AN/FSQ-7 (XD-1) are the operation log, which is kept at the central computer maintenance console, and function logs, which are kept at various units or groups of units.

The operation log (fig. 4-21) provides a record of a 24-hour system surveillance which can be associated with the records of intermittent local effort kept in the various functional logs. An assigned incident number is the key to both the operation log and the entire record



OPERATION LOG — I.B.M. XD-1

INCIDENT NUMBERS: OPERATIONAL | REFERENCE
SYSTEM ASSIGNMENT
DATE
PROGRAM NUMBER

TYPE OF INCIDENT
SUCCESSFUL PROGRAM: NON-INTERRUPTED; INTERRUPTED
SYSTEM FAILURE: EXPLAINED; UNEXPLAINED
OTHER: PROGRAM IN ERROR; LOW MARGINS; RE-RUN PROGRAM (due to mach. failure); SEE REMARKS

48 ALARM/INITIAL FAILURE INDICATION
MEMORY PARITY 49; DRUM PARITY; TAPE PARITY; POWER/VOLTAGE 50; HALT ERROR 51; CHECKSUM; R. OVERFLOW 52; L. OVERFLOW; I/O INTERLOCK 53; DRUM A.P.C. 54; WORD COUNTER; VISUAL/AUDIO 55; OPERATOR/ACCIDENTAL
OUTPUT 56; HUNG 57; NOT-READY 58; SEE REMARKS 59

MISC. DATA
60 CARD JAM; FAIL TO LOAD; PRINT FAILURE; PUNCH ERROR

61 NEON INDICATION OF MACH. CYC. AFTER HALT
ON O.T. CYC. B ON

TIME START →
TIME STOP →
ELAPSED TIME →

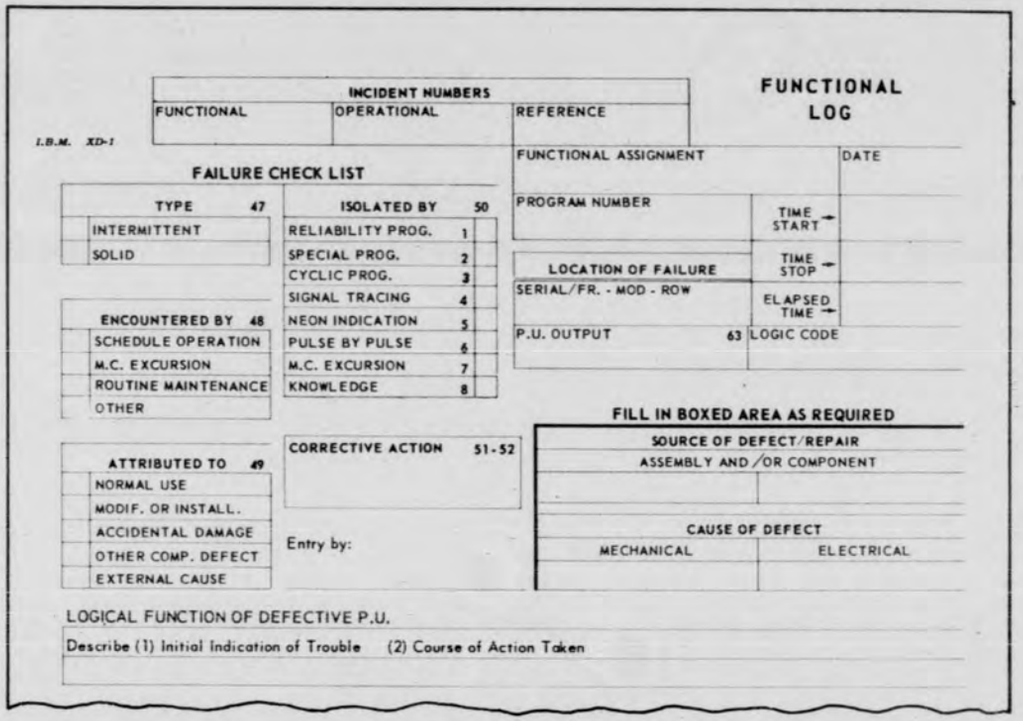
ASSIGNED TIME
USEFUL 47; LOST

PROGRAM STEP ON ERROR
FAILURE/WORK AREA

62 MEMORY SWITCH: ☐ NORMAL ☐ INTERCHANGE

REMARKS/DETAILS OF FAILURE INDICATION
Entry by:
MEMORY BUFFER L R IX REG. #1 #2

FIGURE 4-21. OPERATION LOG FORM



I.B.M. XD-1

FUNCTIONAL LOG

INCIDENT NUMBERS		
FUNCTIONAL	OPERATIONAL	REFERENCE

FUNCTIONAL ASSIGNMENT — DATE

PROGRAM NUMBER — TIME START → — TIME STOP → — ELAPSED TIME →

LOCATION OF FAILURE

SERIAL/FR. - MOD - ROW

P.U. OUTPUT 63 — LOGIC CODE

FAILURE CHECK LIST

TYPE 47	ISOLATED BY 50		
INTERMITTENT	RELIABILITY PROG.	1	
SOLID	SPECIAL PROG.	2	
	CYCLIC PROG.	3	
	SIGNAL TRACING	4	
ENCOUNTERED BY 48	NEON INDICATION	5	
SCHEDULE OPERATION	PULSE BY PULSE	6	
M.C. EXCURSION	M.C. EXCURSION	7	
ROUTINE MAINTENANCE	KNOWLEDGE	8	
OTHER			

ATTRIBUTED TO 49
- NORMAL USE
- MODIF. OR INSTALL.
- ACCIDENTAL DAMAGE
- OTHER COMP. DEFECT
- EXTERNAL CAUSE

CORRECTIVE ACTION 51-52

Entry by:

FILL IN BOXED AREA AS REQUIRED

SOURCE OF DEFECT/REPAIR	
ASSEMBLY AND/OR COMPONENT	
CAUSE OF DEFECT	
MECHANICAL	ELECTRICAL

LOGICAL FUNCTION OF DEFECTIVE P.U.

Describe (1) Initial Indication of Trouble (2) Course of Action Taken

FIGURE 4-22. FUNCTIONAL LOG FORM

system. Each system failure can be traced through this incident number to all areas affected. The general rule for the operation log is that an operational incident number shall be assigned for each series of identical operations; thus, a number of successful programs may be entered under one operational incident number. A new operational incident number is initiated each time a failure occurs that should be investigated. The previous incident is considered a successful program up to the time of failure. The number assigned to the incident on the functional log in the failure area, or past operational incident numbers, are placed in the REFERENCE INCIDENT NUMBER box. By proper use of the reference numbers, all associated incidents may be linked together.

The functional log (fig. 4-22) is used to keep a record of all repairs, routine and preventive maintenance, engineering changes, modifications, and new installations performed on a unit or group of units. The operational incident number is picked up from the operation log. A functional incident number is initiated for each assignment entered in a functional log. The number is prefixed by the fault or work area which denotes the group or unit assignment of the log.

Various reports pertaining to the maintenance of the AN/FSQ-7 (XD-1) are compiled from information entered on red tags which are placed on pluggable units when they fail, and from information on envelopes into which are

placed faulty components and tubes. The information from the red tags and component tube envelopes is summarized weekly on quadruled sheets, and then entered into an IBM punched card system. This enables the sorting of cards and the printing of various kinds of information on summary sheets in tabular form. The pluggable unit listing, for example, gives the date each pluggable unit was removed, reason for removal, pluggable unit type, pluggable unit serial number, location, incident number, and date of installation.

4.8 PUBLICATIONS

The preliminary manuals on the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals, which are listed in Chapter 7, were forwarded to the Air Force on September 30 in fulfillment of obligations under Contract AF 30 (635)-1404. These manuals are subdivided into theory of operation, maintenance, and engineering data books, and supersede all manuals previously issued on the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals.

347

CHAPTER 5
AN/FSQ-7 ENGINEERING

This chapter describes the engineering which has been the basis for production of the AN/FSQ-7 Combat Direction Centrals. This engineering has involved changes and additions made to the prototype equipment to insure greater reliability and to improve adaptability to manufacturing processes. The major change required to improve reliability is to duplex essential units of the production type Direction Centrals.

Engineering has included planning, design, monitoring of subcontract activities, test planning, and establishment of stable sources of supply for critical components.

5.1 PLANNING

Planning for AN/FSQ-7 Combat Direction Centrals may be divided into two general types of activity: to seek ways of improving the defense system through improvement of the AN/FSQ-7, and to optimize the performance of the presently designed AN/FSQ-7. The former is being carried on by the recently formed System Development Group, who will work in the following general areas:

a. Investigation of improvements to the AN/FSQ-7 which will be required by SAGE system development, and will seek other improvements to the equipment which may be made possible by new electronic techniques and components.

b. Investigation of the possibility of improving the efficiency of the standby computer program. It is also planned to make a statistical analysis of marginal checking data taken on the AN/FSQ-7 (XD-1, XD-2) to determine optimum values for voltage excursions which are required on the various lines to enable them to be considered as trouble-free lines. Determination of this optimum voltage excursion would also decrease maintenance time.

c. Maintenance of liaison with goverment agencies and other SAGE contractors relative to new developments, such as the tie-in of new weapons, etc.

The planning necessary to insure proper operation of the presently designed AN/FSQ-7 is accomplished largely by IBM-MIT concurrence on changes or additions to equipment specifications. Among the documents concurred on during this quarter were:

a. A specification on the console equipment and label layouts called for in Lincoln Laboratory memorandums 6M-3632 through 6M-3636 and supplements thereto.

b. A specification on the maintenance intercommunication system for the Direction Centers. This system will provide direct communication between various points in the Direction Center for maintenance purposes, and will be an addition to the automatic dial and signaling system used for tactical communication. It will require a minimum of manual intervention to operate. Standard equipment will be used throughout the system, and sizes and methods of enclosure and mounting will be such as to effect a minimum of inconvenience

in the operation of the Direction Center.

c. A listing of the equipment for each of the first six sites, which was submitted to the Air Force. The Air Force is to indicate the minimum acceptable quantity of the various types of units.

d. A specification for a Kelvin-Hughes rapid process projection display system to be used in the Command Post.

Planning for the installation of the presently designed AN/FSQ-7 equipment is being assisted by the construction of a scale model of a combined Direction Central-Control Central. The building models are made of plexiglass at a scale of a quarter of an inch to a foot. The scale model is very useful in uncovering interferences of various kinds; e.g., between air-conditioning ducts and cable racks. Figure 5-1 shows the scale model of the second floor of a Direction Center, and figure 5-2 shows the scale model of the fourth floor of a Direction Center. For the sake of clarity, the ceilings were removed when the photographs were taken. The individual floors can be stacked to form the complete building. A table has been constructed, the top of which is a scale model of the terrain of the site of the first combined Direction Center-Control Center. The scale model buildings are placed on this table.

5.2 DESIGN

The design of AN/FSQ-7 Combat Direction Centrals, except for the Display System and certain units of the Input System, has been

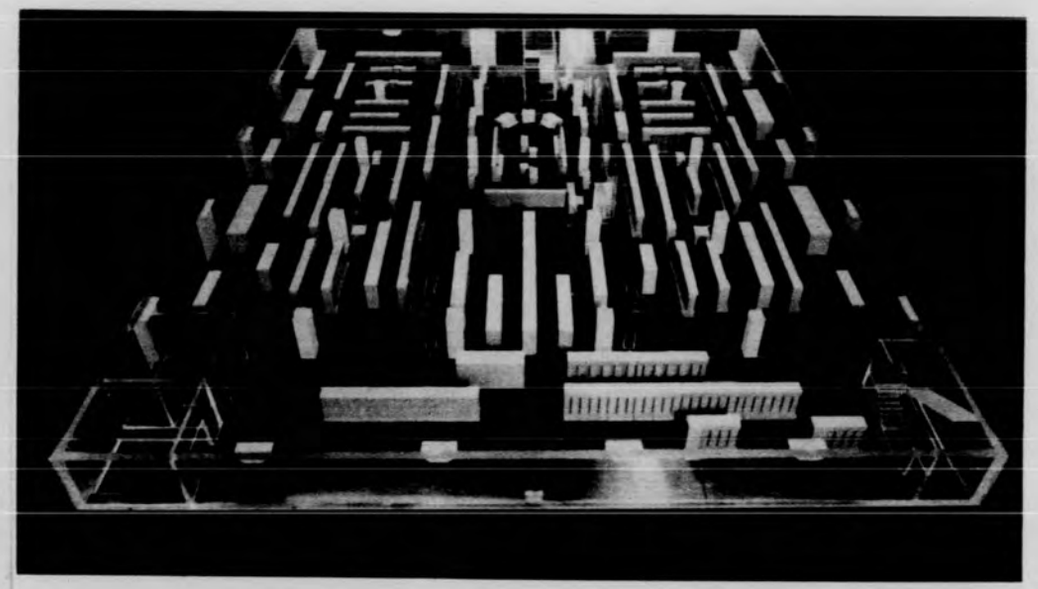


FIGURE 5-1. AN/FSQ-7 COMBAT DIRECTION CENTER, SECOND FLOOR - SCALE MODEL

347

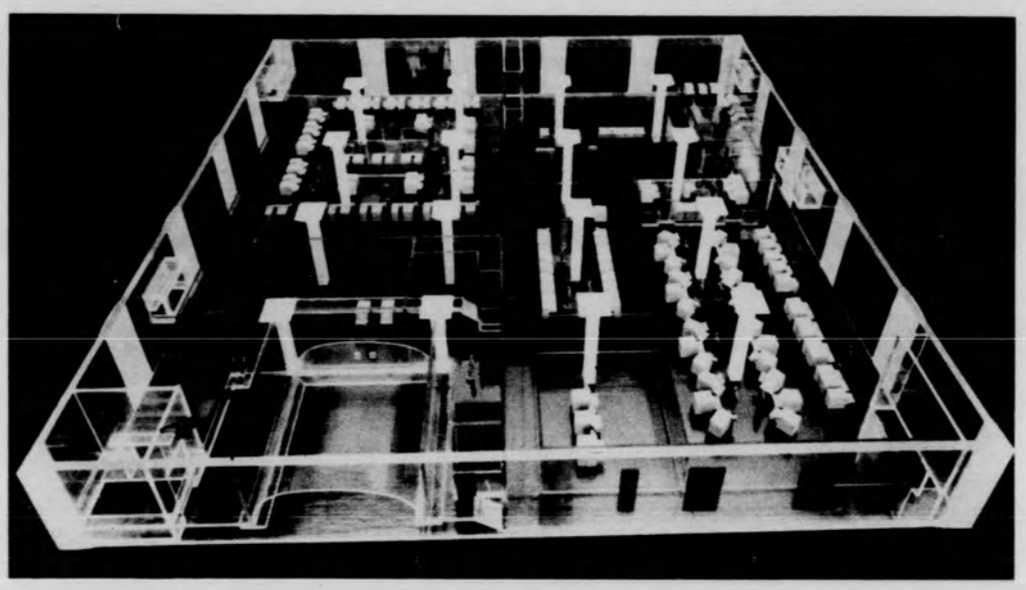


FIGURE 5-2. AN/FSQ-7 COMBAT DIRECTION CENTER, FOURTH FLOOR - SCALE MODEL

continued by IBM. By the end of this quarterly period, all the units which are being designed by IBM had been released to production, with the exception of interconnecting cables and units of special test equipment for the field sites. Cabling is scheduled to be released to production in January, 1956, and the special test equipment should be released to production by April, 1956. The status of work being carried on by subcontractors is reported in 5.3, Subcontract Engineering.

The following IBM-designed units were released to production during this quarterly period:

a. Unit 33 - output storage

b. Unit 42 - output control

c. Unit 23 - manual data input

d. Unit 34 - mapper counter

e. Unit 41 - long-range radar input

f. Unit 32 - erosstell input

g. Unit 1 - duplex maintenance console

h. Unit 47 - simplex maintenance console.

5.2.1 Central Computer System

Considerable effort was expended during this quarter on redesigning certain of the core memory circuits. Notably the sense amplifier and the digit plane driver were improved upon in order to guarantee 6-microsecond memory operation.

5.2.1.1 Core Memory Sense Amplifier Redesign

The originally designed sense amplifier circuit, the schematic diagram of which is shown in figure 5-3, did not give sufficient operating margins. Modifications were made to AN/FSQ-7 (XD-1, XD-2) equipment, which improved the operation of this circuit. This modified circuit was released for incorporation in AN/FSQ-7 equipment early in this reporting period, but work continued on the design of a new model sense amplifier. This new sense amplifier, a schematic of which is shown in figure 5-4, was released to production near the end of this reporting period. It will be retrofitted into AN/FSQ-7 (DC-1) and AN/FSQ-7 (DC-2) equipment, but it has not yet been determined whether it will be retrofitted into AN/FSQ-7 (XD-1, XD-2) equipment.

In the originally designed sense amplifier (fig. 5-3), one end of the sense winding is connected to INPUT 1, and the other end is connected to INPUT 2. The symmetrical loading of the sense winding by the input networks of the first stage causes one-half of the voltage induced in the sense winding to be applied to one input as a positive signal with respect to ground, while the other half of the voltage induced in the sense winding is applied to the other input as a negative signal with respect to ground. Thus, if a signal of 100 millivolts is induced in the sense winding, a 50-millivolt positive signal will be measured from one input to ground, and a 50-millivolt negative signal will be measured from the other input to ground. Since the voltage induced in the sense winding may be of either polarity, each of the two input voltages may be of either polarity. The polarities of signal flow noted on figure 5-3 represent those obtained from one polarity of induced sense-winding voltage.

The first three stages of the amplifier are symmetrical difference amplifiers, with the output of the third stage providing negative feedback to the input of the first stage. The advantage of using a difference amplifier as the first stage is that stray capacitance pickup by the sense winding will cause equal voltages to be applied to each input grid, thus causing cathode degeneration of the unwanted signal. The cathodes of the first three stages should remain constant, however, when the sense winding induced voltage results in equal voltages of opposite polarity being applied to the two input grids; i.e., no cathode degeneration should take place. The fourth stage of the amplifier is the gain control stage. The gain is varied by the potentiometer in the cathode circuit. During static operation both cathodes of the fourth stage are at the same level. Cathode degeneration exists when the signals are applied to the fourth stage. The amount of cathode degeneration is controlled by the 1K resistor and the 2.5K potentiometer which connect the two cathodes. The balanced outputs of the fourth stage are then a-c coupled to the rectifying cathode follower which comprises the fifth, and last, stage. The cathode of the cathode follower is controlled by the positive pulse, with the result that a positive signal output, biased at -22 volts dc, is obtained at the cathode follower output regardless of the input polarity.

The output voltage third stage is approximately 5 volts. Since the input to the first stage is approximately 50 millivolts, the gain of the first three stages is approximately 100. Since the output of the fourth stage is approximately 40 volts, it has an approximate gain of 8. The overall gain of the amplifier, then, is approximately 800.

Since the originally designed sense amplifier just described did not give satisfactory operating margins, the circuit was modified. The following modifications were made:

a. The first stage was changed from a type 6072 to a type 5965 tube.

b. The plate load of the first stage was changed from 12K ohms to 10K ohms.

c. The two parallel 39K ohm resistors of the first stage were replaced with three 22K ohm resistors connected in parallel.

d. In the fourth stage, a 1.5-millihenry choke was connected in series with each plate load resistor.

Circuit operation was improved by this modified sense amplifier. There was increased gain in the first stage as a result of using a higher gain tube; peaking chokes in the fourth stage increased bandwidth.

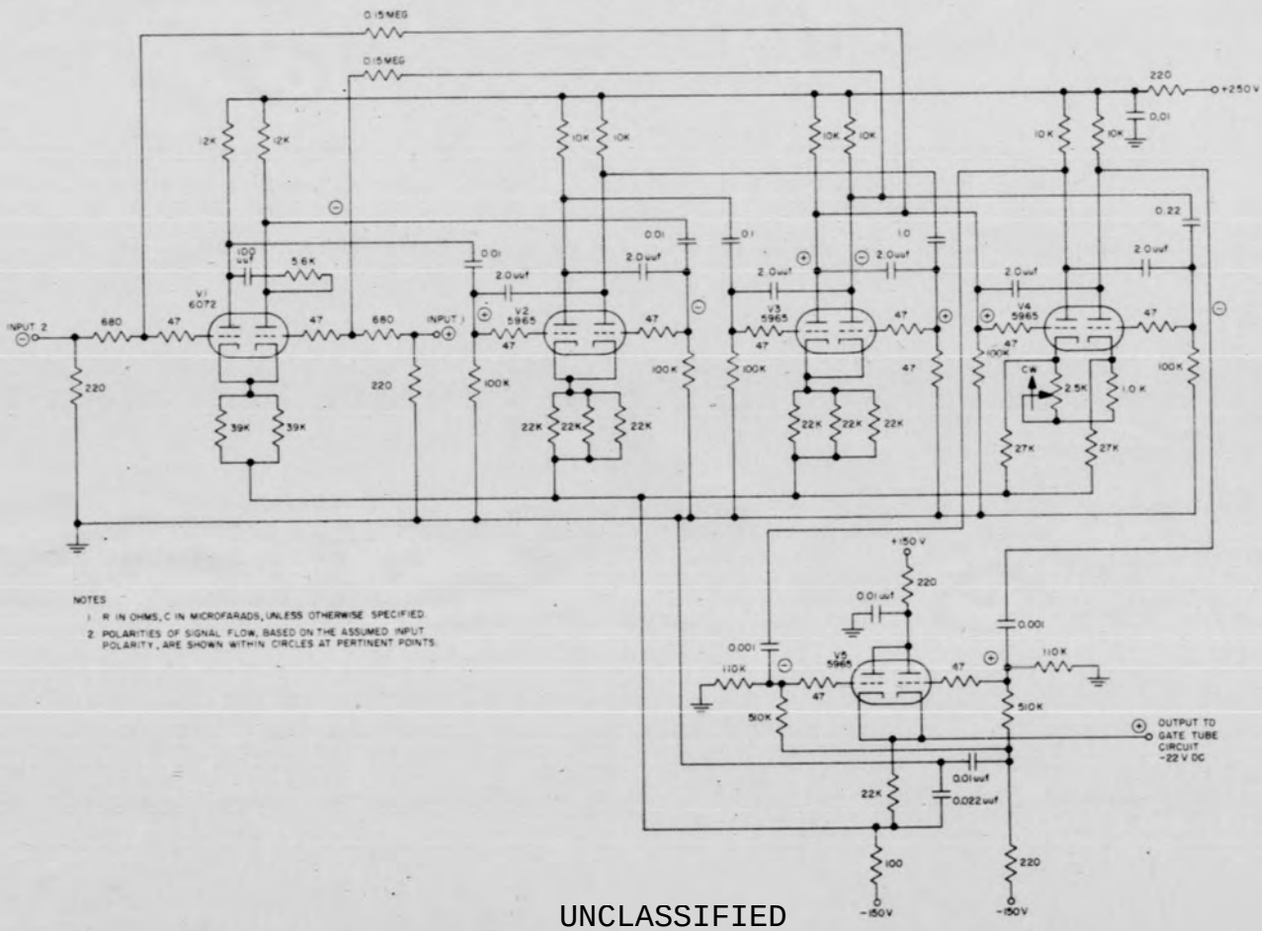
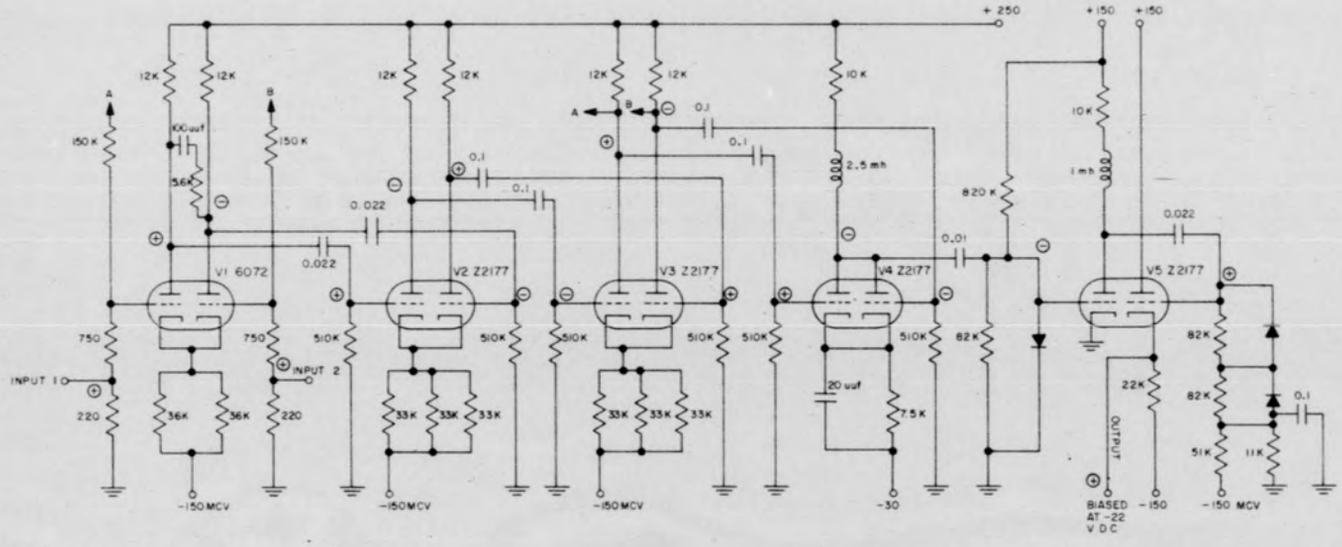


FIGURE 5-3. ORIGINAL PROTOTYPE SENSE AMPLIFIER



NOTES

1 - R IN OHMS, C IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.

2 - POLARITIES OF SIGNAL FLOW, BASED ON THE ASSUMED INPUT POLARITY, ARE SHOWN WITHIN CIRCLES AT PERTINENT POINTS.

FIGURE 5-4. NEW MODEL SENSE AMPLIFIER

Further effort resulted in the new model sense amplifier (fig. 5-4), which provides better operating characteristics than the modified sense amplifier. The polarities of signal flow noted in figure 5-4 represent those obtained from one polarity of sense-winding induced voltage. The first three stages of the new sense amplifier are almost identical to the first three stages of the original sense amplifier. To improve the low-frequency response of the new design, the grid input networks of the new model sense amplifier use lower values of coupling capacitance and grid resistance than the original sense amplifier. The 2.0-micro-microfarad Miller effect capacitors are not used in the new model sense amplifier, since their effect was questionable. Also, a slightly smaller amount of feedback is used in the new model sense amplifier.

The outputs of the third stage of the new sense amplifier are fed to the grids of a rectifying amplifier. The tube characteristics of this fourth stage are such that the tube responds to the positive signal. This causes the tube to conduct harder. Thus, the output of the fourth stage is a negative pulse, regardless of the polarity of the sense-winding signal. This negative signal is applied to the fifth stage, a single-ended amplifier, which is normally drawing grid current. The positive output pulse of the single-ended amplifier is applied to the sixth stage, a cathode follower. (Note that tube V5 is used for the fifth and sixth stages.) The cathode follower output is a positive pulse biased at -22 volts dc. This is the same type of output which was obtained from the original and from the modified sense amplifiers.

The new model sense amplifier is an improvement in that its gain is slightly greater than the previous models. More important, however, is the fact that it has broader bandwidth and also a delay 0.18 microsecond less than the modified sense amplifier.

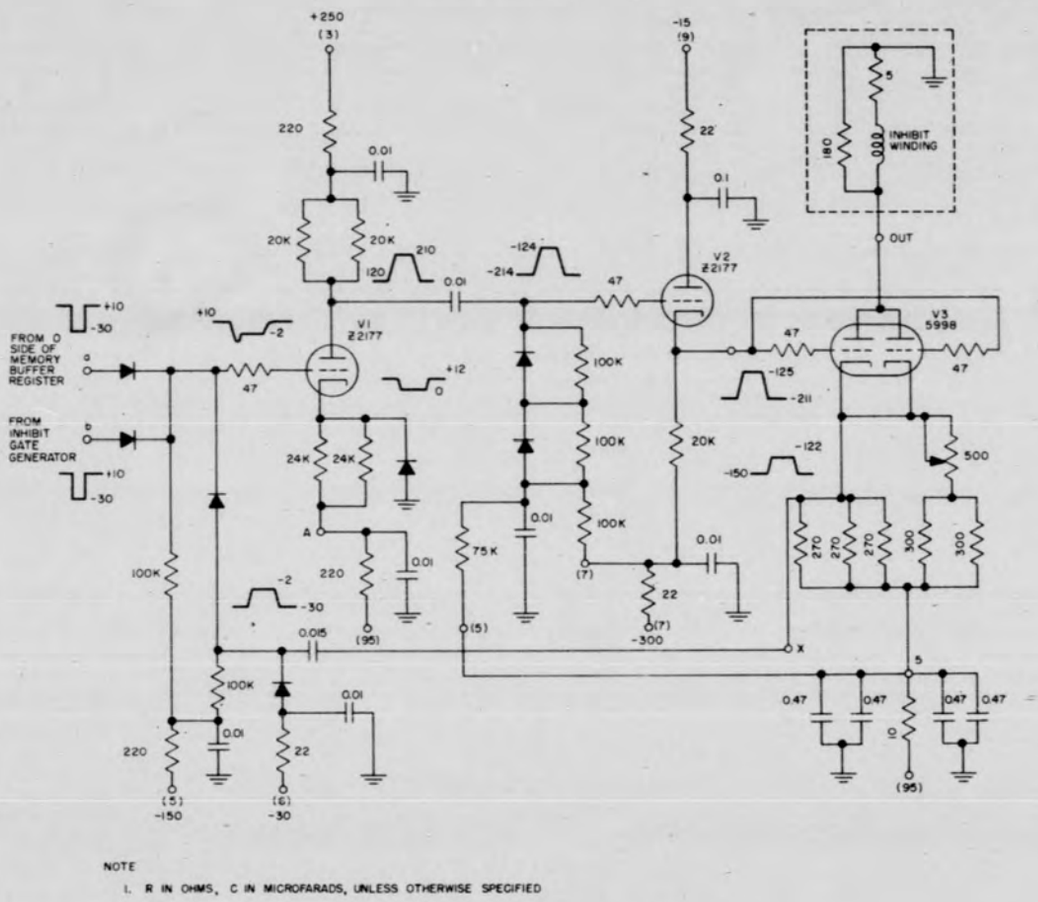
5.2.1.2 Core Memory Digit Plane Driver Redesign

To improve the performance of core memory, a new digit plane driver (DPD) with 0.4-microsecond less circuit delay than the original DPD has been designed. The new DPD had not, by the end of this quarter, been incorporated into either the prototype or production systems because it has not yet been decided whether to retrofit the new circuit into XD-1, XD-2, DC-1, or DC-2.

A test model of the new DPD has been built as an XD-1 pluggable unit using Cambridge Thermionic Corporation (CTC) lugs and insulated wiring. This model was placed in Memory I of XD-2 and tested by the memory tester. A special inverter stage was used during test to convert the positive gate signals used with the old DPD to the negative signals required by the new one. Data is now being obtained to determine the effects of the faster rise and fall times of the inhibit pulse on the noise pickup in the sense winding.

A production unit layout of the new digit plane driver has been prepared. This is now in the process of being released. Production cards will be used to build 12 of the XD-1 type pluggable units which, when completed, will be tested in Memory I of XD-2 using the memory tester.

The new model of the DPD, shown in schematic form in figure 5-5, will develop a current pulse for the inhibit winding only if two coincident negative pulses appear at input terminals a and b. The grid of tube V1 is held at +10 volts until such coincidence occurs. When the two negative pulses are applied concurrently, the grid level tends to fall to -30 volts but its fall is arrested at -2 volts by the feedback signal from the cathode of tube V3. The resultant -12-volt pulse applied to the grid of V1 causes the V1 cathode to fall from approximately +12 volts to 0 volts and the V1 plate voltage to rise from +120 volts to +210 volts. This +90-volt signal is coupled to the grid of tube V2, normally biased at -214 volts. Since V2 is a cathode follower, its output level is raised slightly because of cathode follower bias buildup. The output pulse of this tube is applied to both grids of V3. Tube V3, normally cut off, is made to conduct, thereby generating a current pulse in the inhibit winding. As was mentioned previously, the cathode signal of V3 is fed back through a capacitor to the grid of V1 in order to arrest its fall. The amplitude of the inhibit pulse which is supplied to the inhibit winding is controlled by potentiometer R24.



NOTE
1. R IN OHMS, C IN MICROFARADS, UNLESS OTHERWISE SPECIFIED

FIGURE 5-5. DIGIT PLANE DRIVER, TYPE II

5.2.2 Power Supply and Marginal Checking System

During this quarterly period, test specifications were released for the following units:

a. Unit 19 - Computer MCD unit
b. Unit 27 - Display-MI-WL MCD unit
c. Unit 29 - Main drum MCD unit
d. Unit 31 - Output MCD unit
e. Unit 48 - Display console CB unit
f. Unit 55 - Simplex input PD unit
g. Unit 56 - Simplex input CB unit
h. Unit 58 - Simplex input MC unit
i. Unit 59 - Duplex input MCD unit
j. Unit 63 - Duplex PCD unit
k. Unit 64 - Simplex PCD unit

Extensive heat dissipation data has been compiled for use in air-conditioning calculations. This work is nearly complete and approximately 250 advance prints have been sent to the installation subcontractor.

5.2.3 Test Equipment for Installation Sites

Special test equipment for use with AN/FSQ-7 and AN/FSQ-8 is divided into three classes, depending upon procurement and manufacturing specifications. Class I embraces all test equipment designed and manufactured by IBM. This equipment must be built of components released by IBM or of components which have been approved by the AN/FSQ-7 Components Group. Class II includes all test equipment designed and manufactured by subcontractors. This equipment must be manufactured under military component specifications or under more stringent specifications, and must be compatible with AN/FSQ-7 and AN/FSQ-8 design requirements. Class III is comprised of commercially available test equipment which can be used as an integral part of, or in conjunction with, special test equipment manufactured by IBM or subcontractors.

Class I special test equipment is being designed and manufactured by the IBM Military Products Division at Kingston, N. Y. To date design has been released to production, and construction has begun on the pluggable unit tester, memory driver panel tester, cathode-ray tube tester, and on the power supply control chassis tester. All test equipment in classes I, II, and III is scheduled for delivery to the AN/FSQ-7 (DC-1) installation site in June, 1956.

5.2.3.1 Field Pluggable Unit Tester

The purpose of the field pluggable unit tester is to check functionally all standard pluggable units used in AN/FSQ-7 Combat Direction Centrals and AN/FSQ-8 Combat Control Centrals. The tester is composed of four modules, A, B, C, and D, as shown in figure 5-6. Module A contains a signal generator and several pluggable units for checking the pluggable unit undergoing test. Module B contains relay switching networks and marginal checking circuits used for checking the pluggable unit on test. Module C is of console-type construction and contains various meters and switches in addition to a type 858 Cardatype Card Reader Unit for diagnostic programming of the pluggable unit being tested. Module D is also console equipment and contains the pluggable unit test mount, an oscilloscope, and neon error indicators for checking the pluggable unit under test.

General testing procedures for checking pluggable units utilize diagnostic programming, marginal checking, and oscilloscope probing. Programming the pluggable unit tester is done with the aid of the 858 Cardatype. The cards are read from side to side from column 1 through column 80 at the rate of eight lines per second. Approximately six cards are required for each pluggable unit test. The exact number of cards required depends upon the pluggable unit being considered and upon the ability of the programmer to program the tests easily.

With the test circuits now available, errors are detected by observing the oscilloscope pattern as the program is being run. If the pattern is not identical to a correct "test" pattern, the circuit being tested is faulty. In the future, programming provisions may be made to include a description of what each card column tests so that faulty circuits can be located rapidly and maintenance and repair of the pluggable unit expedited.

The field pluggable unit tester is scheduled for delivery to the first AN/FSQ-7 (DC-1) installation site in June, 1956.

5.2.3.2 Cathode-Ray Tube Tester

The cathode-ray tube tester (fig. 5-7) is being built for acceptance testing and maintenance of the 19-inch, 16-inch, and 5-inch cathode-ray tubes. Provisions for checking the area discriminator and light-gun circuitry probably will be included in the tester at a later date. The tester is physically composed of a console and a standard AN/FSQ-7 module. It includes equipment for checking the electrical specifications of the cathode-ray tubes. In addition, jigs and gauges are supplied with the tester for checking mechanical specifications of the tubes.

The cathode-ray tube to be tested is held by a dolly mounted on casters. The dolly holding the cathode-ray tube can be easily moved into the console equipment where various potentials are applied to the tube. Meters, switches, and other testing devices are built into the con-

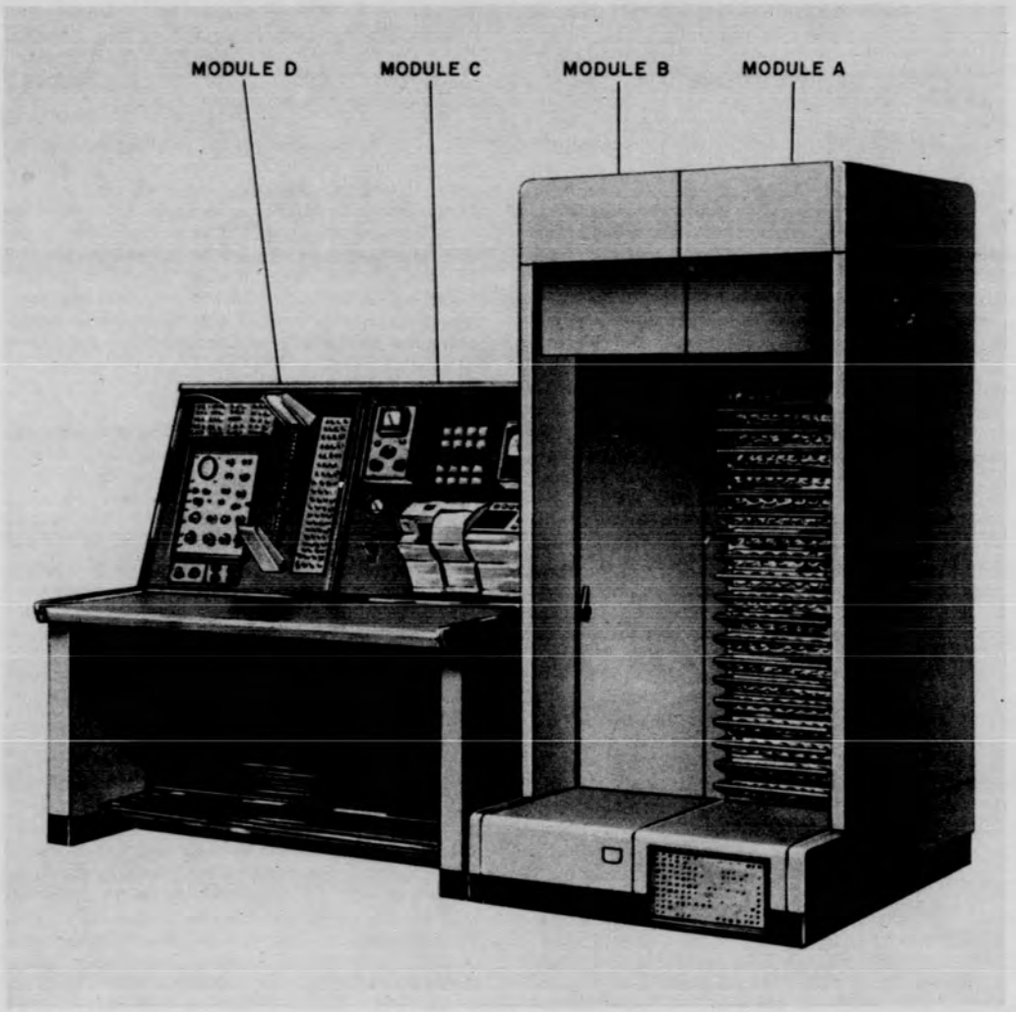


FIGURE 5-6. PLUGGABLE UNIT TESTER

sole. Additional space is provided on the console table for mounting an oscilloscope. All pluggable units of the tester are housed in the module equipment. The tester includes a power supply for providing +12.0 kilovolts dc and -3.3 kilovolts dc to the tester console. The maintenance room power supply furnishes 10 additional d-c voltages to the tester.

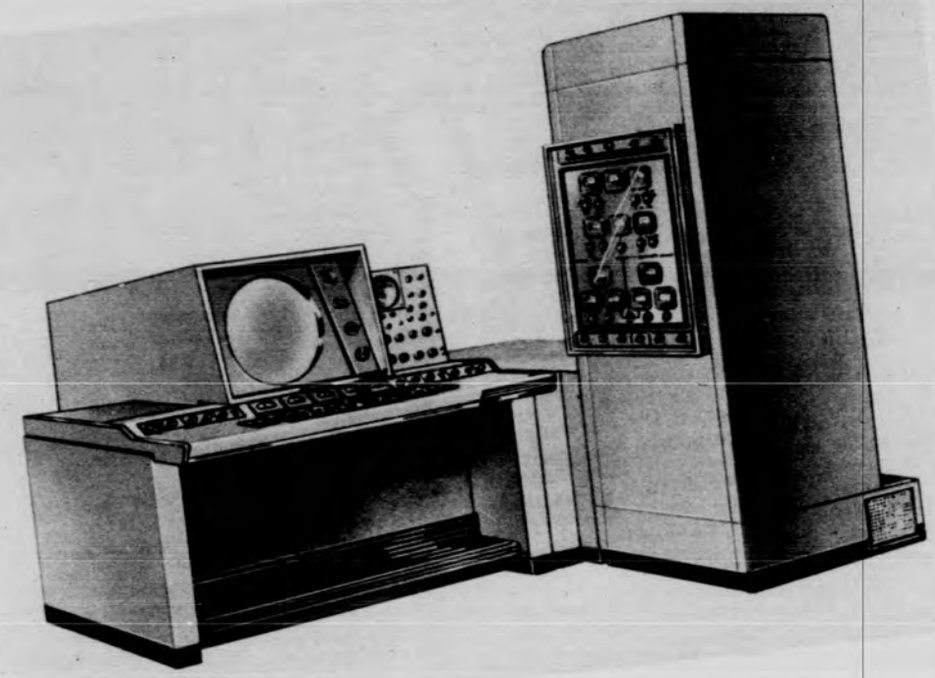


FIGURE 5-7. CATHODE-RAY TUBE TESTER

Major tests which the tube tester will perform include: high potential and leakage tests, gas test, static operating test, dynamic test, and tests unique to the individual tubes.

There will be one tester at each Direction Central and one will be assigned to each vendor supplying the tubes. Delivery to the first site is scheduled for June, 1956.

5.2.3.3 Memory Driver Panel Tester

The memory driver panel tester is used to check the circuitry of the core memory array driver panels. Each core memory array contains four driver panels, and each panel contains one nonstandard (32-tube) pluggable unit.

The tester consists of one standard AN/FSQ-7 module and a console two modules wide with a desk top. The module equipment includes eight 9-tube pluggable units, two 6-tube pluggable units, and relay switching circuits. The tester console contains an oscilloscope, switches, meters, and provision for holding the memory driver panel under test. The tester utilizes a built-in blower assembly for air cooling.

Tests are accomplished by applying various combinations of test signals generated by the tester to the driver panel. The output signals from the driver panel can be observed on the oscilloscope, enabling maintenance personnel to determine whether the driver panel

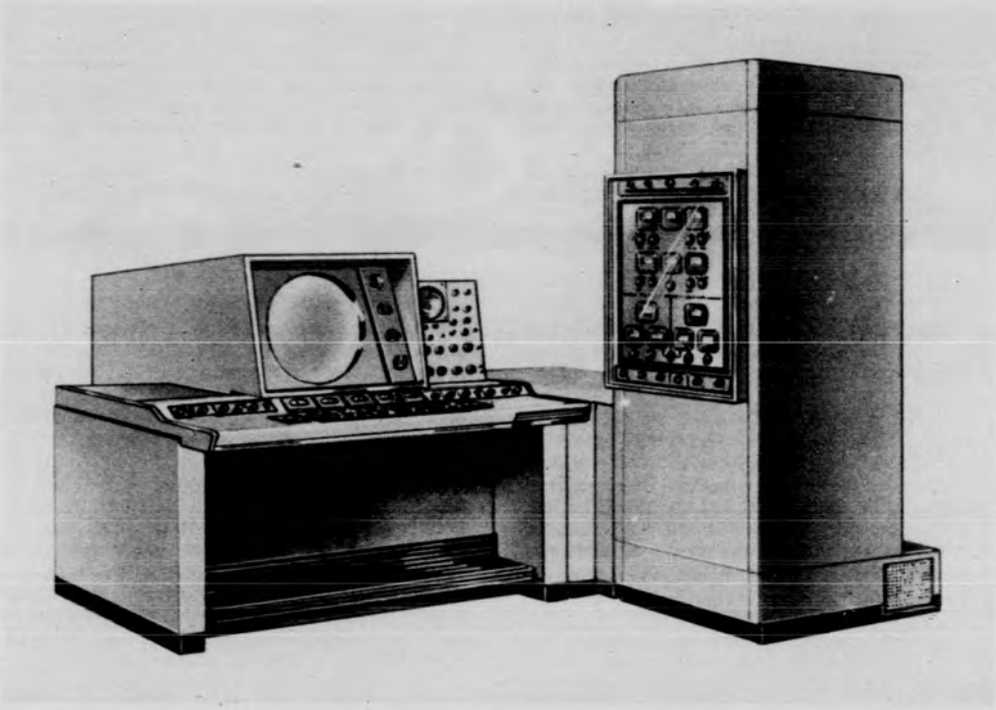


FIGURE 5-7. CATHODE-RAY TUBE TESTER

Major tests which the tube tester will perform include: high potential and leakage tests, gas test, static operating test, dynamic test, and tests unique to the individual tubes.

There will be one tester at each Direction Central and one will be assigned to each vendor supplying the tubes. Delivery to the first site is scheduled for June, 1956.

5.2.3.3 Memory Driver Panel Tester

The memory driver panel tester is used to check the circuitry of the core memory array driver panels. Each core memory array contains four driver panels, and each panel contains one nonstandard (32-tube) pluggable unit.

The tester consists of one standard AN/FSQ-7 module and a console two modules wide with a desk top. The module equipment includes eight 9-tube pluggable units, two 6-tube pluggable units, and relay switching circuits. The tester console contains an oscilloscope, switches, meters, and provision for holding the memory driver panel under test. The tester utilizes a built-in blower assembly for air cooling.

Tests are accomplished by applying various combinations of test signals generated by the tester to the driver panel. The output signals from the driver panel can be observed on the oscilloscope, enabling maintenance personnel to determine whether the driver panel

circuits are operating properly or to locate driver panel circuits which are causing errors. The tester duplicates the actual function of the memory circuits. Facilities for marginal checking the driver panels are also included on the tester. The first field memory driver panel tester is scheduled for delivery to the first Direction Central site in June, 1956.

5.2.3.4 Power Supply Control Chassis Tester

The control chassis tester is used to check and adjust the control chassis of d-c power supplies. The equipment consists of one console about the width of a standard AN/FSQ-7 module. The tester is used to test and adjust the power supply magnetic amplifiers.

The tester is mounted on casters so that testing can be done without removing equipment from the power supplies. Circuitry is contained in the tester for supplying the required signals to the units or equipment being tested. When testing magnetic amplifiers, meters on the console front panel of the tester indicate the values of the inputs to and outputs from the magnetic amplifiers.

Electrical and mechanical design of the control chassis tester has been completed and work has begun on its construction. It is scheduled for delivery to the first Direction Central site in June, 1956.

5.3 SUBCONTRACT ENGINEERING

Major engineering subcontracts have been let for work on the Input and Display Systems. The information contained herein has been abstracted from subcontractor reports.

5.3.1 Input System (Bendix Aviation Corporation, Bendix Radio Division)

The design of the Input System for the first four production centrals, except for the GFI mapper consoles, LRI monitor, and input pattern generator (IPG), has been continued by IBM. The design of these excepted units has been assumed by Bendix Radio under a letter of intent which was originally issued on April 6, 1955. Bendix Radio is also designing the GFI monitor equipment for the AN/FSQ-7 (DC-4) and will modify the design of the Input System in order to incorporate changes or additions. Interim reports on these new designs will be submitted to IBM, so that these designs can, where feasible, be incorporated into present production. It is contemplated that Bendix Radio will have design responsibility for the Input System of the AN/FSQ-7 (DC-4) and for subsequent production centrals. Bendix is now to fabricate engineering models of Input System units in accordance with most recent design.

5.3.1.1 GFI Mapper Console

Progress was made during this report period in solving problems leading up to production release of the GFI equipment. These problems relate to the gear train and its housing redesign, the electromagnetic brake, the azimuth drive motor, and the circuitry associated with the CRT sweep and write-head driver.

A study of gear tolerances and the combined mechanical-electrical influence on backlash resulted in a more realistic manufacturing tolerance at the high-speed end of the train. During the study it also became apparent that the universal joint at the low-speed end of the train introduced backlash into the system. An improved spring-loaded model of the universal joint is being built for test and evaluation.

The electromagnetic brake, as used on the prototype mappers and as presently available for the production mappers, does not satisfy the brake specification in regard to coil insulation and torque. By increasing the length of the brake housing, space will be allowed for the required Formvar insulation, and the specification as regards coil insulation can be met. Torque, as measured on the existing design, was approximately 10 percent below the specified value. However, since brakes with this lower value of torque have operated satisfactorily on prototype mappers, approval is being sought to change the specified torque to a value consistent with that of the available design.

Both torque and impedance of the azimuth drive motor were measured and found to be lower than the specified values, but the efficiency was as high as could be expected from a motor of good design. A more thorough study of the drive and read-head circuits must precede any motor or circuit redesign.

Reliability tests are now being run on a modified version of the CRT sweep circuit. Two component specification deviations have been made: exceeding the +25-volt heater-cathode rating of a Z2177 tube by 5 volts, and placing the driving signal on the screen grid of the 6146 sweep driver tube instead of on the signal grid.

Reliability tests are also being run on the modified write-head driver circuit (fig. 5-8). The modifications should prevent tube ratings from being exceeded with regard to peak current and peak inverse voltage.

5.3.1.2 GFI Monitor

The general approach to the design of the GFI monitor consoles for AN/FSQ-7 (DC-4) and subsequent production centrals has been to have them approximate the GFI mapper console design as much as possible, and, in the case of the camera mount, to use the LRI scheme as completely as possible, since that design was well advanced by the time the comparable GFI design began.

The general approach to the design of the associated module equipment has been to keep the amount of circuitry added to the existing channel equipment to an absolute minimum. Consequently, one of the principal GFI monitor design efforts is to determine, and then minimize, loading effects of the monitor equipment on the channel mapper circuits.

In particular, the emphasis on standardization has resulted in the same camera and hood arrangement being used for both GFI and LRI consoles. This arrangement is shown in figure 5-9. Simplification of circuitry for duplex switching has been studied, but will depend upon a decision as to the importance of lost-information time.

5.3.1.3 LRI Monitor

The LRI monitor console will have the same exterior form as the GFI mapper consoles. With the exception of the top front cover, all access panels will also be the same. However, to provide for easier manufacturing and at the same time meet all the physical requirements of the structure, the interior structure of the LRI unit will have gussetted angle construction

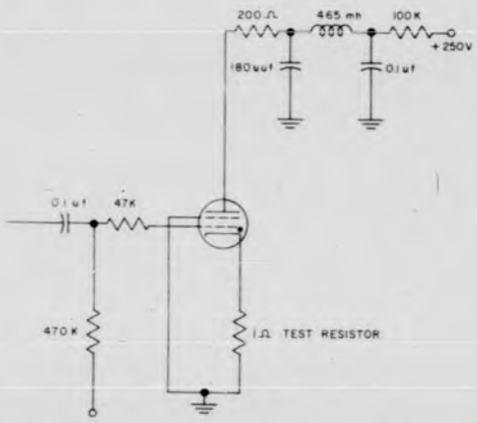


FIGURE 5-8. MODIFIED WRITE-HEAD DRIVER CIRCUIT

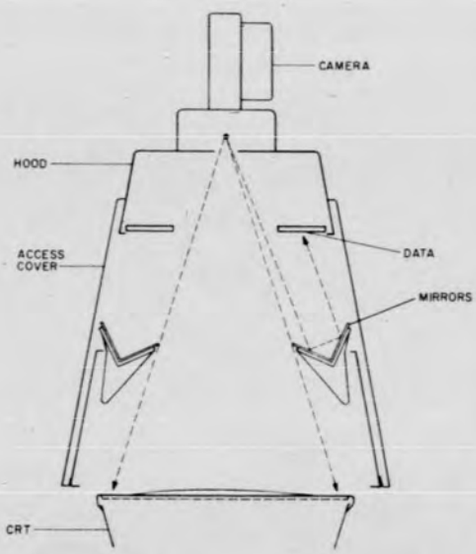


FIGURE 5-9. CAMERA OPTICS SCHEMATIC

rather than the rectangular tubular construction of the GFI mapper consoles. The primary difference between the LRI monitor consoles and the mapper consoles will be in the method of mounting the CRT. Whereas the mapper tube is mounted on a separate subpanel requiring removal of the front panel for servicing, the LRI monitor CRT will be clamped in a tube shield mounted on the front panel and will be serviced through that panel. (See fig. 5-10.)

The type of camera to be used with the LRI monitor has been chosen, and one such camera has been ordered for a prototype camera assembly. The LRI monitor camera assembly is so designed that by changing the data which is adjacent to the CRT, the same assembly may be used on a GFI monitor console. The CRT and data will be visible to the operator through a shuttered peep-hole located at the center of the hood in front of the camera. Arrangements for mounting the camera data on the front panel of the console were discarded because the high voltage on the front edge of the CRT and interference with the tube shield required the data to be located so far from the tube-display area that resolution in the photograph was poor. A hood-mounted data arrangement which would allow photographing the data almost tangent to the CRT display was devised. A sketch of the camera and hood arrangement is shown in figure 5-9.

The basic circuit design of the analog section of the LRI monitor is virtually complete, and effort is being directed toward having a complete breadboard system in operation. Mechanical design of the console is also virtually complete and construction of a model should start shortly. Final logic has been established for the digital section of the LRI monitor and orders have been placed for the necessary components. Some components (circuit board assemblies and pluggable unit frame) have been received and assembly has started. Test equipment for both the digital and analog sections is being designed, and some construction work has started in this area.

5.3.1.4 Input Pattern Generator

Bendix Radio's design of the originally specified input pattern generator (IPG) had advanced far enough to predict good reliability. Midway in this reporting period, however, a new IPG specification was deemed necessary. The overall logic design for this new IPG was virtually completed by the end of this reporting period. The IPG will generate test signals identical to those normally received by the GFI, XTL, and LRI units. These signals will be used during maintenance programs for the above-mentioned units.

5.3.1.5 Input System Design Modifications

A method for obtaining a parity rate alarm signal has been developed. A model is being constructed and if it proves satisfactory, a proposal based on its logic will be made. Concurrently with this experimental work, an analysis of the parity rate alarm problem has been undertaken which will result in a description of the input to the device, a determination of necessary measurements, an evaluation of alarm devices, and the choice of a device.

5.3.1.6 Light-Gun Simulator Circuit

A thyratron circuit has been developed to simulate a light-gun signal pulse for testing the coding circuits in the standby manual input (MI) unit. Operational analysis tests have been conducted on a breadboard model. The layout of the entire light-gun simulator circuitry on IBM wired circuit cards has been developed and completed. These layouts will be used as patterns

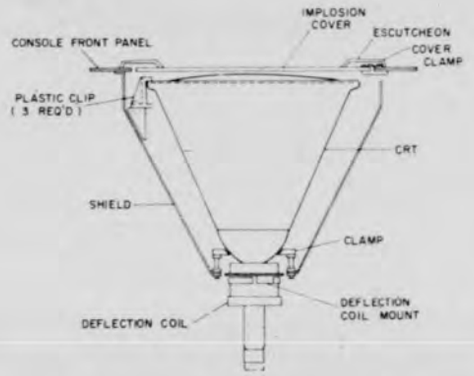


FIGURE 5-10. CATHODE-RAY TUBE MOUNTING, LRI MONITOR

for the etched circuits on the printed circuit cards. The space requirements for the simulator switch panel have been determined, and the panel switches and knobs have been selected and ordered. A new layout drawing showing the proposed locations of pluggable units and the switch panel in the MI unit has been prepared.

5.3.2 Display System (Hazeltine Electronics Corporation)

Hazeltine began engineering work on the AN/FSQ-7 Display System in January, 1955, under a letter of intent from IBM. Hazeltine is now performing under a definitive subcontract, an executed copy of which was received by IBM from Hazeltine on October 21, 1955. The information contained herein is abstracted from Hazeltine's report of the period from August 1, 1955, to October 31, 1955.

Table 5-1 presents a listing of the tasks assigned to Hazeltine by the engineering subcontract.

During the reporting period, Hazeltine completed the design of the display generator units and of the signal distribution boxes. The planning of cable layout for AN/FSQ-7 has been almost completed. Display consoles continue to be re-engineered for production design. The bulk of this work has been in simplification of physical design structure and layout.

Strong emphasis is being placed upon the design and production of both engineering and production test equipment. Display tube testers and display generator input simulators have been fabricated and are currently in engineering use. Production test equipment built by Hazeltine include card testers (one of these is now being used in production), pluggable unit testers, and display console test facilities. Two production versions of the display generator input simulator are also being designed and assembled.

Table 5-2 presents the schedule for Hazeltine's engineering activities.

5.3.2.1 Display Generator Units

The circuit design for the situation and digital display generators has been virtually completed. The only design work remaining is the detailing of some display assignment bit (DAB) driver circuit modifications and new display console diode protection circuits.

TABLE 5-1. SUMMARY OF TASKS, ENGINEERING SUBCONTRACT

Task Number	Description
I, IV-A	Conduct study and design program on AN/FSQ-7 Display System. (Task I) Design Command Post console, photographic recorder-reproducer, and projection screen. (Task IV-A)
II	Assemble and test display generator units of AN/FSQ-7 (XD-2).
III, IV-B	Acquire or fabricate engineering models designed on Tasks I and IV-A.
V	Participate in installation and testing AN/FSQ-7 (XD-1) Display System at MIT Lincoln Laboratory.
VI	Acquire or fabricate special test equipment for developmental work.
VII	Prepare semi-monthly letter-type progress reports, quarterly engineering progress reports, final reports, etc.
VIII	Prepare instruction manuals for the Display Systems of AN/FSQ-7 (DC-1, DC-2).
IX	Design interconnecting cables and junction boxes for Combat Command Center AN/FSQ-8.

All card details and card assemblies have been released, including those cards affected by recent changes in the DAB driver section, and the addition of diode protective circuits. All pluggable unit drawings have been released and all of the logic drawings redrawn. These are awaiting engineering check.

Hazeltine has redesigned the situation display generator output DAB drivers so as to redistribute and improve their driving capacities. This unit had had DAB drivers having

[redacted]

TABLE 5-2. HAZELTINE ENGINEERING SCHEDULE

Unit	Scheduled Date For Completed Design
Situation display generator	Completed*
Digital display generator	Completed**
Situation display console	December 15, 1955
Auxiliary display console	February 1, 1956
Input data selection control panels	January 15, 1956
Light gun	December 1, 1955
Area discriminator	December 1, 1955
Semi-automatic camera	December 1, 1955
Signal distribution boxes	Completed
Interconnecting cables	December 15, 1955
Command Post junction box	December 1, 1955
Instruction manuals	February 1, 1955+

* Complete except for driver circuit modifications and new diode protection circuits now in development.

** Complete except for new diode protection circuits now in development.

\+ Will reflect engineering level as of December 31, 1955. Supplementary instruction manual information will be issued for each unit April 1, 1956, or 30 days after delivery of the unit, whichever is later.

weak (capable of driving 1 to 3 display consoles) and strong (capable of driving to 50 display consoles) load capacities. The new circuit is designed for an intermediate load capacity of 15 display consoles. A request for approval of this circuit has been prepared by Hazeltine engineering and has been transmitted to IBM.

Hazeltine has submitted a proposal to IBM which would modify existing power cathode follower circuits in the display generators in order to protect diodes within the display consoles in the event of component failure within a generator. Ten pluggable units are being changed to incorporate these circuits. The modification consists of a voltage divider network and a crystal diode. The voltage divider supplies a positive potential of +15 volts. Should a failure within a power cathode follower circuit cause the voltage on a signal line to rise above the +15 volts, a IN93 crystal diode will conduct, thereby preventing the signal voltage from rising considerably higher. The IN93 diodes will conduct forward current as great as 280 milliamperes. The signal voltages to the consoles are thus clamped at a safe maximum (approximately +30 volts).

[redacted]

Recently received circuit changes for the situation display generator concerning the character selection decoder, character position decoder, analog line driver, and vector generator are being analyzed to determine the practicability of adding these changes to the AN/FSQ-7 (DC-1).

5.3.2.2 Display Consoles, General

The display consoles as originally designed required three different types of high-voltage units: a situation display (SD) high-voltage unit, a digital display (DD) high-voltage unit, and a DD potentiometer box. As described in the previous quarterly report, Hazeltine has redesigned the DD high-voltage units to include the features of the DD potentiometer box, thus eliminating the need for that unit. In addition, both SD and DD high-voltage units have been moved from the rear of the display consoles to the front, thus eliminating the need for flexible control shafts.

A model of the redesigned high-voltage unit has been constructed and wired in place. This has necessitated some slight modification of the display console subpanel and re-layout of some component boards.

Redesign of the unit status switch has been completed and a mechanical model has been made. It is both stronger and easier to build than the equivalent XD-1 switch.

5.3.2.3 Situation Display Consoles

Redesign of the sample prototype console is continuing at Hazeltine's Little Neck plant and under Hazeltine supervision at the Crosley plant. Both mechanical and electrical features of the SD console are under review and are being investigated for possible improvements. In connection with this effort, Hazeltine has given Crosley permission to build a partial engineering model of the console for use in proving out certain elements of design.

Three XD-2 SD consoles have been received from IBM for use in engineering development work. An SD CRT has been installed in one of the Crosley consoles, and a rack of Burroughs test equipment has been assembled to provide test signals for the console.

Circuit approval drawings have been submitted to IBM for all SD console circuits. Some additional data has been requested by IBM, including waveshapes. These will be submitted as soon as a console is operating properly and the measurements can be made.

The deflection driver and decoder circuits both have provisions for the inclusion of settling-time compensation circuits similar to those proposed by MIT's Lincoln Laboratory.

5.3.2.4 Auxiliary Display Consoles

The auxiliary display console is still in the process of being designed. Since the production of auxiliary display consoles is scheduled after the production of SD consoles, their physical parts are being based on SD console design wherever possible.

An auxiliary display console received from IBM's plant at Vestal, N. Y., has been prepared for use with the DD generator and is currently in active engineering use. The console's front panel and subpanel are being redesigned and a breadboard mock-up of the new versions have been built in order to evaluate the changes. Also being constructed is a revised audible alarm chassis.

The requirements of MIT's engineering memorandums 6M-3632 through 6M-3636 regarding the location and interchangeability of release and activate switches have been investigated by Hazeltine engineering. Two proposals which will permit complete flexibility are under consideration. One provides for engraving the switch function on top of the switch so that changing its position will not affect panel lettering. The second provides for a transparent panel area adjacent to the switch, over which can be placed a small plate containing the switch function lettering.

The release button solenoid poses a problem. When the release button is in its depressed state, the resultant continuous 48-volt current may damage or destroy the solenoid. Hazeltine is designing a special pushbutton which will provide only a momentary current surge even if the release pushbutton is held in its depressed state. This will eliminate the damage hazard which appears to exist in the prototype console.

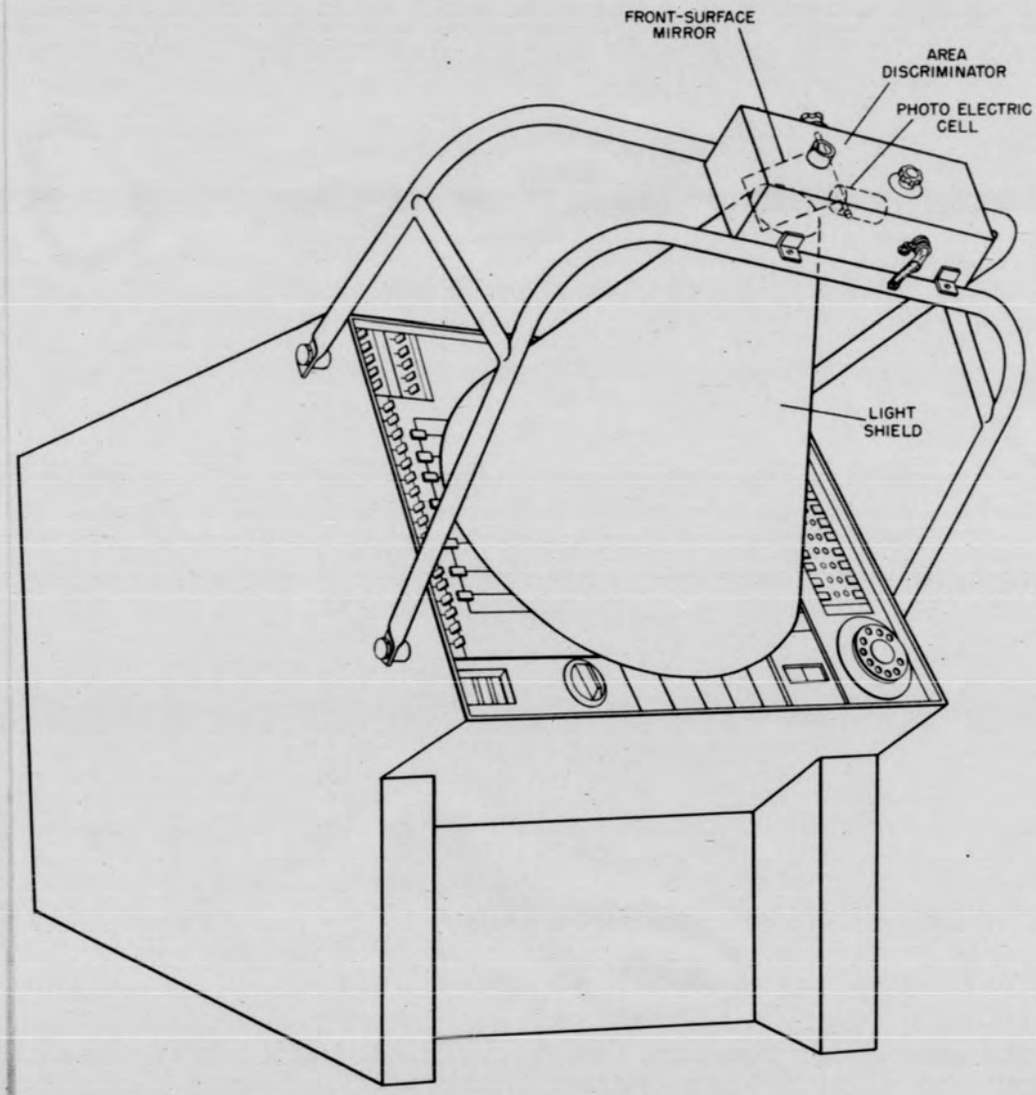


FIGURE 5-11. AREA DISCRIMINATOR

5.3.2.5 Input Data Selection Control Panel (Side-Wing Unit)

A control panel received by Hazeltine from Crosley on September 8 is being used as an engineering model. The problem of providing complete interchangeability between right-hand and left-hand control panels has been resolved. Production models of the panel will be adaptable for either right- or left-hand use.

A Hazeltine mock-up of the control panel has been made. It appears that considerable savings in usable bottom area can be had with some redesign. This space can possibly be used for warning lights and as a special audible alarm panel.

5.3.2.6 Light Gun

Extensive tests have been conducted on the newly designed light gun described in the previous quarterly report. The tests were carried out with XD-1 SD consoles both at Hazeltine and at MIT's Lincoln Laboratory. The new gun, which uses a front-surface mirror to reflect light to the photomultiplier, has proven to have greater light sensitivity (5:3 compared with the earlier prototype light gun) with comparable area sensitivity. Additional tests to determine the variation in sensitivity of the photomultiplier tube in the light gun with variations in the dynode voltages have indicated that the photomultiplier sensitivity was not appreciably affected if, with all other dynodes receiving rated voltages, the voltage of a particular dynode was lowered as much as 30 percent. A revised engineering model of the light gun received from Bausch & Lomb has been successfully tested.

5.3.2.7 Area Discriminator

The area discriminator is being redesigned in order to make use of a front-surface mirror rather than the dichroic mirror used in the original model. The mirror will be pivoted so that when the discriminator action is being set up, it can be swung out of the way of the eyepiece. The operator thus has a clear view of the SD CRT. After the SD CRT has been properly masked according to operational requirements, the mirror is swung back to normal position and the SD CRT image is reflected onto the photoelectric pickup. A breadboard model of the new unit (fig. 5-11) has been constructed. A mounting framework for the area discriminator has been designed and built. It is essentially the same as that being used for the semi-automatic camera. The area discriminator pluggable unit and its card drawings are being revised according to the latest changes received from IBM and MIT. These correct an overload condition which existed in the pluggable unit cathode follower.

5.3.2.8 Semi-Automatic Camera

A redesigned 3-point adjustable camera mount has been constructed for use with a Fairchild 0-15 camera. This mount is based on sketches received from IBM's industrial designer, which, in turn, were prompted by designs submitted to IBM by Hazeltine. A Fairchild camera has been received and mounted, and is undergoing engineering tests.

Work is continuing on the final design of the tubular frame, camera mounting casting, and flexible light shroud. (See fig. 5-12.) The electrical components of the camera control circuits will be panel mounted. This panel will have the same size and shape as the DD high-voltage unit and will be in the same position in the SD console. The purpose of this design is to enable any standard SD console to be readily converted to a camera console by replacing the DD high-voltage unit with the new camera package.

5.3.2.9 Command Post

The problem of packaging the various electronic circuits in the command console desk is still underway. Design of the unit is proceeding on the basis of an agreement reached at a meeting held September 13, 1955, at Lincoln Laboratory, which was attended by representatives of MIT, IBM, Hazeltine, and the U. S. Air Force. The meeting agreed upon final command console desk specifications. Hazeltine is now investigating the cable requirements for the console. Consideration of the duplex switching logic is in progress in order to determine the arrangement which will provide the most suitable operational features. An informal proposal is being prepared and will be submitted to IBM for approval.

Hazeltine has received proposals for a rapid film-processor from Eastman-Kodak, the Fairchild Camera and Instrument Company,

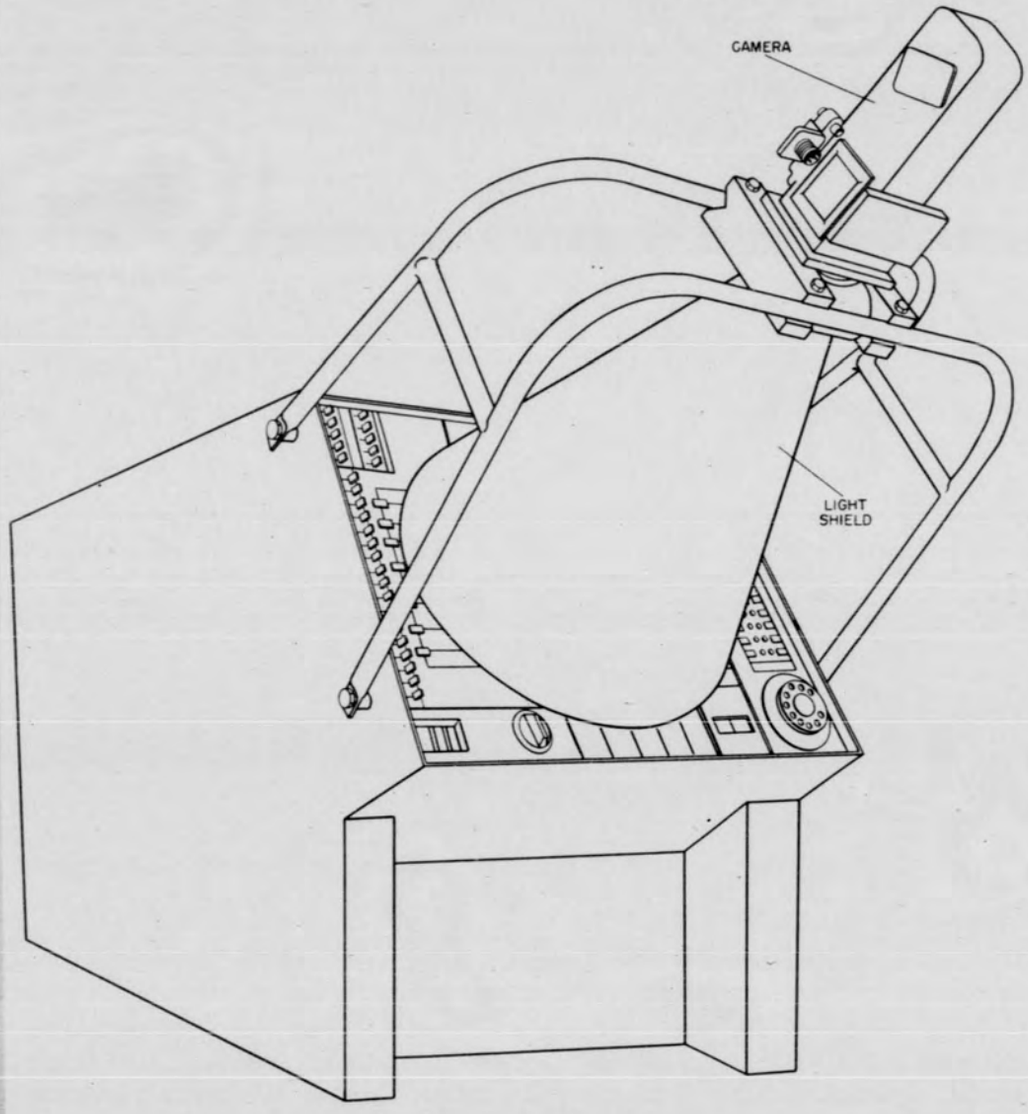


FIGURE 5-12. SEMI-AUTOMATIC CAMERA

Stromberg-Carlson, Ansco, and Kelvin & Hughes, Ltd. At meetings attended by IBM, MIT, and Hazeltine representatives, held at Lincoln Laboratory on September 28 and October 5, IBM instructed Hazeltine to order an engineering model of the Kelvin & Hughes system. A Kelvin & Hughes camera was inspected and specifications for the final machine were agreed upon. The above parties met again October 11, 17, 18, and 19, this time with a Kelvin & Hughes representative in attendance, to discuss technical and contractual aspects involved in acquiring a rapid-process projector. Operation of the machine was discussed in detail, as were preparations which will be required for its use. Hazeltine will place an order for an engineering model of the Kelvin & Hughes unit (with delivery estimated at 6 to 8 weeks) after approval from IBM. An engineering sketch of the projection display system is shown in figure 5-13.

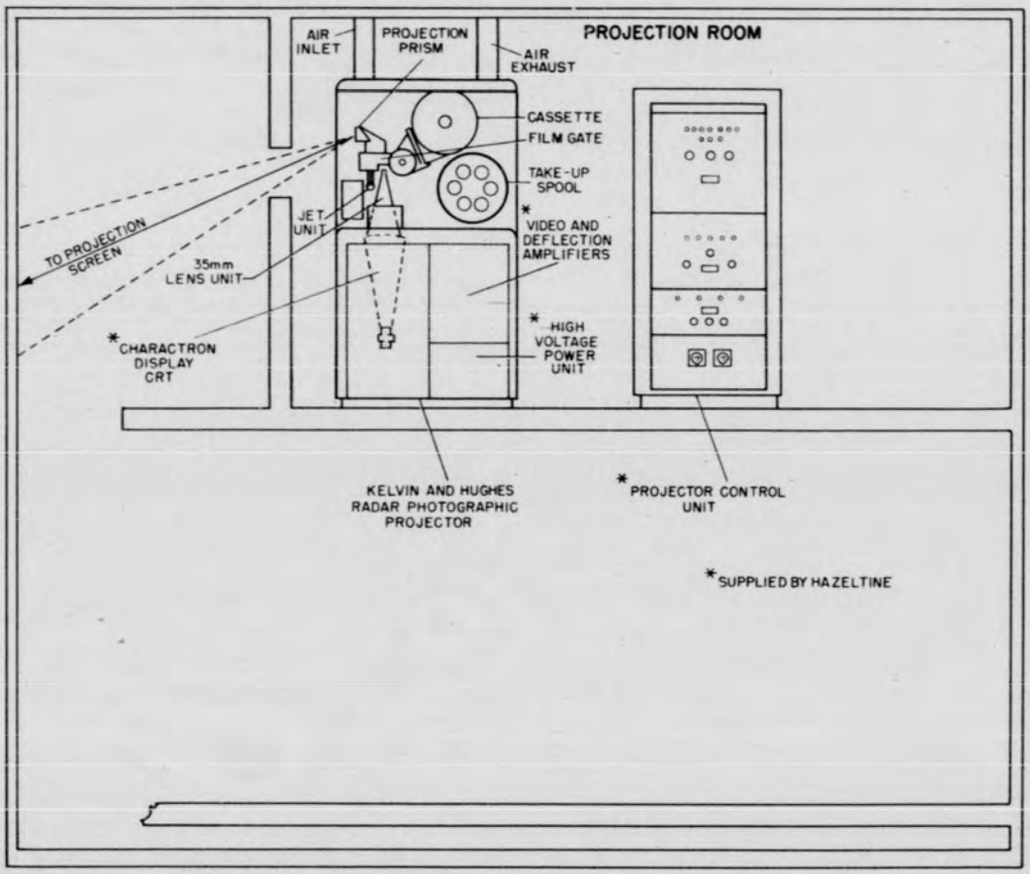


FIGURE 5-13. PROPOSED PROJECTION DISPLAY SYSTEM

[redacted]

5.3.2.10 Signal Distribution Boxes

The three basic types of signal distribution boxes have been designed. They are the 5-foot box, the 7-foot box, and the large box (No. 19) in the command area. Engineering models of the 5-foot and 7-foot boxes have been made and wired to determine production wire lengths. Production models of these two boxes have been fabricated and are being wired.

At a meeting on August 15 between Hazeltine, IBM, and Western Electric, it was agreed that the A and B sections of box No. 19 would be mounted separately against different walls. This arrangement will ease the congestion of ceiling cables going to the command console. A mock-up of box No. 19 has been constructed and is being wired in order to determine internal cable lengths. All distribution box connectors have been assigned and this information has been distributed to IBM and Western Electric.

It is presently planned that the jumpers for DD slot lines and display assignment bit lines will be shipped in bulk after delivery of the boxes for Combat Direction Central AN/FSQ-7 (DC-1 and DC-2). The jumpers will then be installed in accordance with final programming.

5.3.2.11 Interconnecting Cables

Hazeltine has held meetings with representatives of Bell Telephone Laboratories, Western Electric, and Burns and Roe to determine cable routing. Western Electric drawings showing the location of cable racks and ladders in Combat Direction Central AN/FSQ-7 (DC-1 and DC-2) have been received and used to determine exact cable locations and lengths. Hazeltine has issued revised drawings showing interconnecting cabling between display generator units, distribution boxes and consoles for signals, warning lights, and manual inputs. These drawings have been transmitted to Western Electric and IBM. Work is continuing on designing cables for distribution box to distribution box, distribution box to console, and display generator to distribution box. Specifications have been written for the three types of 50-conductor cables being used. Burns and Roe drawings showing final locations of signal distribution boxes and cable racks are expected shortly.

Specifications for signal, power, manual input, warning light, and light gun cables are being released. The quantity of each type of cable required per AN/FSQ-7 has been determined; this information is presented in table 5-3.

TABLE 5-3. INTERCONNECTING CABLE REQUIREMENTS

Function	Number
Signal, SD	372
Signal, DD	310
Signal, trunk*	276
Power	294
Manual input	362
Warning light	76
Light gun	38
Special	6
Total	1,734

*Cables connecting signal distribution boxes

[redacted]

5.3.2.12 Test Equipment for Development

Acquisition of developmental test equipment is progressing at a satisfactory rate. A conference has been held between Hazeltine and the Burroughs Corporation to coordinate development of Burroughs test equipment with the special needs of Hazeltine.

Two pluggable unit evaluation testers have been substantially completed and are in daily use. A display tube tester is now being used for correlation tests on SD CRT's being made by Stromberg-Carlson. Further modifications are planned, however, which will include means to facilitate meter calibration, and which will reflect changes in performance specifications. The portion of the tester designed for DD CRT leakage tests has been completed and is also in use.

Hazeltine has modified the display tester element module of the XD-2DD generator so that it will function as a display generator input simulator for both the SD and DD generators. The input simulator is now being tested preparatory to actual use.

5.3.2.13 Test Equipment for Manufacturing

All incoming inspection test equipment scheduled for use has been received or fabricated and is in operation. Some items are still under construction or design, such as test positions for type 6161 tubes, test jigs for circuit breakers and relays, etc., but these are not scheduled for use at the present time. Also under construction are a deflection yoke tester and a life tester for DD CRT's. A similar tester for SD CRT's is being procured from Stromberg-Carlson.

Construction of the first set of static and functional production card testers, which consists of floor rack and bench rack units, is completed. As shown in figure 5-14, the static tester is divided into two sections: the bench unit which contains standard card slots, standard components, a slot for the card to be tested, and indicator lights; and a floor unit which contains comparison bridges for checking card components against the standards and the power supplies.

This unit has been run successfully with an initial number of cards in order to evaluate the test accuracy obtainable, and is now in production use.

A functional card tester has been designed and is being fabricated. This unit will test cards in operating circuits as opposed to the static tester described above, which merely checks component values and wiring. Test instructions for the functional card tester are being prepared in the order that the various types of cards are required for production.

Construction of the first three pluggable unit testers is completed and plans are being made for construction of two additional testers. These differ from the pluggable unit evaluation testers mentioned in 5.3.2.12 in that the latter are designed to provide detailed engineering information on prototype pluggable units, whereas the former will only be used to insure that production pluggable units are correct.

5.4 SYSTEM TEST PLANNING

Programs and procedures are being prepared for system testing of the AN/FSQ-7 (DC-1). To prepare these programs and procedures, AN/FSQ-7 (DC-1) equipment is divided into two major categories, central computer equipment and input-output equipment.

System testing of the DC-1 central computer will go through the following phases:

a. Phase 1, which consists of test memory routines and manual procedures for checking the operation of machine instructions and essential equipment. This phase includes initial instruction tests, essential central computer equipment tests, secondary central computer equipment tests, and marginal checking control equipment tests. All phase 1 material has been completed.

b. Phase 2A, which consists of card-loaded programs comparable to the test memory routines and procedures of phase 1. The system-

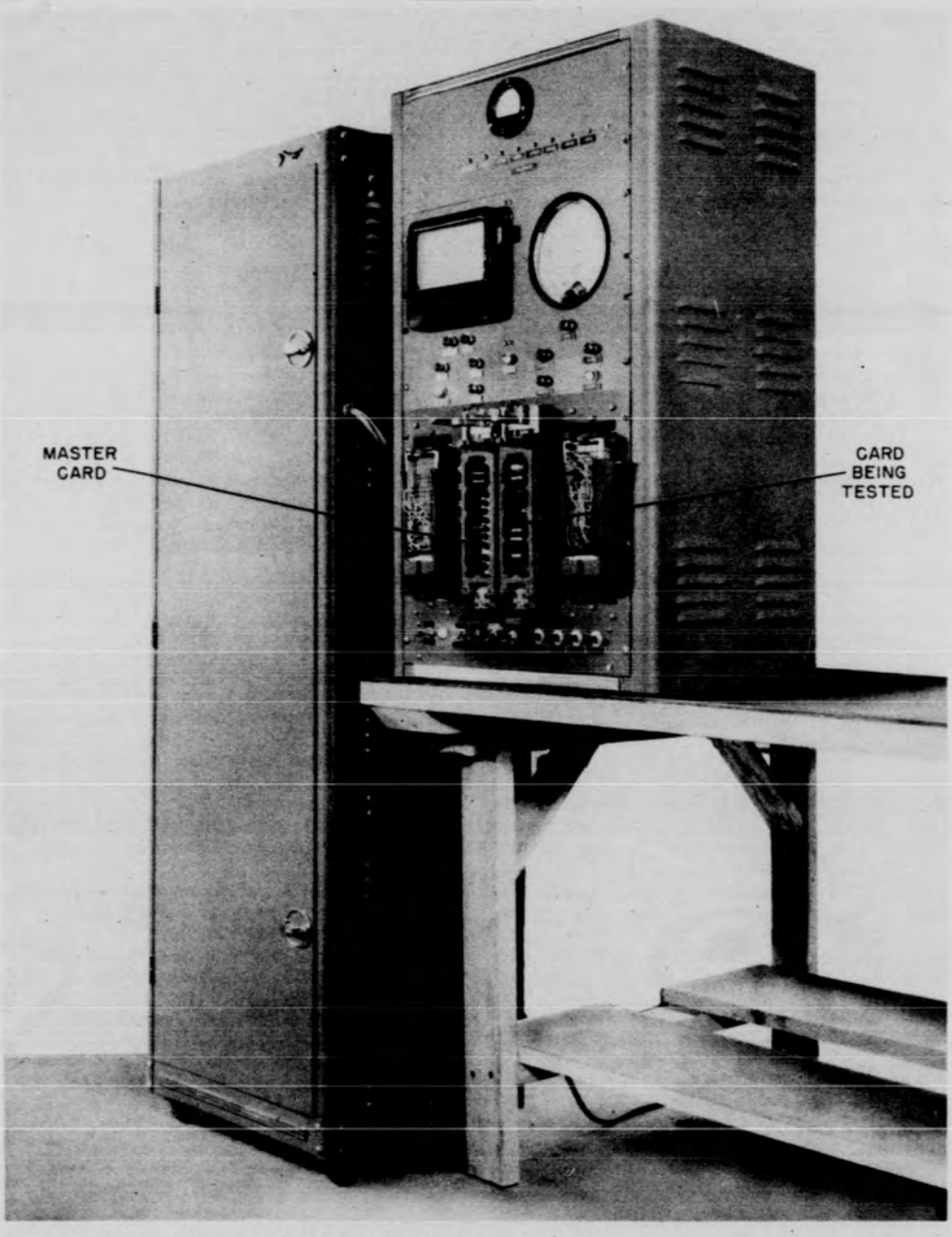


FIGURE 5-14. PRODUCTION CARD TESTER

test plans include data charts and procedures for using these programs. The material for this phase has been completed.

c. Phase 2B, which consists of the more comprehensive card-loaded programs used in XD-1 and XD-2 testing which are being adapted for DC-1 system test. In certain cases, special programs have been prepared. Some programs of this phase include automatic marginal checking routines; the remaining programs of this phase can be used with the manual mode of marginal checking. The material for this phase has been completed, except for a few programs which require program descriptions and additional rework.

Table 5-4 gives the status of proposed programs for system testing DC-1 IO equipment.

TABLE 5-4. STATUS OF PROPOSED PROGRAMS FOR SYSTEM TESTING DC-1 IO EQUIPMENT

Equipment Group	Program Status
Drums	Essentially complete
GFI	Scheduled for completion by February 1, 1956
LRI	Complete
MI	Scheduled for completion by mid-January, 1956
XTL	Scheduled for completion by mid-February, 1956
Outputs	Scheduled for completion by March 1, 1956
Displays	Scheduled for completion by mid-February, 1956

5.5 COMPONENTS

To meet its contractual obligations, IBM's Military Products Division must establish and maintain stable sources of supply of critical components. To do this, the Military Products Division maintains close contact with vendors of critical components, offering them assistance whenever possible, and investigates the potentialities of possible new vendors. It carries on its own investigations of problems relating to components, and also lets subcontracts for development of more reliable components, as it has done to obtain an improved type 5998 power duo-triode. Also, it has authorized development programs by IBM groups who are outside the Military Products Division.

5.5.1 Tubes

A subcontract has been let to Tung-Sol Electric, Inc., to obtain a more reliable version of the type 5998 power duo-triode. The improved tube, which will have the same electrical characteristics as the type 5998, is currently designated as the DT-438. Final specifications on this tube should be completed by IBM in June, 1956. An interim specification was released near the end of this quarterly period to assure continuity of production between the time when the present development subcontract commitments are met by Tung-Sol (March, 1956), and the time when the final specifications are released by IBM (approximately September, 1956).

To evaluate the tubes that are currently being produced by Tung-Sol, life test equipment has been constructed. (See fig. 5-15.) Tubes which are placed in the life test modules can be life tested under either of the following conditions:

a. Rated d-c plate current in order to check cathode activity.

b. No plate current in order to check cathode interface resistance.

The tubes are periodically removed from the life-test module so that the tube characteristics may be measured and recorded. These records will assist in determining whether tube specifications should be changed.

5.5.2 Tape Cores

Because of difficulty experienced by the vendor in producing acceptable 7-wrap tape cores

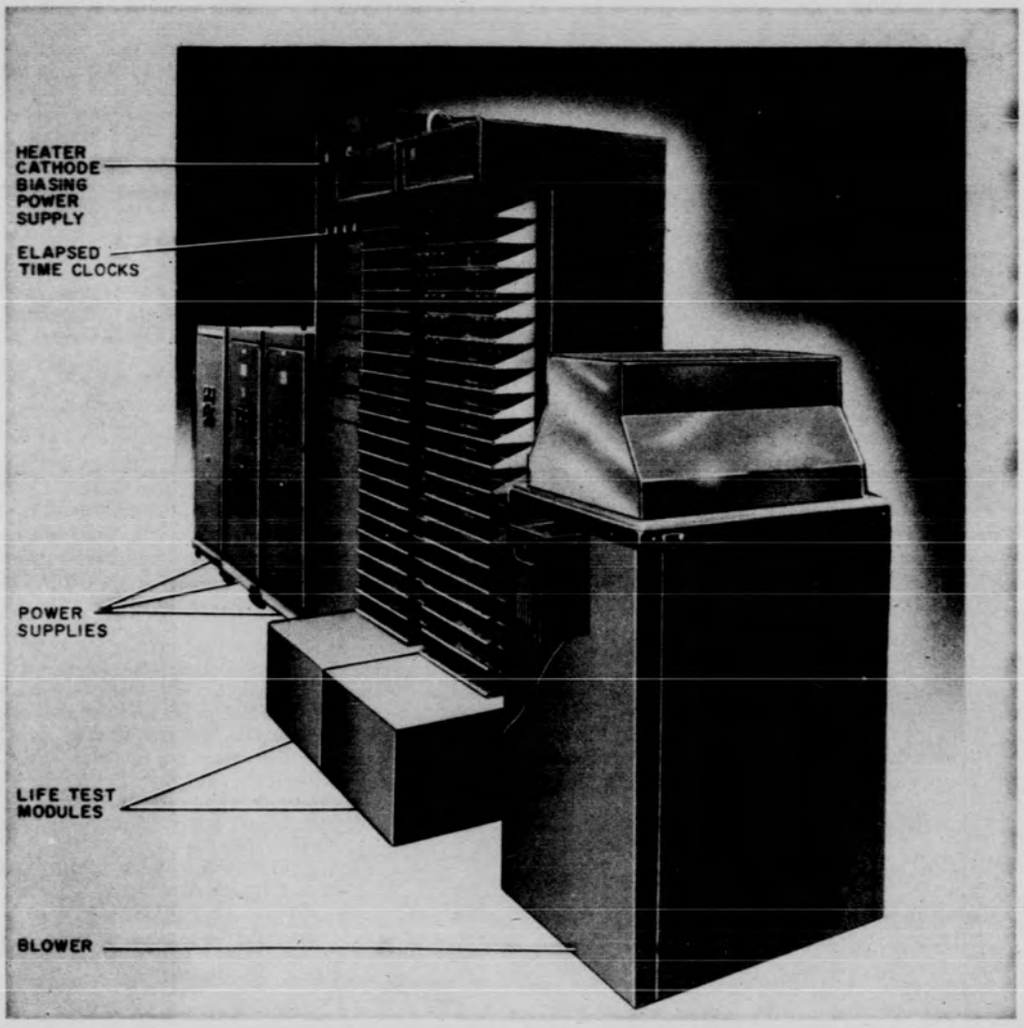


FIGURE 5-15. DT-438 LIFE TEST EQUIPMENT

347

for GFI tape core circuits, all circuits using these cores were redesigned to use 14-wrap cores. This redesign was not of major proportions, and the necessary engineering changes were released to production during the first half of this quarterly period.

The vendor is having difficulty in producing 14-wrap cores which meet specifications. Enough cores are being supplied to meet existing needs, but at an increased price to compensate for low yield. The difficulty is caused by the vendor not having effective control of the raw magnetic material. Efforts to develop a second source have increased.

All tape core circuits are being reinvestigated in an attempt to arrive at more realistic tape core purchase specifications. In the GFI core circuits, for example, a program is underway for determining just how loose the specifications can be and still have the circuits perform properly. These cores have four important parameters, each one of which may be normal (within specification), lower than normal, or higher than normal. In conducting this program, various combinations of off-specification cores are being tried in the different bit positions of the counter.

5.5.3 Precision Resistors

Difficulty has been encountered in obtaining reliable precision film resistors of the varnish-coated type. Work on a procurement specification for hermetically sealed resistors is about 90 percent completed.

Two pieces of test equipment were constructed during this quarter to assist in evaluating the suitability of hermetically sealed resistors as replacements for varnish-coated resistors. Figure 5-16 shows equipment for life-testing precision resistors under static d-c conditions. Resistors, both varnish-coated and hermetically sealed, and made by several manufacturers, are placed in the trays in the test rack (1) on figure 5-16. Power supplies are indicated by (2) and (5). The panel (3) contains switches used to test the resistors at rated load or at 1/10 of rated load. The latter condition is provided by applying the rated d-c voltage during only 1/10 of the time. The panel (4) contains the switches for applying voltage to the test trays, an elapsed time clock, and the meter for the 48-volt power supply for relays. The resistors are periodically removed from the trays and measured.

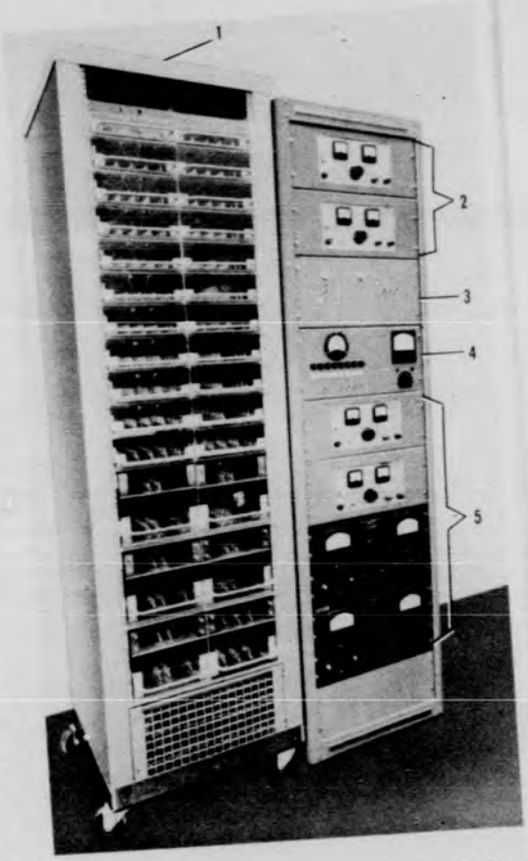


FIGURE 5-16. PRECISION RESISTOR LIFE TEST RACK

Figure 5-17 shows equipment which is primarily used for life-testing precision resistors under dynamic conditions, but may also be used in life testing other components. The resistors and other components are wired into pluggable units to form circuits of the type which have been experiencing varnish-coated, precision

347

for GFI tape core circuits, all circuits using these cores were redesigned to use 14-wrap cores. This redesign was not of major proportions, and the necessary engineering changes were released to production during the first half of this quarterly period.

The vendor is having difficulty in producing 14-wrap cores which meet specifications. Enough cores are being supplied to meet existing needs, but at an increased price to compensate for low yield. The difficulty is caused by the vendor not having effective control of the raw magnetic material. Efforts to develop a second source have increased.

All tape core circuits are being reinvestigated in an attempt to arrive at more realistic tape core purchase specifications. In the GFI core circuits, for example, a program is underway for determining just how loose the specifications can be and still have the circuits perform properly. These cores have four important parameters, each one of which may be normal (within specification), lower than normal, or higher than normal. In conducting this program, various combinations of off-specification cores are being tried in the different bit positions of the counter.

5.5.3 Precision Resistors

Difficulty has been encountered in obtaining reliable precision film resistors of the varnish-coated type. Work on a procurement specification for hermetically sealed resistors is about 90 percent completed.

Two pieces of test equipment were constructed during this quarter to assist in evaluating the suitability of hermetically sealed resistors as replacements for varnish-coated resistors. Figure 5-16 shows equipment for life-testing precision resistors under static d-c conditions. Resistors, both varnish-coated and hermetically sealed, and made by several manufacturers, are placed in the trays in the test rack (1) on figure 5-16. Power supplies are indicated by (2) and (5). The panel (3) contains switches used to test the resistors at rated load or at 1/10 of rated load. The latter condition is provided by applying the rated d-c voltage during only 1/10 of the time. The panel (4) contains the switches for applying voltage to the test trays, an elapsed time clock, and the meter for the 48-volt power supply for relays. The resistors are periodically removed from the trays and measured.

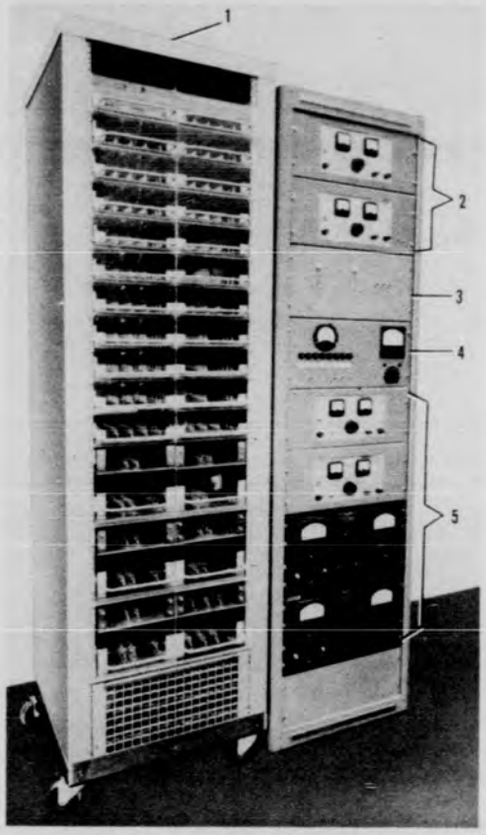


FIGURE 5-16. PRECISION RESISTOR LIFE TEST RACK

Figure 5-17 shows equipment which is primarily used for life-testing precision resistors under dynamic conditions, but may also be used in life testing other components. The resistors and other components are wired into pluggable units to form circuits of the type which have been experiencing varnish-coated, precision

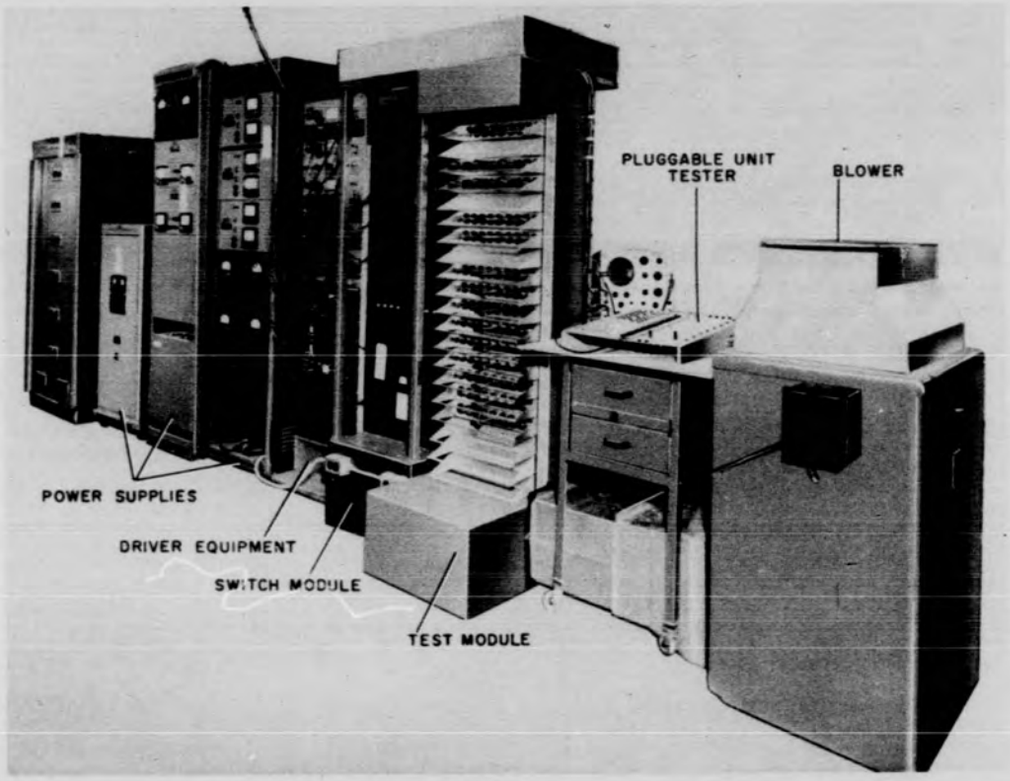


FIGURE 5-17. DYNAMIC LIFE TEST EQUIPMENT FOR PRECISION RESISTORS AND OTHER CRITICAL COMPONENTS

film resistor failures. The pluggable units are then put into the test module and are periodically checked for proper performance.

5.5.4 Diodes

Procurement of type W diodes is still critical. One of the programs being carried on by other IBM groups is aimed at developing a satisfactory type W diode which can be manufactured in quantity. Figure 5-18 shows a piece of equipment that was developed for life-testing these IBM type W diodes. Diodes which are placed on this life-test rack have a 60-cycle voltage applied to them. Each diode on the rack can then have its characteristics determined at any time without being removed from the rack. The input from the dynamic tester is applied to a particular diode through the diode selector switch.

5.6 SPARE PARTS POLICY

Bills of material for quantities of various initial sites and depot spare parts are being

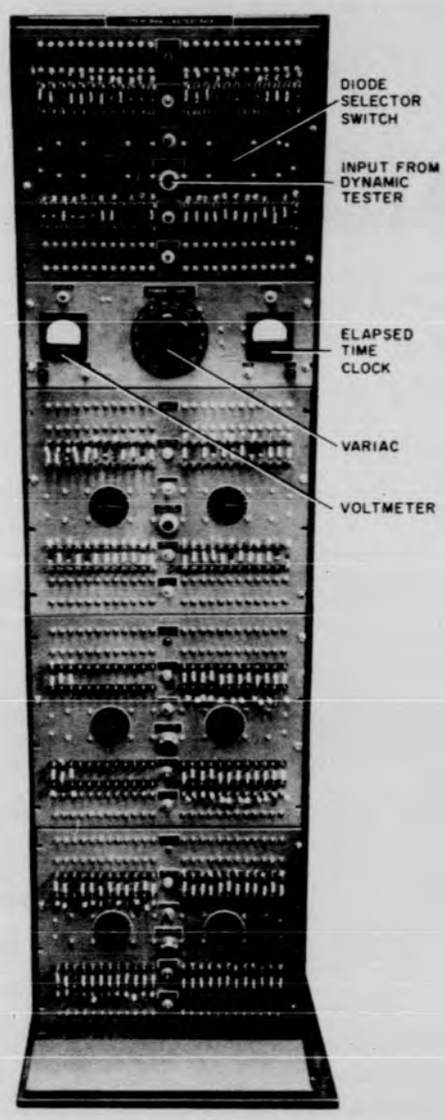


FIGURE 5-18. TYPE W DIODE LIFE TEST RACK

prepared and formally released for procurement.

5.7 PUBLICATIONS

Military Reference Data (MRD) Standards for AN/FSQ-7 and AN/FSQ-8 were published during this period. Previously, the MRD standards had only been published for AN/FSQ-7 (XD-1, XD-2). These standards are based on applicable military specifications wherever possible. If no military specifications are applicable, the MRD standards are then based on accepted commercial standards.

To provide easy identification of specific material for the various MRD standard books a coding system has been devised and incorporated in the format. The significant feature of this coding system is that it divides the MRD standard books into the following three parts:

a. Part 1 - Design and Components Data

b. Part 2 - Basic Circuits

c. Part 3 - Special Circuits

The coding of each MRD standard consists of a series of three numbers; e.g., 1-2-4. The first number indicates the part; the second, the chapter; and the third, the section. The MRD standards are contained in loose leaf binders to facilitate changes and permit expansion.

Keeping MRD standards up to date is a continuing process. At the present time 12 of 13 sections on drafting standards in Part 1 have been printed. Five of seven sections on mechanical design standards have been written and are in the process of being published. Of 111 sections on electrical design standards, 72 have been printed and 29 more are in the process of publication. Standards have been printed for 18 of 19 basic circuits and for 46 of 48 special circuits on which information is available.

As a result of having new MRD standards for the production machine, a differentiation must be made between prototype and production material. This is accomplished by using the code number as indicated above for the production material, and by prefixing the code number with an X for prototype material. During this quarter many of the prototype standards on special and basic circuits were reviewed.

347

CHAPTER 6
LIST OF MANUALS AND REPORTS

This chapter contains a list of all manuals published during the life of the contract and a list of reports issued during this reporting period.

6.1 MANUALS

The preliminary manuals on the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals, which are herein listed, were forwarded to the Air Force on September 30, 1955, and supersede all previous manuals on the AN/FSQ-7 (XD-1, XD-2) Combat Direction Centrals.

THEORY OF OPERATION

PH 22-00001	Central Computer System
PH 23-00006	Drum System
PH 24-00001	Input System
PH 25-00001	Output System
PH 40-00003	Display System
PH 42-00001	Power Supply and Marginal Checking System
PH 45-00002	Theory of Programming

MAINTENANCE

PH 36-01002	Techniques
PH 36-02002	Procedures
PH 36-00002	Operation

ENGINEERING DATA BOOKS

PH 22-25002	Central Computer System, Vol. I
PH 22-25002	Central Computer System, Vol. II
PH 23-25002	Drum System
PH 24-35002	Input System

[redacted]

PH 40-25002 Display System

PH 25-25002 Output System

6.2 TERMINAL REPORTS

TR-4
PH 06-00003 Edwards, N. P., Basic Electronics, 8/15/55 (32 pp), Unclassified

Abstract: The following report was written as support material for a class in elementary electronics. The class was intended as a review of the standard circuit theory, with an emphasis on digital control applications. The circuits presented were those being used in current IBM equipment design.

The intent of the report is to explain the behavior of common circuits, thus giving an understanding of the fundamentals of circuit design which can be carried over to the analysis and design of new circuits.

TR-43
PH 23-00003 Jackson, C. D., Drum Manual Erase, 8/15/55 (17 pp), Unclassified

Abstract: In order to maintain reliable exchanges of digital information between the Drum System and its associated systems, it is essential that only those drum-surface areas written by the drum heads be magnetized. In addition, these magnetized surfaces must be contained within the specified area of the drum registers. Thus, before a drum is placed in operation, and following any circuit failure which may have caused writing (magnetizing) between drum registers, it is imperative that the drum be demagnetized. The process of demagnetizing a drum is known as erasing. This terminating report describes an erase mechanism that quickly and effectively demagnetizes a drum surface.

TR-65
PH 24-14002 Kippenhan, B. W., Gap-Filler Input Element North Synchronizing Circuit, 5/10/55 (28 pp), Unclassified

Abstract: Target information from the gap-filler radar is displayed on a PPI-type indicator at the mapper console. Should any difference in synchronization occur between the transmission of radar target data and the display of this information at the mapper console, serious errors in target data could be fed over to the Central Computer System. The north synchronizing circuit was developed in order to prevent or reduce errors from the out-of-synchronization condition.

TR-67
PH 24-22001 Kraus, C. J., Gap-Filler Input Element Azimuth Synchronizer (Motor Drive) Circuit, 5/5/55 (20 pp), Unclassified

Abstract: The azimuth synchronizer (motor drive) synchronizes the speed of the deflection yoke of the mapper cathode-ray tube (CRT) with the radar antenna, which is located at a distant point from the azimuth motor drive circuit. For a more complete explanation of the function and operation of this circuit with respect to the over-all gap-filler input element, refer to TR-60.

TR-72
PH 23-00004 Kippenhan, B. W., Gap-Filler Input Element Drum Circuit, 5/18/55 (12 pp), Unclassified

Abstract: The GFI drum circuits produce a time delay of successive azimuth pulses between gatings. Azimuth signals are converted to magnetic signals by drum write circuits and are applied to the surface of a single-channel magnetic drum. The magnetic drum stores these pulses for a length of time required by the protection cir-

cuits. Drum read circuits reconvert the magnetic signals to electronic signals for use in the protection circuits.

TR-73
PH 06-00002
Ogg, J., Gap-Filler Input Element Alarm Circuits, 4/14/55 (12 pp), Unclassified

Abstract: The azimuth alarm circuit is used in detecting abnormal conditions which are related to azimuth pulses received by the GFI element. Azimuth pulses fed to the GFI element are derived from telephone line signals. These pulses control the rotation of the azimuth drive motor, which drives the yoke of the mapper tube. The azimuth pulses also determine the frequency of the sweep applied to this tube.

TR-92
PH 22-10002
Shortle, J. W., and C. H. Taft, Memory Plane Tester and Testing, 9/1/55 (34 pp), Unclassified

Abstract: The ferrite core memory planes used in the memory element of the Central Computer System require testing prior to installation and periodically after installation to ensure trouble-free operation of the memory element. The memory plane tester contains the circuits necessary to test the continuity of plane selection lines and the response of each ferrite core in the plane.

TR-102
PH 06-01001
Levine, I., Magnetic Tape Core Protection, 5/10/55 (16 pp), Unclassified

Abstract: Because of their construction, magnetic tape cores require some form of protection against damage from handling and potting. Initial attempts at providing this protection (transparent tape, plastic sprays and dips, etc.) were unsuccessful because they produced changes in the tape core characteristics. The method of protection adopted (nylon capping before potting) has been tested successfully. This report contains the results of tests on nylon-capped cores.

TR-112
PH 33-04001
Astrahan, M. M., and L. R. Walters, Computer Reliability Through Marginal Checking and Maintenance Programming, 7/20/55 (8 pp), Unclassified

Abstract: Having designed and built a digital computer using the best available components and circuits techniques, one must still devise methods of maintenance, since even the best of components will deteriorate. The method of maintenance which has been devised for the AN/FSQ-7 Combat Direction Central has two separate but related features, involving the use of marginal checking and programming for the detection and location of imminent failures during periods of preventive maintenance.

6.3 INTERMEDIATE REPORTS

IM-132-1
PH 24-12002
Paddock, R. J., Sequence of Operations for Types 713, 718, and 723 Card Machines, 9/15/55 (16 pp), Unclassified

IM-139
PH 54-02002
Raser, C. J., H. Rotticci and D. J. Skelly, Phase IX System Test Plans for Manual Inputs, Direct IO-Buffer Entry Section, 3/31/55 (29 pp), Unclassified

Abstract: This report describes the system test plans for the Manual Inputs, Direct IO-Buffer Entry Section. A summary of the test activities and the program descriptions and listings are also included.

IM-145
PH 09-03001
Gibson, J. W., Ferrite Core Fabrication and Testing, 5/15/55 (10 pp), Unclassified

[redacted]

Abstract: This interim report consolidates two progress reports: one on ferrite core fabrication and one on ferrite core testing. Among the recent objectives of the Project High development program have been the improvement of the electrical properties of ferrite memory cores for AN/FSQ-7 use and the improvement of processing techniques to provide better uniformity and higher acceptance rates. From January 1 to May 1, 1955, the emphasis has not been on further improvement in electrical properties, but rather on making a core type which is identical to the General Ceramics type described in Engineering Specification No. 3043000. Cores meeting this specification are now being supplied to Project High in quantity.

IM-150
PH 54-01001 Dennison, A. N., Unit Test Procedure Proposal for XD-1 Output System, 6/10/55 (37 pp), Unclassified

Abstract: This report outlines the unit test procedure for the XD-1 Output System, units 42 and 33. Further detailed instructions will be furnished in a subsequent report.

IM-151
PH 51-03001 Brownlow, J. M., and A. H. Eschenfelder, Progress Report on Ferrite Core Research, 5/15/55 (32 pp), Unclassified

IM-153
PH 19-05002 Electrical Drawings Released for AN/FSQ-7 Combat Direction Central, 8/15/55 (32 pp), Unclassified

IM-154
PH 54-02003 Murray, R. F., and D. J. Skelly, Phase XI System Test Plans for Long-Range Radar Input System, 7/8/55 (29 pp), Unclassified

Abstract: This report describes the plan for system testing the Long-Range Radar Input System (LRI) with the Central Computer and the Drum System of the XD-1. A description of the programs is also given, as well as a brief summary and evaluation of the initial phase of system testing in Poughkeepsie. The initial phase of system testing was performed with the XD-2.

The LRI Group comprises the LRI digital data input equipment.

IM-155
PH 27-00001 Cammans, J. A., IBM Changes and Releases for Project High Installation Drawings and Specifications, 8/8/55 (3 pp), Unclassified

6.4 H-NOTES

H-189 Palmer, R., Binary Loading Program UBLM04, 9/20/55 (1 p), Unclassified

Abstract: This report discusses the use of binary loading program UBLM04 for loading binary punched card information into core memory.

H-190 Lowrie, R., Methods of Radix Conversion, 9/30/55 (5 pp), Unclassified

Abstract: Because it is frequently necessary to convert binary numbers to decimal numbers, a simple method for conversion is highly desirable. Such a method is given in this report. In addition, the report contains methods of converting numbers of any radix to numbers of any other radix.

H-201
PH 33-03001 Mancuso, P., Bit Assignments for Marginal Checking Control Words, 10/20/55 (5 pp), Unclassified

[redacted]

Abstract: This H-note summarizes the assignments that have been given to bits of the marginal checking control word. Table 1 gives the bit assignments for XD-1 and XD-2. Table 2 gives the bit assignments for DC-1.

APPENDIX

Included in this appendix are a Glossary of Abbreviations and five illustrations of foldout size which supplement the text of both Chapters 4 and 5.

GLOSSARY OF ABBREVIATIONS

AFCRC	Air Force Cambridge Research Center
CB	Circuit Breaker
CCD	Core Current Driver
CCN	Contract Change Notification
CRT	Cathode-Ray Tube
CTC	Cambridge Thermionics Corporation
DAB	Display Assignment Bit
DD	Digital Display
DPD	Digit Plane Driver
ECP	Engineering Change Proposal
FA	Flux Amplifier
G/A	Ground-to-Air
GFI	Gap-Filler Radar Input
G/G	Ground-to-Ground
IO	Input-Output
IPG	Input Pattern Generator
LRI	Long-Range Radar Input
MC	Marginal Check
MCD	Marginal Checking and Distribution
MI	Manual Input
MRD	Military Reference Data
PD	Power Distribution
RID	Reset Inhibit Driver
SD	Situation Display
TTY	Teletype
WL	Warning Lights
XTL	Crosstell

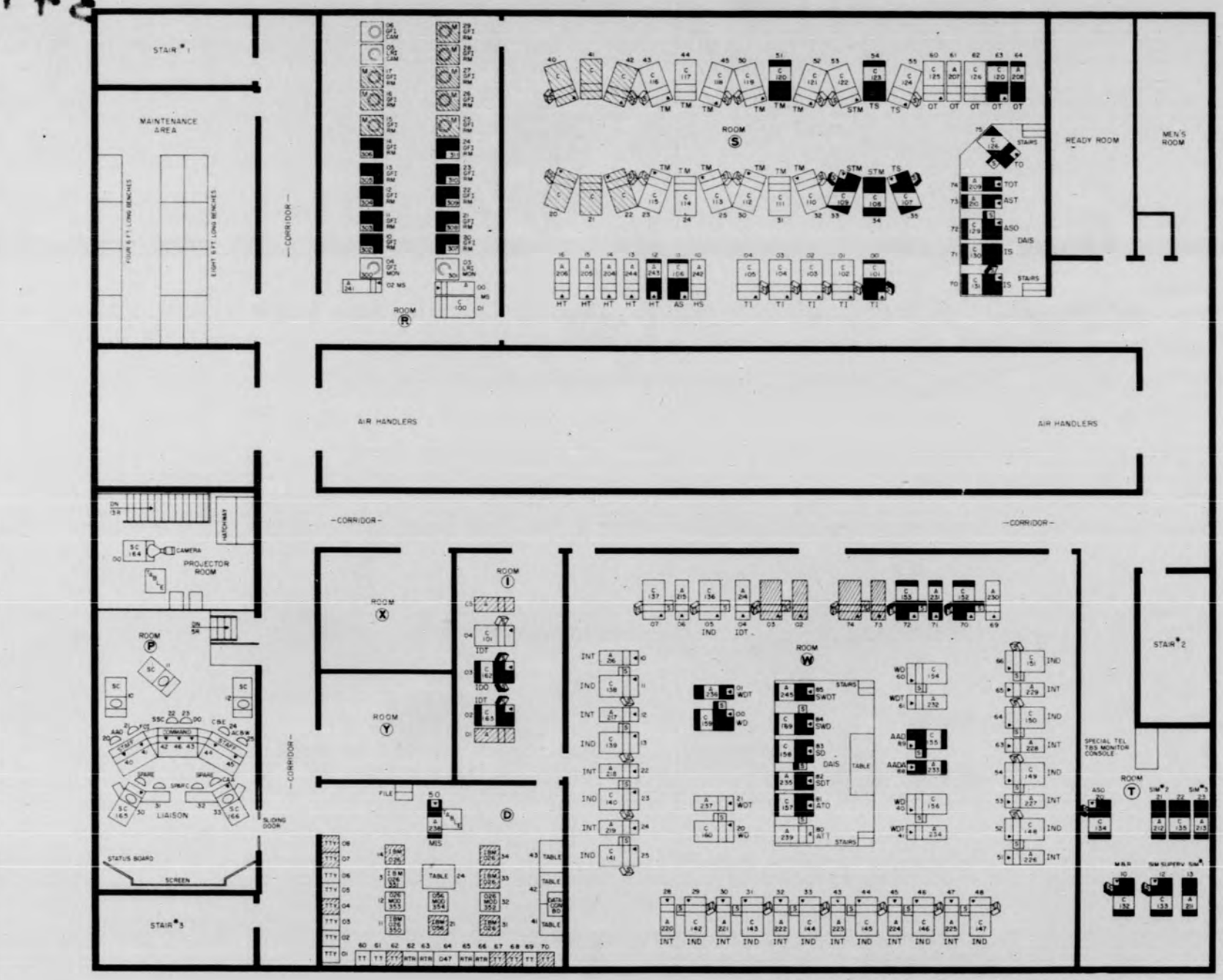


FIGURE 4-8. SECOND FLOOR LAYOUT, BUILDING F

LIST OF ABBREVIATIONS

A	Auxiliary Display Console
AAD	Anti-Aircraft Director
AADA	Anti-Aircraft Director's Assistant
AAO	Anti-Aircraft Office
AC & W	Aircraft Control and Warning
ASO	Air Surveillance Officer
AST	Air Surveillance Technician
ATO	Air Tactics Officer
ATT	Air Tactics Technician
C	Situation Display Console
CAA	Civil Aeronautics Administration
CADW	Civil Air Defense Warning
C & E	Communications and Electronics Officer
CIO	Combat Intelligence Officer
DD	Digital Display
DO	Deputy for Operations
FOI	Fighter Officer-Interception
FOM	Fighter Officer-Missiles
HS	Height Supervisor
HT	Height Technician
IDO	Identification Officer
IDT	Identification Technician
IND	Intercept Director
INT	Intercept Technician
IS	Initiation Supervisor
MIS	Manual Inputs Supervisor
MS	Mapping Supervisor
OT	Overlap Technician
RM	Radar Mapper
RTR	Receiving Typing Reperforator
S	Side-Wing Unit
SD	Senior Director
SDT	Senior Director's Technician
SIM	Simulator
STM	Senior Tracking Monitor
SSC	Subsector Commander
SWD	Senior Weapons Director
SWDT	Senior Weapons Technician
TI	Tracking Initiator
TM	Tracking Monitor
TO	Tracking Officer
TOT	Tracking Officer's Technician
TTY	Teletype
WD	Weapons Director
WDT	Weapons Director's Technician

NOTES

1. Numbers inside boxes are unit numbers
2. Numbers outside boxes give room location
3. Letters outside boxes give operators title
4. Cross-hatched units will not be in original installation
5. Darkened-in units were among those which had been installed by November 21, 1955

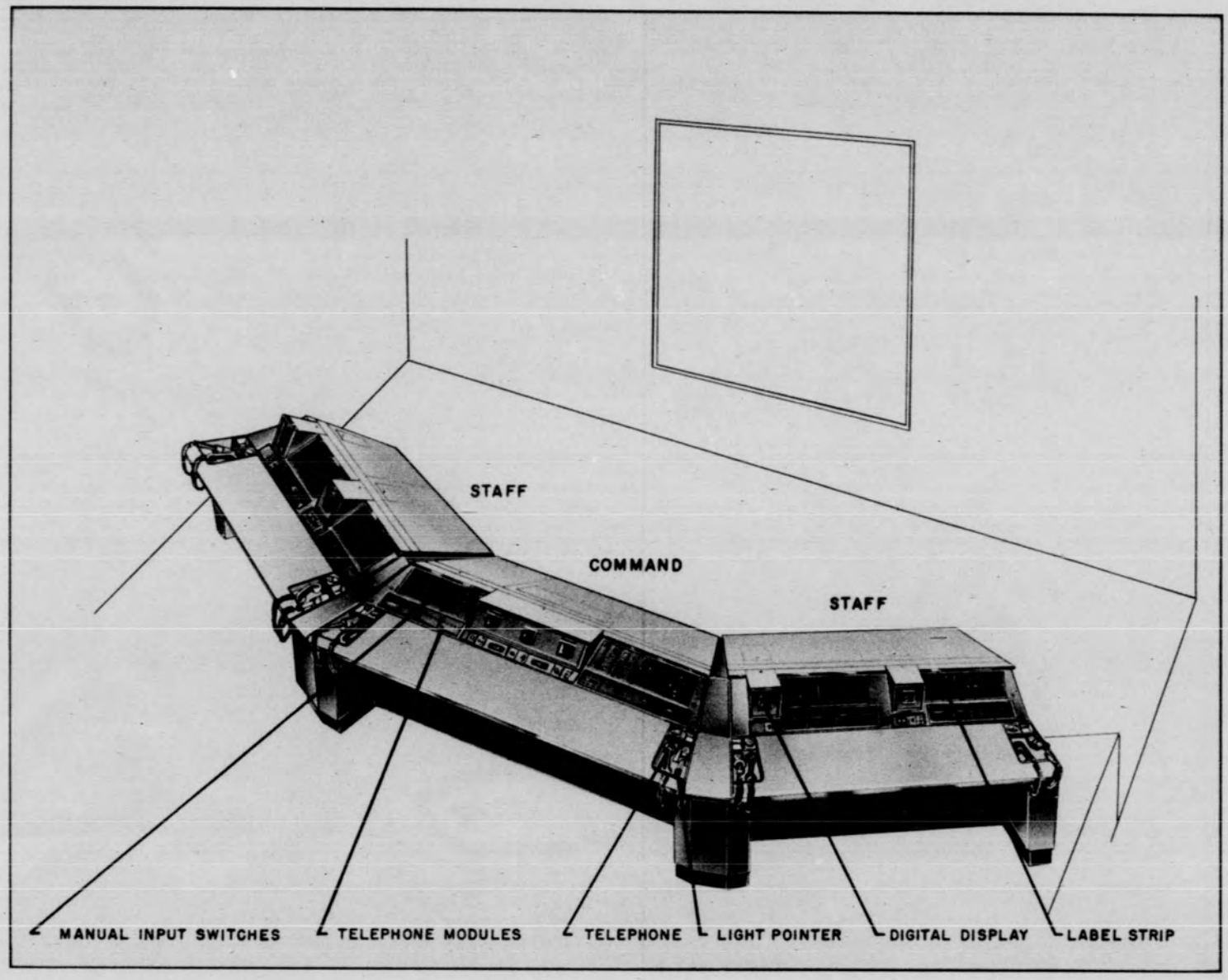


FIGURE 4-9. AN/FSQ-7 (XD-1) COMMAND POST DESKS

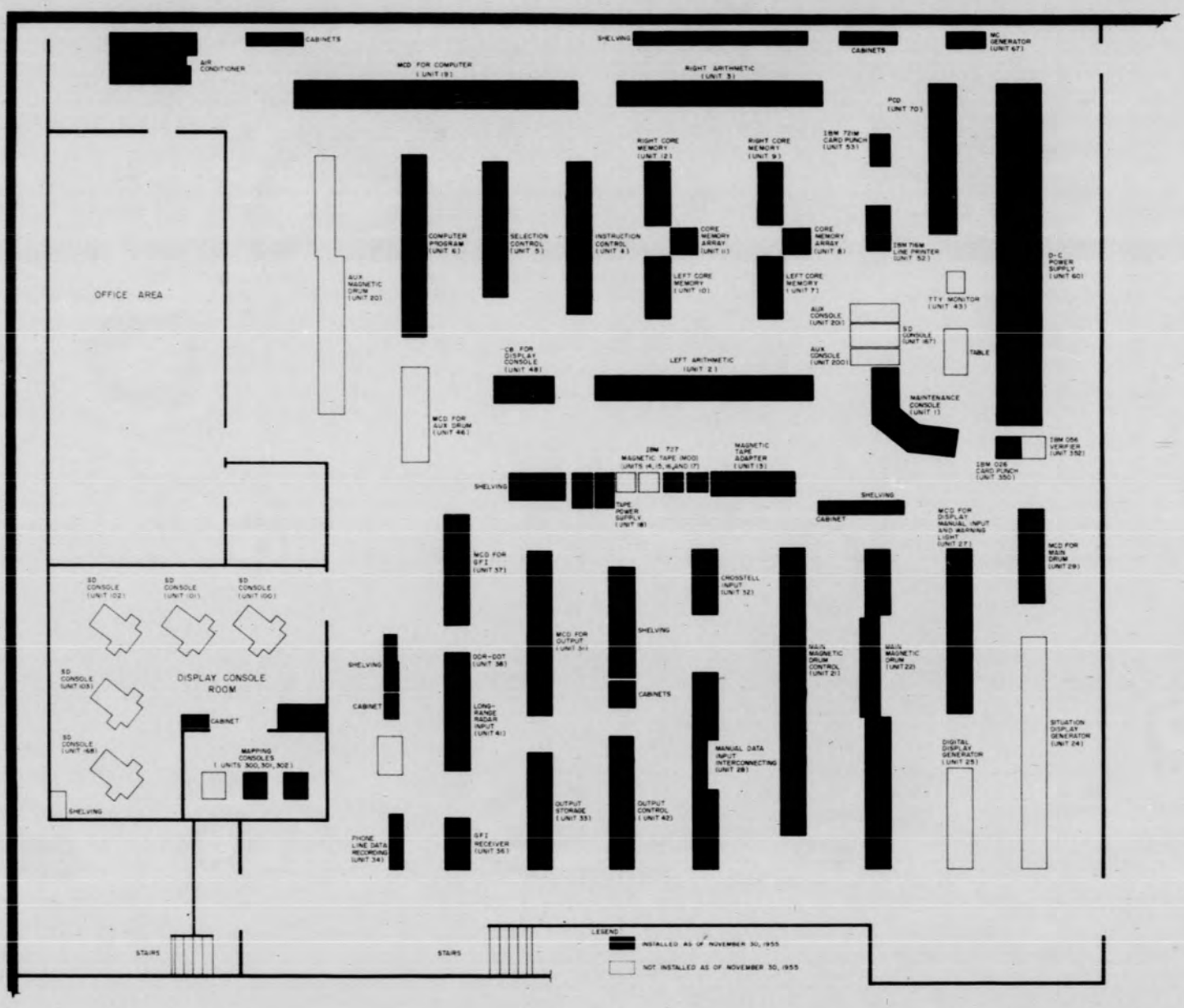


FIGURE 4-17. AN/FSQ-7 (XD-2) AT KINGSTON, FLOOR LAYOUT

1613

Possible Change in SAGE Schedule

Dir, C&E
DCS/O
DCS/C
DCS/M
VC
(In Turn)

ADOPR

11 Oct 55
L/Col D.H.Higgins/ADHPG/2441

1. The attached correspondence, received by this office on 4 October 1955, is forwarded for your information. The Air Materiel Command letter has been annotated in accordance with the information contained in the basic letter from the ADC representative at the ADES Project Office.

2. The AMC letter is their reply to a wire from USAF requesting submission of a revised SAGE schedule with minimum funding in FY-56, 57 and 58. This command was not an information addressee of the USAF wire, nor have our comments been requested by AMC, ARDC, or Headquarters USAF. It appears that this is a routine examination of possibilities to reduce present and future USAF budgets without any consideration, at this time, of operational requirements.

3. The studies attached as inclosures to the AMC letter form the basis for their final recommendation that, from the production and procurement point of view, the current SAGE schedule should be replaced by one which will reduce FY-56 and 57 obligations and the financial risks of a development-production program.

4. AMC Study No. 1, which details the recommended schedule, embodies the following major points:

a. No changes were made in quantities of equipment or dollars in FY-54 and 55 programs. However, the time period for installation and test was increased from eight to ten months at all direction center and combat centers, with a resultant program slippage of two months.

b. Delivery of computers would be held to a rate of one every two months through FY-1957. Thereafter, four computers would be delivered at one and one half month and the remainder at one month intervals.

c. The operational date of the SAGE System would be delayed 16 months, until 1 March 1962.

d. Overall cost of the system would remain the same.

ADHPG FILE COPY

8/5/496

SECRET

Possible Change in SAGE Schedule
11 Oct 55
(Cont'd)

5. Study No. 2, which proposed a longer stretch-out of the schedule resulting in an operational date of 1 September 1962, was rejected by AMC on the basis that it would adversely affect production and personnel employment and could result in significantly increased overall costs.

6. This does not appear to be an action matter for this command at the present time. We have recently expressed our position on the SAGE schedule to USAF in our reply to the Management Review. Our letter, forwarded on 15 September, not only emphasized the operational requirement for the SAGE System at the earliest possible date, but also pointed out the continued requirement for full and prompt budgetary support of the program. It is not considered necessary to reiterate this position until we are approached directly on this matter.

OSCAR T. HALLEY, JR.
Colonel, USAF
Director, SAGE Proj. Group
Ext 2441-2443

LOREN G. McCOLLOM
Colonel, USAF
Director, P&R
Ext 2216-2217

1 Incl
ADES Proj Office ltr,
Subj: Trans. of AMC
Comments Pertaining to
Mgt. Review & Rescheduling
Of the SAGE System, w/4
Incls., 23 Sep 55

350

AD G

1. In accordance with your letter [illegible], subject as above, dated [illegible] June 1955, the following information is furnished for those items which are the responsibility of this [illegible]

a. Leased communications facilities

(1) Terminal circuits. Required terminal circuits have been provided the [illegible] Company for all subsectors through Tom City (No. 12 priority) and the [illegible] and Iron Mountain Centers. The [illegible] Company has indicated that they anticipate no difficulty in providing the circuits to meet the dates set forth in the requirements. No problems are anticipated by this Headquarters in providing the remaining requirements to the [illegible] Company to meet a 3 month desired lead time.

( ) Teletype equipment. Teletype equipments of the SAGE System are both government owned and leased. At a recent meeting held at this Headquarters with Lincoln Laboratory, Western Electric (AD) and Bell Telephone Laboratories representation, equipment requirements were made firm and a determination was made as to what types would be leased and what types government owned. The government owned requirements for the first five subsectors have been submitted for inclusion in the [illegible]. No problems are anticipated in the procurement of the leased equipment.

This correspondence is classified UNCLASSIFIED in accordance with Par _____, AFR 205-1, 25 Dec 53, or for the reason (s) stated.

V-30-1

350

Hq ADC, Subj: (UNCL) Management Review of [illegible], ADHIG

(3) Direction Center and Combat Center Interchange Communications Systems. This includes the telephone system with a dial and [illegible] [illegible]

[illegible]

[illegible] . [illegible] and [illegible] to include [illegible]. [illegible] quarters is [illegible] a [illegible] and [illegible] recommendation for [illegible] heavy-[illegible] and [illegible]. [illegible] Bell System design and manufacture rather than [illegible] design previously contemplated. [illegible] to the [illegible] on [illegible] September [illegible]. [illegible] program delay is expected.

[illegible] . Computer Programming.

(1) The time phased schedule for the [illegible] of computer programs for [illegible] and subsequent subsectors is being [illegible]. This schedule is based upon the original [illegible] phasing for the installation of the [illegible] SAGE subsectors.

(2) The only possible [illegible] in meeting this schedule lies in further delays by the [illegible] Corporation to make certain modifications required in the [illegible] system for [illegible]. Although [illegible] estimates that these modifications will delay the operational date of [illegible] by four to [illegible] months, it is the opinion of this headquarters that this need not be the case, provided that the necessary work is begun immediately. In view of the overall impact of such a delay on the operational date of subsequent installations, this problem should be settled at once and [illegible] directed to proceed with the required modifications without further delay.

4

350

Hq ADC, Subj (U/CL) Management Review of SAGE, ADHPG

(3) Progress made to date by the Sand Corporation in preparation for the discharge of their part of the computer programming effort is on or ahead of schedule and appears to be completely adequate.

d. Operational Employment and Deployment. The Air Defense Command requirements for operational employment and deployment of the SAGE System remain as stated in our Operational Plan, Semiautomatic Ground Environment System for Air Defense, dated 7 March 1955 and approved by your Headquarters on 27 June 1955. It is not contemplated that any change in this requirement will be made unless this management review generates drastically new or significant information.

2. The vital requirement for the integration of the SAGE System into the air defense of the United States cannot be over stressed. The development-production program chosen as the method by which this is to be accomplished at the earliest possible date, is one which requires the constant managerial attention of all concerned. However, our primary objective in this critical program must be to insure its completion and activation on or ahead of schedule. It is believed that this can be done by prompt and positive action on any and all problems as they arise. Most of the people involved in this program have this attitude and the outlook is good.

3. The greatest concern regarding the management of the SAGE Program is in the budgetary area. As indicated in previous correspondence, the cut proposed for this command in Fiscal Year 1956 is out of context in view of the increasing requirements already made known for Fiscal 1957. As the SAGE System becomes operational, operating costs will rise substantially. Successful implementation of this program according to the schedules presently established will require full and prompt budgetary support not only for production but for maintenance and operating costs as well. This constitutes the real danger to effective management of this program.

GEORGE F. SMITH
Major General, USAF
Acting Vice Commander

OPI: Comdr AMC
Comdr ARDC
Comdr ATC
ADES Proj Office

L/CD H Higgins/ch
2441-3
30Aug55

3

This correspondence is classified _____ in accordance with Par 23c, AFR 205-1, 15 Dec 53, or for the reason (s) stated

V-590-3x

DOCUMENT NO. 351

THIS DOCUMENT MAY BE FOUND IN

VOLUME XI OF THE SUPPORTING DOCUMENTS

TO THIS HISTORY.

UNCLASSIFIED

FILE NO. 1023

352d

13 OCT 1955

SUBJECT: Critical Construction Delays (U)

TO: Chief of Staff
Headquarters USAF
Washington 25, D. C.

1. [illegible] Quarterly [illegible] Construction Conference was held at this headquarters during the week of 26 September 1955. Estimated beneficial occupancy dates for all required facilities during FY 1956 were developed during this conference.

2. An analysis of the estimated completed construction versus the required BOD dates indicated delays severely affecting the SAGE program and the AN/GPA-37 program.

a. SAGE Program. We will require 12 annexes to operational [illegible] sites prior to 1 January 1957. (Annexes required after this date can be built with FY 1957 funds.) All 12 annexes are authorized and funded in the FY 1956 MCP. Seven of the 12 will be delayed past required beneficial occupancy dates (Incl. 1). These delays are from one to seven months. All of the annexes required for the McGuire Subsector (both primary and overlap) will be delayed.

b. GPA-37 Program. We will require approximately 72 annexes prior to 1 January 1957 to permit installation of the GPA-37 equipment that will be available by that date. Thirty-one (31) of these 72 are now authorized and funded. Four (4) additional annexes have been made available by reprogramming action. USAF has been requested to obtain authorization and funding for the remainder. Current estimates of BOD of the approved annexes indicate an average 5-month slippage past our required dates.

3. Unless immediate and extraordinary action is taken, the operational date for the first SAGE subsector (McGuire) will be delayed by this minor construction program. It is appalling that a program of such magnitude as SAGE should be limited by normal handling of certain construction items that cannot react rapidly to changes in building design

Will be Confirmed in
Std Publication Form
Under par 3a, ADCGM
No
~~Col Weiner~~/TC
Prepared by
Telephone 2228
7 Oct 55

Cy of Incl not rqrd for AG file
MEMO FOR RECORD & diary item not required.

JAMES H. WEINER- Col, USAF

V639-1

A-78933/0425

ADC HQ Form 1
5 Feb 54 Revised

105548

UNCLASSIFIED

[redacted]

352

Hq ADC, ARDCH, Subj: Critical Construction Delays (U)

dictated by newly developed equipments, such as the AN/FST-2 data transmitting equipment. Although there are two or three areas in the SAGE program extremely tight time-wise, to date there has been no schedule slippages established. As a result, the delay of annex construction could be the cause of an official schedule slippage.

4. It is the opinion of this headquarters that much of this potential slippage could be averted by expedited construction for those sites indicated by an asterisk on the attached inclosure. If the Corps of Engineers cannot meet the required dates, then more drastic action could be taken to make premium payment for expedited construction. Authority for such action is given to the Secretary of Defense under Chapter 3 of Supplemental Appropriation Act 1956, Public Law 219, 84th Congress, Chapter 341, 1st Session.

5. It is urgently recommended that the Corps of Engineers be requested to expend every effort to meet the required beneficial occupancy dates and further, if this is not possible, approval of the Secretary of Defense be obtained to expedite the construction of the annexes indicated above.

1 Incl
List of Opns Bldg
Annexes for SAGE
rqrd thru 1Jan57

V639-2

[redacted]

DISPOSITION FORM

SECURITY CLASSIFICATION (If any) 352

[redacted]

SUBJECT: Critical Construction Delays

FROM: DCS/O

DATE: 10 Oct 1955 COMMENT NO. 1

Lt Col JRWeiner/2228

1. Serious delays in estimated beneficial occupancy dates have been determined during the USAF-OCE AC&W Construction Conference recently held in this headquarters- 26 September. These delays create a slippage in the GPA-37 program by approximately five months and, most important, indicates a one to seven months [illegible] delay in the McGuire Subsector (SAGE).

2. The attached letter states this problem to the Chief of Staff, USAF, and urgently recommends action to expedite construction with Corps of Engineers and, if necessary, obtain Secretary of Defense approval for release of funds for premium payment to expedite construction.

3. Excerpts of Chapter 3 of Supplemental Appropriation Act 1956, Public Law 319, 84th Congress, Chapter 541, 1st Session. General Provisions Section 304. None of the fund appropriated by this chapter shall be expended for additional cost involved [illegible] construction, unless the Secretary of Defense certifies that such cost to be necessary to protect the National defense [illegible] A reasonable completion date for each such project, [illegible] consideration the urgency of the requirement, the type [illegible] the climatic and seasonal conditions [illegible] construction, and the application of economical construction."

/s/ Hugh A. Parker

HUGH A. PARKER
Major General, USAF
DCS/Operations

353

5 Aug 55

ADOCE-CR

SUBJECT: (Uncl) Justification for Radio Receiver and Transmitter Buildings for SAGE

TO: Director of Communications
Headquarters USAF
Washington 25, D. C.

1. Reference your message AFCIE-WI 57003, dated 29 July 1955, which requested an explanation of the requirements for communications receiver and transmitter buildings that are included in the SAGE portion of the FY-56 and FY-57 MCP.

2. During the SAGE period, a requirement exists to provide continuous UHF ground/air/ground communications to interceptors at all points in the ZI 5,000 ft above terrain. Communications will be by means of ground/air data link and ground/air/ground voice.

3. Approximately five ground/air UHF radio stations will be required in each subsector to perform function noted above. In most cases, these stations can be located at prime radar sites. However, in certain instances, it will be necessary to provide UHF ground/air communications stations at other locations.

4. All UHF ground/air transmitters and receivers at all stations within a subsector will be controlled from the MSQ-7 direction center by means of remote control lines. Each ground/air station will be provided with the following equipment:

a. 1 - 10 KW data link transmitter

b. 1 - 1 KW data link transmitter

c. 26 - AN/GRR-7 receivers and 26 AN/GRT-3 transmitters

d. 2 - AN/GRC-27 transmitter/receivers

e. 1 - HF transmitter/receiver.

5. Because of the large number of UHF transmitters at each station which are necessary to implement the SAGE program, plus the fact that one of the transmitters is 10 KW, it is necessary that separate buildings be provided for the transmitters and receivers. The exact spacing between these buildings is as yet undetermined and the problem is presently being

Hq ADC ADOCE-CR Subj: (U) Justification for Radio Receiver and Transmitter Buildings for SAGE

studied by Hq USAF, Hq ARDC, and the Bell Telephone Laboratories.

6. In the case of "P" type ACSW direction centers which have separate transmitter and receiver buildings presently available, it may be possible to use the buildings for SAGE UHF equipment. However, since the average spacing of the buildings is only 1,000 feet, it is necessary that firm separation criteria be received by this headquarters before such planning can be solidified. Therefore, this command has programmed for an additional building to be used for the remote receiver building. At all direction centers, except the "P" sites, a requirement exists for an additional building to provide for SAGE UHF ground/air communications. This is due to the fact that in the first, second, and third phase radar programs before the SAGE System was approved, all UHF ground/air transmitting and receiving equipment was programmed to be located in one building. This is no longer feasible since the number of 100W voice transmitters and compatible receivers has been tripled, and in addition a 10 KW unit has been added to meet SAGE requirements.

7. The equipments noted in paragraph 4 above will be used as follows:

a. The 10 KW transmitter will be used for data link control of manned interceptors.

b. Twenty-two (22) of the 26 AN/GRT-3's and AN/GRR-7's will be used for voice control of interceptors which are not data link equipped, and to pass additional traffic to interceptors which are data link controlled.

c. The additional 4 AN/GRR-7's and AN/GRT-3's are used as back-up for the 22 active channels.

d. The two AN/GRC-27's will be used as standby units in case of breakdown of the 22 active AN/GRR-7's and GRT-3's during the period while the back-up AN/GRR-7's and AN/GRT-3's are being tuned. The AN/GRC-27 is a 10-channel equipment which can be retuned in a matter of seconds. The AN/GRR-7's and GRT-3's are single channel crystal controlled units and require approximately 15 minutes for retuning.

e. The 1 KW transmitter will be used for back-up 10 KW data link transmitter.

f. The HF transmitter/receiver will be used for emergency point/point communications.

8. It is necessary that some manual capability for local operation be provided at all prime radar sites which have UHF ground/air communications capability in case of failure of the FSQ-7. In addition to the

ADC Form 11 (REV)

This correspondence is classified ______ in accordance with Per ______, AFR 205-1, 15 Dec 53, or for the reason (s) stated.

V555-3

353

Hq ADC ADOCE-CR Subj: (U) Justification for Radio Receiver and Transmitter Buildings for SAGE

functions of equipment noted above, the 1 KW transmitter will be used for a manually operated AN/GPA-37 data link system to be operated by personnel at the prime radar stations. Also approximately 6 of the AN/GRR-7's and GRT-3's will be used for voice operation.

9. In addition to the UHF program required for the SAGE System, an additional requirement exists at certain locations to provide HF communications circuitry from SAGE direction centers to Picket Vessels and Airborne Early Warning & Control aircraft. These HF stations will be located at the following subsector direction centers (AN/FSQ-7):

a. Tapsham

b. Stewart

c. Fort Lee

d. Adair

e. McGuire

f. Pope

g. McChord

h. Norton

i. Robins

j. Hamilton (to be used to provide communications to PV's and AEW&C off-shore of the Beale and Bakersfield subsectors).

10. It is not technically advisable to use the UHF buildings which are programmed at any of the above locations for HF communications because of frequency congestion and interference problems. Therefore, separate transmitter and receiver buildings must be provided to house equipment used for communications to seaward extension units during SAGE.

11. The amounts of equipment in each HF station will vary from location to location depending upon the number of seaward extension units controlled from each subsector. However, it is anticipated that an average of 9 - 3 KW transmitters will be required in the HF transmitter buildings and an equal number of space diversity receivers will be required in the receiver buildings.

12. Existing HF transmitter and receiver buildings or HF transmitter and receiver buildings which are programmed and required prior to

This correspondence is classified _____ in accordance with Par _____, AFR 205-1, 15 Dec 53, or for the reason (s) stated.

353

Hq ADC ADOCE-CR Subj: (U) Justification for Radio Receiver and Transmitter Buildings for SAGE

the SAGE period, will be used in the Stewart, McChord, Norton, and Hamilton areas. All other subsectors noted above will require new HF transmitter and receiver buildings to provide adequate communications to off-shore units of the seaward extension program during the SAGE period.

13. In conclusion, UHF building requirements were based on the fact that we cannot put all UHF transmitters and receivers in one building at any one specific location, and probably can only use one of the existing buildings at "P" sites. Therefore, it was necessary to:

a. Program a remote receiver building in all cases at prime radar direction centers.

b. Program both transmitter and receiver buildings at FSQ-7 centers which are to be used also as ground/air communications stations.

c. Program both transmitter and receiver buildings at certain prime radar sites which are now classified as surveillance stations with no air/ground capabilities.

d. Program transmitter and receiver buildings at certain additional locations which are required to give 5,000 ft communications coverage above terrain in locations at which neither radar sites or FSQ-7 direction centers are available.

FOR THE COMMANDER:

Memo for record: Above information requested by Hq USAF in message AFCIE-WI 57443.

DP - N/R
COMEBACK CY REQ.

COMEBACK COPY

Will be Confirmed in ... Publication Form
No

Prepared by D. C Hardacker/gk
Telephone 2645
Date 4 Aug 55
Reply to Forfeld No. 22374

4

This correspondence is classified [redacted] in accordance with Par 23, AFR 205-1, 15 Dec 53, or for the reason (s) stated.

V555-1

[redacted]

HEADQUARTERS
AIR DEFENSE COMMAND
ENT AIR FORCE BASE
COLORADO SPRINGS, COLORADO

354

ADOCE-CR

5 DEC 1955

SUBJECT: (Uncl) Siting Directive for Ground/Air Radio Facilities for SAGE

TO: Commander, each Defense Force

1. References:

a. Air Force Regulation 100-46, subject: Fixed Communications Electronics Facilities, dated 13 January 1955.

b. Technical Order 31-1-8, subject: Implementation of Fixed Communication-Electronics Program, dated 19 January 1953, and revised date 14 January 1954.

c. Letter ADOCE-CR, subject: Radio Sites, dated 4 October 1955, to Project Manager, WE-ADES, 220 Church Street, New York 13, New York, with information copy to EADF. This letter contains the general locations of radio sites approved by this headquarters pertaining to HQ EADF. Similar letters will be forwarded to the appropriate Air Defense Force, as general site locations are approved for implementation.

d. Operational Plan, Semi-automatic Ground Environment System for Air Defense, dated 7 March 1955.

2. Radio ground/air transmitter/receiver sites are required to support the SAGE System. Weapon control orders in the form of voice or data link information will be sent from a direction center through a network of wire circuits to the remote radio transmitter sites for transmission. Voice information will be received at the remote radio receiver sites and returned through the network of wire circuits to the direction center.

3. Radio coverage in each subsector is required down to 5,000 feet above the terrain. To provide this coverage, several radio sites will be required in each subsector. Western Electric Air Defense Engineering Services, in conjunction with the Air Defense Forces, is responsible for making theoretical radio coverage studies and recommending general locations for the radio ground/air sites. Subsequent to the approval of these general site locations by this headquarters, action must be taken to establish and implement these sites.

V549-1

[redacted]

[redacted]

354

Hq ADC ADOCE-CR Subj: (Uncl) Siting Directive for Ground/Air Radio Facilities for SAGE

4. The Air Defense Force concerned, upon receipt of approval of general site locations for a subsector, will immediately coordinate with AMA's and AFIR's and other appropriate agencies, and will establish a siting schedule for each site. The schedule will indicate the completion dates for the major actions required from siting through construction and equipment installation. The schedule for each site will be distributed to all concerned. The Defense Force will continuously monitor and take appropriate corrective action to insure that delays do not occur. The Defense Force will also keep this headquarters advised of delays and action taken.

5. Selection of exact site locations for the SAGE ground/air radio sites will be accomplished in accordance with TO 31-1-8, referenced in paragraph 1 b above. The SAGE Operational Plan, referenced in paragraph 1 d above, has been distributed to all agencies concerned. The information provided in this letter will be considered as supplemental data to the SAGE Operational Plan.

6. The criteria for siting the SAGE radio ground/air sites are as follows:

a. General Locations. General locations of sites selected jointly by HQ EADF and WE-ADES, that have been approved by this headquarters, are attached as inclosures 2, 3, 4 and 5 for the McGuire, Stewart, Syracuse and Topsham subsectors. Similar information will be furnished to the appropriate Air Defense Forces, when additional general site locations are approved for each subsector.

b. Separation Criteria. The following data was extracted from SAGE Summary Report UHF Frequency Allocation Plan issued by WE-ADES, dated 20 October 1955. The complete report will be forwarded to those concerned at a later date.

(1) The separation criteria between UHF transmitter and receiver antenna sites have been established at a minimum of 1000 ft (about 80 DB isolation between half-wave dipoles, as determined by equipment measurements). However, a greater spacing of up to 2000 ft should be taken advantage of, where it can be conveniently obtained

(2) A minimum horizontal separation of 25 ft (about 40 DB isolation between half-wave dipoles) or an equivalent vertical separation has been established between each individual antenna at the respective transmitter and receiver sites.

1549-2

[redacted]

[redacted]

354

(3) It has further been established that the data link antenna should be removed from the voice transmitting site by about 300 feet in the direction away from the voice receiving antennas, if possible. This increases the isolation between the data link and voice transmitting antennas by over 20 DB, to allow for the increased data link power.

c. Antenna Farm Area. The size of the antenna farm area for both voice transmitter and receiver sites only has been tentatively established as an area of 228 x 228 ft or 51,984 sq ft, based upon a 25 ft antenna separation for a maximum of 35 antenna masts. This area size will be used in your siting criteria until such time as RAFD provides a standard antenna farm layout for SAGE G/A radio sites. Additional space is required for one 10 KW data link antenna.

d. Building Requirements. Rome AF Depot has established that adequate space would be provided in transmitter buildings based on AF DEF 38-12-10C and in receiver buildings based on AF DEF 38-12-10A.

(1) Existing radio buildings at "P" or "M" sites will be used wherever appropriate.

(2) Present receiver and transmitter buildings that meet the separation criteria will be enlarged to provide usable floor space equivalent to that indicated by AF DEF 38-12-10A and C. Add 10% of total square feet required to provide space for any additional equipment needed during simultaneous operation period of manual and SAGE Systems.

(3) In those cases where the buildings at "P" sites do not meet the separation criteria, the matter will be referred to this headquarters for decision on action to be taken.

(4) At "M" and some "SM" sites one new radio building will be provided. The one existing building should be used as the transmitter building, if technically feasible. Enlargement will be necessary to provide usable floor space equivalent to that indicated by AF DEF 38-12-10C. The 10% factor should be added, as outlined in paragraph 6 d (2) above.

(5) At "TM" sites, one new receiver building will be required, based on AF DEF 38-12-10A. A building based

[redacted]

354

Hq ADC ADOCE-CR Subj: (Uncl) Siting Directive for Ground/Air Radio Facilities for SAGE

on AF DEF 88-12-10C is to be provided with initial "TM" construction.

(6) At radio sites, not in conjunction with AC&W sites, new transmitter and receiver buildings will be required. The AF DEF 88-12-10A and C drawings will apply.

e. Typical Layout Plan. Rome AF Depot is preparing typical equipment room and outside plant plans for SAGE radio sites. These plans are to be distributed upon completion.

f. Equipment List. A list of major equipments that are required at each radio site is attached as Inclosure 1. PC programming has been accomplished for McGuire, Stewart, Syracuse and Topsham subsectors. Additional programming action will be initiated by the ADF's, based upon information that will be provided by this headquarters.

g. Power Requirements. General power requirements are as follows: 150 KW for transmitter building and 15 KW for receiver building. Emergency power will be obtained from existing facilities, where economically feasible.

h. Screening Angles. Screening angle information for each site will be included in the site survey report. At a radar site, available radar screening angle information may be suitable. Based on screening angle information, the coverage expected from a specific site should compare with the theoretical coverage for the general location recommended by WE-ADES. Wherever possible, the radio ground/air sites will be on-base.

i. In reference to coverage chart on the Syracuse subsector, sixty (60) foot antenna heights will be used, unless screening angles indicate that one-hundred (100) foot antenna heights are required to give necessary radio coverage.

j. The attached coverage charts depict a general 5,000 feet coverage above average terrain. Some coverage deficiencies do exist; however, they are not considered serious enough to warrant the selection of additional sites at this time. Radio calibrations will determine the degree of radio coverage deficiencies. The location of a site on the chart is shown by a cross. The data in the quadrants of a cross are interpreted as follows:

(1) Upper left - site designation.

(2) Upper right - site elevation above sea level in feet.

(3) Lower left - suggested height of antenna in feet above local terrain.

[redacted]

354

Hq ADC ADOCE-CR Subj: (Uncl) Siting Directive for Ground/Air Radio Facilities for SAGE

(4) Lower right - radio distance extremity in nautical miles from site to aircraft at 5,000 foot elevation above average terrain at location of aircraft.

7. Radio equipments are required to be operational prior to dates scheduled for subsector operation. This lead time is required to allow for testing. The dates that radio sites are scheduled to be operational by subsector area are as follows: (Similar information for additional subsectors will be furnished to appropriate Air Defense Forces when available.)

McGuire Subsector:

	P-45	P-54	DC
2 - UHF Voice	1 Nov 56	15 Sep 56	15 Sep 56
10 - UHF Voice	1 Nov 56	1 Nov 56	1 Nov 56
1 - UHF Data Link	1 Nov 56	1 Nov 56	1 Nov 56
All others	1 Jan 57	1 Jan 57	1 Jan 57

Stewart Subsector:

	P-10	P-50	DC
2 - UHF Voice	15 Nov 56	1 Jan 57	1 Jan 57
10 - UHF Voice	1 Jan 57	1 Jan 57	1 Jan 57
1 - UHF Data Link	1 Jan 57	1 Jan 57	1 Jan 57
All others	1 Mar 57	1 Mar 57	1 Mar 57

Syracuse Subsector:

12 - Voice and Data Link	Approximately 1 May 57.
All others	Approximately 1 Jul 57.

Topsham Subsector:

12 - Voice and Data Link	Approximately 1 Aug 57.
All others	Approximately 1 Oct 57.

V549-5

[redacted]

354

Hq ADC ADOCE-CR Subj: (Uncl) Siting Directive for Ground/Air Radar Facilities for SAGE

8. It is desired that site survey reports to include all pertinent data, be submitted to this headquarters for approval as soon as possible, and not later than the following dates: McGuire Subsector - 5 January 1956; Stewart Subsector - 30 January 1956; Syracuse Subsector - 15 February 1956, Topsham Subsector - 15 March 1956.

9. If the attached inclosures 2, 3, 4 and 5 are withdrawn (or not attached), the classification of this correspondence is downgraded to CONFIDENTIAL in accordance with AFR 205-1.

BY ORDER OF THE COMMANDER:

R. E. PALMER
Major USAF
Asst Comd Adj

5 Incls
1. List of Equipment (Dup)(C)
2. Radio G/A Sites-McGuire SS (Dup)(S)
3. Radio G/A Sites-Stewart SS (Dup)(S)
4. Radio G/A Sites-Syracuse SS (Dup)(S)
5. Radio G/A Sites-Topsham SS (Dup)(S)

(Incls 2, 3, 4 and 5 not furnished CADF and WADF)

Info: Hq USAF (1 cy ea 5 Incls)
MAAMA (2cys ea 5 Incls)
RAFD (1 cy ea 5 Incls)
AMC (1 cy ea 5 Incls)
4620 AD WG (Experiment (1 cy ea 5 Incls)
SAGE)
EDSD-ADES (1 cy ea 5 Incls)
WE-ADES (1 cy ea 5 Incls)
All AFIR's (1 cy Incl 1 only)
All AMA's - except MAAMA - (1 cy Incl 1 only)

1549-6

[redacted]

354

SAGE UHF Transmitter and Receiver Site
Maximum Equipment List

		Quantity
1.	Transmitter Site Equipment:	
	a. AN/GRT-3	27 ea
	b. AN/GRC-27 (Transmitter Portion)	2 ea
	c. BC-640 (Varies from 3 to 4)	4 ea
	d. Low Pass RF Filter for BC-640	4 ea
	e. Carrier-on Indicator Equipment	32 ea
	f. 10-KW UHF/FM Transmitter	1 ea
	g. 1 KW AN/GPA-24 Amplifier	1 ea
	h. RC-81C Antenna Systems	4 ea
	i. UHF Antenna System (w/o Multicouplers)	29 ea
	j. Low Power Multichannel HF Transmitter (Voice)	2 ea
2.	Receiver Site Equipment:	
	a. AN/GRR-7	26 ea
	b. AN/GRC-27 (Receiver Portion)	2 ea
	c. BC-639 (Varies from 3 to 4)	4 ea
	d. CODAN Units for GRR-7 and BC-639	30 ea
	e. AM-409/FRC Level Equalizing Amplifiers for use with all Receivers	32 ea
	f. RC-81-C Antenna System	4 ea
	g. Low Pass Filter for AN/GRR-7	26 ea
	h. Receiver Muting Relays	30 ea
	i. HF Receivers	4 ea
	j. UHF Antenna System (w/o Multicouplers)	28 ea

Incl 1

V529-7

[redacted]

[redacted]

354

NOTE 1: Duplex 25 subchannel data link equipments will be installed in the transmitter buildings at radio sites where operations buildings annexes of heavy radar sites are not available.

NOTE 2: One-hundred square feet in transmitter building must be provided for telephone terminal equipment.

FILE NUMBER 107.1

355

28 SEP 1955

AIREPG

SUBJECT: (U) Facility for SAGE Computer Programming and Training

TO: Chief of Staff
Headquarters USAF
Washington 25, D. C.

1. References:

a. Headquarters ARC Confidential letter, subject: (U) Operational Plan, Semi-Automatic Ground Environment System for Air Defense (SAGE), 30 April 1955.

b. Headquarters ARC Confidential letter, subject: (U) Computer Programming, 21 June 1955.

c. Headquarters ARC Secret message, ARCDC 2006, 27 August 1955.

2. Since publication of Air Defense Command's plan for accomplishing its computer programming responsibilities for SAGE at Sycamore (Reference 1.a., above), additional study by the Lincoln Laboratory, MIT Corporation, RAND Corporation, Western Electric Company and the ARDC Project Office has conclusively indicated that this additional use of an operational facility is not acceptable. As a result, it has been necessary to select an alternate location, Stanford Air Force Base. The studies on this subject further indicated that individual operator training could be conducted at Stanford on a joint use basis.

3. Our plan for providing a facility to support the tasks of computer programming and training is attached. It recommends the diversion of SAGE equipment from a high priority site to a low priority site, (i.e., Hancock to Stanford.) In this manner, no additional SAGE equipment is required, no major additional costs are incurred and the completion date of the entire SAGE System remains unchanged. It must be recognized that this method of providing the required facility is based upon the best technical knowledge currently available and will support the minimum requirements for these

UNCLASSIFIED

C 5-1509
C 5-1510

V628-1

This correspondence is classifie... in accordance with Par _____, AFR 205-1, 15 ... or for the reason (c) stated.

[redacted]

355

Hq ADC, Subj: (U) Facility for SAGE Computer Programming and Training

functions. As more experience is gained, it may be necessary to extend the overall schedule to provide a separate facility. This decision, however, could be made as late as 1957.

4. This plan has been approved by the Air Defense Command and has the concurrence of the Air Training Command. In view of the urgent requirement for this facility, and its impact upon the overall integration and operation of the SAGE System, it is urged that review and approval of the plan be expedited. Further, it is requested that an implementing directive be issued to all agencies concerned for necessary program adjustments.

GEORGE F. SMITH
Major General, USAF
Acting Vice Commander

1 Incl
a/s

cc: Comdr, ATC (10 cys)

MEMO FOR THE RECORD: Coordination of this letter has been limited with the approval of the Command Council. The attached plan was submitted to the Command Council on 23 September 1955 and approved by ADC for implementation on that date. Coordination with Air Training Command will be effected by briefing on 29 September 1955.

O.T.H.

COMEBACK COPY

Not requested, not furnished
Furnished 28 SEP 1955
(Date) (Initials)

Col O.T.Halley,Jr
2441-3
27 Sep 55

[redacted]

This correspondence is clas[redacted] in accordance with Par 23c, AFR 205-1, 15 Dec 53, or for the reason (s) stated

V628-2x

0510

[redacted]

107 356

COMDR ADC

PRIORITY ROUTINE

COFS HQ USAF WASH DC

COMDR ARDC BALTIMORE MD AFOOP-OC- F/3 51704 SECRET

COMDR APGC EGLINE AFB FLA

4 NOV 1955

~~(SECRET)~~ ADHPG 4328. FOR AFOOP-OC-F/3. URMSG 51704. Part 1. Your proposal to COMB OST of Bomarc and Talos with functions of computer programming and TNG unacceptable for FOL reasons: a. Computer programming and TNG will utilize at least entire capability of AN/FSQ-7 on 24 HR, 7 day WK basis. ADD of FSQ-8 computer may be RQR for these functions alone. Our LTR, SUBJ: FAC for Computer Programming and TNG, details the CFMS thi RQR. No stretch out of either function is possible if Es.. operational dates for SAGE are to be met. b. SUBQ to ARDC REQ REF to in your MSG, representatives of APGC and ARDC have contacted this COMD on an ALTN solution of joint use of another SA DC FAC. Meeting planned at ADC WK of 7-11 NOV for purpose of attempting to work out joint plan of OPR. Resolution of the LOC for missile OST is independent of RQR for Grandview FAC.

1 2

Col O. T. Halley, Jr/mm

ADHPG

[redacted]

2441-2443

This correspondence is classified [redacted] accordance with Per _____, AFR 205-1, 15 Dec 53, as for the reason (s) stated.

M526-1

356

(SECRET) ADHPG 4328.

Part 2. In view of the above INFO and the urgency of the RQR to remove the lead of computer programming and TNG from XD-1, REQ your APPR of the Grandview FAC for computer programming and TNG as originally outlined in our plan 28 SEP.

CONFIDENCE COPY
Furnished 4 NOV 1955 (Date) (Initials)

AC - PURCHASE NOT PROHIBITED EXCEPT ... TO (CATEGORY B ... MOVE ALL ... GROUP PRIOR TO ... CLASSIFIED REFERENCE IF DATE-TIME GROUP IS QUOTED.

MESSAGE TRANSMITTED
WITH FOLLOWING DATE TIME GROUP
B-22-04 042200Z

Will be Confirmed in 3rd Publication Form Under Par 3c ADCSin

53 Prepared by Col O.T.Halley,Jr/mm
Telephone 2441-3
Date 4 Nov 55

R. E. PALMER
Major USAF
Asst Comd Adj

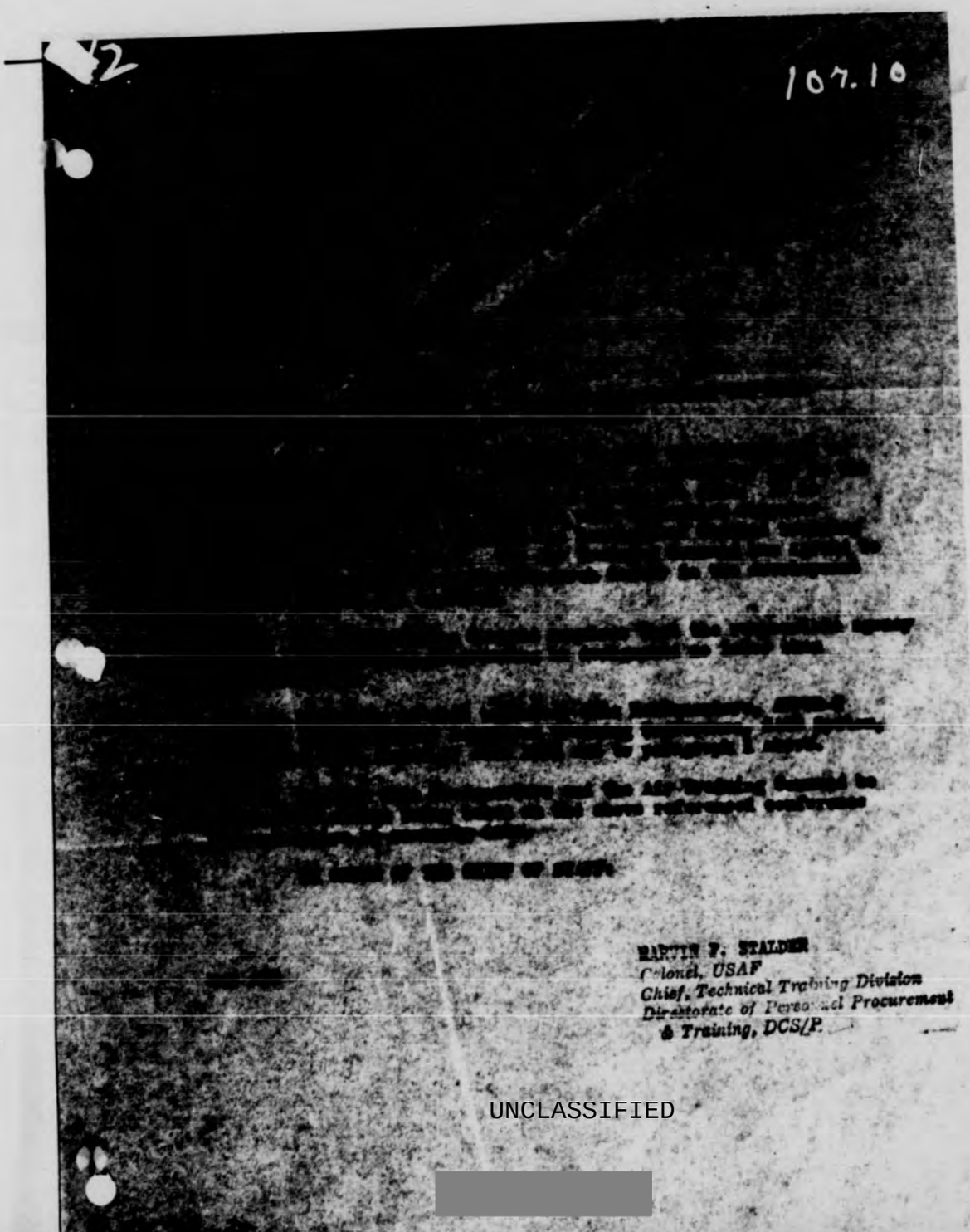
UNCLASSIFIED

Page 2 of 2 Pages

ADC Form 11 (REV)

This correspondence is classified ... in accordance with Par 23c, AFR 205-1, 15 Dec 53, or for the reason (s) stated

M526-2X



107.10

MARTIN F. STALDER
Colonel, USAF
Chief, Technical Training Division
Directorate of Personnel Procurement
& Training, DCS/P

357

R/S, Hq USAF, AFPER-T, Subj: (UNCL) Computer Programs for SAGE System Training

FILE NUMBER 107.10

ADOPC (16 Aug 55) 1st Ind 31 AUG 1955

HQ AIR DEFENSE COMMAND, Ent AFB, Colorado Springs, Colorado

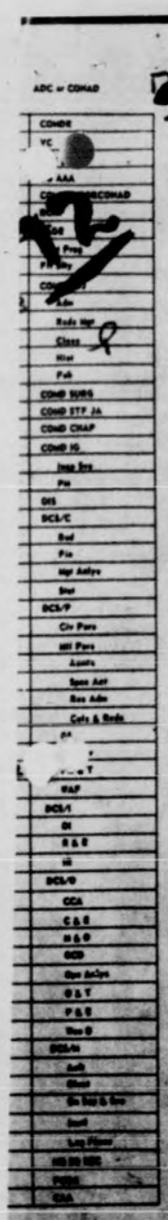
TO: Director of Personnel, Headquarters USAF, Washington 25, D. C.

1. Reference Air Defense Command Plan for Accomplishing Computer Programming for SAGE, dated 6 June 1955.

2. The assignment of responsibility for development of computer programs has been delineated in above referenced plan. The preparation of synthetic air defense situation data, to be used for training of personnel at ED-1, is being accomplished by Lincoln Laboratory and the 4620th Air Defense Wing (Experimental SAGE). Thereafter, the 4620th contractually supported by the RAND Corporation, will provide training data for operational direction centers and combat centers. It is believed this data primarily designed for team training will also produce the basic data which will be acceptable to ATC for individual training.

3. The 4620th with Lincoln Laboratory and the RAND Corporation is investigating the most economical and operational method for inserting this synthetic data into the computer for personnel training. Final determination of exact methods will be made within the next few months.

4. A [illegible] study of the Syracuse Direction Center [illegible] initially disclosed that this location was [illegible] economically suitable for Phase II [illegible] training. However, this head- [illegible] a [illegible] on [illegible] at the [illegible] New York City to finalize the selec- [illegible] these functions may be accomplished [illegible] use of this facility with ATC. When [illegible] finalized it is felt that provision can [illegible] the dissemination of synthetic data [illegible] to support both individual training (ATC) and team [illegible]



357

B/L Hq USAF, AFPTR-T, Subj: (UNCL) Computer Programs for SAGE System Training

5. Your headquarters has also been invited to attend above referenced conference in ADC message, ADMPG 3768, dated 23 August 1955.

FOR THE COMMANDER:

JOSEPH D. HORNSBY
Lt Col, USAF
Asst Command Adj

A39262/0105
MCG

COMEBACK COPY

.....Not requested, not furnished

HPG Furnished 31 AUG 1955 DM
(Date) (Initials)

44

HEADQUARTERS
AIR DEFENSE COMMAND
Ent Air Force Base
Colorado Springs, Colorado

ADPRT-PA

SUBJECT: Personnel Requirements for SAGE System

TO: Director of Military Personnel
Headquarters USAF
Washington 25, D. C.

1. During the period in which this command will be converting from the manual AC&W system to the SAGE system, it will be necessary to maintain a high capability in manual operation while building a high capability in the SAGE operation. Since these two requirements will exist concurrently in any given Air Division, it is necessary that the problems created by the conversion be planned for well in advance. With this in mind, this headquarters has developed the monthly requirements to man both the SAGE and the Manual systems during the first part of the conversion period. Also, since the training requirements for SAGE are in addition to those required for personnel in the manual system, it was necessary to plot the monthly requirements for the SAGE buildup in order to determine the training flow needed to support the SAGE buildup.

2. Attached as inclosure 1 is a tabulation which indicates the requirement by months. The balance of the columns depict cumulative requirements in specialties in which SAGE buildup increase the overall requirement in this command. They also indicate the number of personnel rendered surplus in specialties in which SAGE will reduce the overall requirement of this command.

3. Only a partial list of the operations type positions that will be required by the SAGE system are included. Since manning documents for the SAGE sectors and sub-sectors have not yet been approved by Headquarters USAF, it was necessary to confine our initial efforts to the kinds of positions the number of which is dictated by the design of the equipment and the requirements of the mission. The amount of option existing to change either the numbers or AFSC's of these specialties is so little that these data possess adequate validity for planning purposes. Once manning documents have been approved, additional specialty requirements will be submitted.

4. From the attached data, it becomes clear that our planning should accomplish the following objectives if conversion is to be completed without loss of Air Defense Capability.

a. The 273X0 requirements make necessary manning at 100% of the strength authorized in the manual system at least six months prior to the operationally ready date for the first sub-sector. (1 March 1957 at McGuire)

b. Overmanning the manual system in 273X0 prior to the conversion period will not be necessary since the conversion requirement

44

239330

43

[redacted]

ADPRT-PA, Subj: Pers Rqrs for SAGE Sys

will never amount to a number of personnel greater than 4% of our authorized strength at the beginning of the conversion period.

c. Since the end result of the conversion will be a reduction of the requirement in this specialty, no change in training command student flow in this specialty need be influenced solely by the requirement for converting to SAGE. However, the activation of additional manual radar squadrons through Fiscal Year 1958 may direct an increase in the Air Training Command's student flow in order for this command to remain 100% manned in this specialty.

d. It is suggested that only the initial personnel for activating a sector or sub-sector be provided solely from the manual system. Thereafter, replacements should be allocated from pipeline resources and from ATC technical schools. All personnel receiving SAGE operational training should have a minimum of six months experience in the manual system. It is suggested that all personnel receiving the SAGE specialized training have a minimum of 12 months retainability upon reporting to the SAGE unit for duty. Furthermore, because of the limited operational training capacity, it appears as if personnel should be retained in the SAGE system during at least the first eighteen months in a frozen status. (All levies for this specialty should therefore be provided from the manual system)

e. School flow for the 1600 career field has been barely capable of meeting the attrition in this command. It appears reasonable that the steadily increasing requirement for this specialty will require an augmented flow once conversion has started.

f. Since six months training in the manual system is required of the personnel reassigned SAGE in the 1600 career field, 100% manning should be attained in the manual system at least 11 months prior to the operationally ready date of the first SAGE sub-sector. Thereafter, the flow to this command from ATC should be increased to meet the additional requirements shown in Inclosure 1, column 6 for this specialty.

g. This command's requirements for aircraft control staff officer (1616) will increase during the installation period of the SAGE Combat Centers and Direction Centers. This command is presently authorized 176 aircraft control staff officers (1616). Our requirement for 1616's will increase to 556 aircraft control staff officers by August 1960. Immediate action should be taken to retain personnel presently on active duty who will become qualified to be upgraded to the 16 level, if this command is expected to efficiently maintain the operational capability of the Combat Centers and Direction Centers.

h. In order to gain the retainability necessary to assure at least one year tenure in SAGE, it will be necessary to start an increase in manning the 1600 career field as soon as possible. Low retainability of officer personnel in this career field makes it highly questionable

20 FEB 1956

V727-2

46

[redacted]

ADPRT-PA, Subj: Pers Rqrs for SAGE Sys

to utilize personnel whose contract tour will end in less than one year after their assignment to SAGE.

i. The 3000 career field requirements will increase during the complete installation period of the SAGE system. In view of the SAGE equipment requirement at the Radar Sites additional officer personnel in the 3044 AFS will also be required.

j. The personnel listed on the remaining inclosures (567X0, 567X1, 566X0, 232X0) appear to be complete new requirements for this command. With the recent establishment of the 567XX career field sufficient information is not available to determine the number of personnel who will be converted to these AFSC's. In view of the size and number of the diesels and cooling equipment required, a definite requirement exists for specialized training on this equipment. The power and equipment cooling personnel will constitute this command's earliest requirements for trained personnel on site. In view of the limited time available to train personnel to operate and maintain the Power and Refrigeration equipment this headquarters is contracting for this service for the first three SAGE units. This contract may be expanded to include additional centers depending on ATC capability to furnish trained personnel by 15 May 1956.

5. Request your headquarters take the necessary action to insure that these requirements for trained personnel will be available to meet the scheduled operational dates of the SAGE units.

FOR THE COMMANDER:

1 Incl:
A/S

JOHN C HORTON
Brigadier General, USAF
DCS/Personnel

Info Cy:
4620 ADW (Exp SAGE)
Air Training Command
ADES Proj Off (AD Engr Svc)
ADES Op (Western Elec Co)

20 FEB 1956

V727-3X

[redacted]

3 UNCLASSI

[redacted]

HEADQUARTERS
AIR DEFENSE COMMAND
Ent Air Force Base
Colorado Springs, Colorado

107.15
359

13 OCT 1955

ADPRT-PA

SUBJECT: (Unclassified) Manning Plan for SAGE System

TO: Commander
Eastern Air Defense Force
Stewart Air Force Base
Newburgh, New York

COMEBACK COPY
ADPRT-3A
Furnished, not furnished
13 OCT 1955
(Date) (Initials)

1. Attached for your information and necessary action are two (2) copies of the phased personnel requirements for Duty personnel of the 26th Air Division (SAGE) Combat Center and Direction Centers, Power and Equipment Cooling Buildings.

2. The information contained in the attached inclosures has not been approved by the command council this headquarters. However, these personnel requirements are based on the kinds of equipment, the design and the number of equipments, and the requirement to operate the positions 24 hours per day. The amount of option existing to change either the numbers or the AFSC's of these specialties is so little that personnel planning actions can be undertaken at this time. Administration and staff personnel will be time phased immediately upon receipt of an ADC approved UMD.

3. Whenever a combat center and direction center is located adjacent to each other, personnel have been programmed to operate and maintain equipment in the combined "communication center and power building" in accordance with the first unit to become operational regardless of the designation of the first unit.

4. Personnel selected to man the combat centers (SAGE) will receive SAGE specialized operator training and should have previous manual experience at an active Air Defense Division or higher echelon combat operation center. In addition for planning purposes, all operator personnel should have a minimum of 6 months experience in the manual system prior to receiving the SAGE specialized training.

No Adv
R. B. PARFITT/Capt,USAF/1mi/
2605
29Sep55

"If inclosures are Withdrawn (or not attached) the classification of this correspondence will be downgraded to [redacted], in accordance with Par 25 (g), AFR 205-1."

This correspondence is classified Secret in accordance with Par 23, AFR 205-1, 15 Dec 53, or for the reason (s) stated.

UNCLASSIFIED

[redacted]

Hq ADC, ADPRT-PA, Subj: (Unel) Manning Plan for SAGE System 359

5. The equipment installation dates, the BOD, International Business Machine Corporation requirements of testing, the Western Electric Company requirements for installing long lines, switchboards, etc., dictated the phasing of these personnel. Listed below are the normal lead times for duty personnel:

Activation of Wing	11 mo prior to opnl dt
Normal load of opr pers (16XX & 273X0)	3½ mo prior to opnl dt
Remaining opr pers	1½ mo prior to opnl dt
Normal Load of C&E oprs	6 mo prior to opnl dt
Remaining C&E pers	2 mo prior to opnl dt
Power & Eqp Cool Engineer (McGuire, Stewart & Syracuse)*	6 mo prior to opnl dt
Power & Eqp Cool Engineer (Mil Pers), (McGuire, Stewart & Syracuse)*	3 mo prior to opnl dt
1 Power Engr (Ft Lee & Sub Sites)	17 mo prior to opnl dt
Remaining Power & Eqp Cool Engr (Ft Lee & Sub Sites)	11 mo prior to opnl dt
Power & Eqp Cooling Pers (Military) (Ft Lee & Sub Sites)	11 mo prior to opnl dt

*Power & Equipment Cooling Personnel have a much shorter lead time for the first 3 SAGE units because this equipment will be maintained and operated by a civilian contractor.

6. Additional personnel required at the P&M sites to support the AN/FST-2, Height, Mark X SIF, and Radar Mapping equipment will be time phased in the immediate future. This action is dependent upon the type and size, etc., of the Power & Equipment Cooling required for the AN/FST-2 which has not been defined at this date. Additional personnel will be required at the P sites in the McGuire Sub-Sector on or about 1 July 1956 for this equipment. Personnel strength will be decreased to approximately 7 officers, 126 airmen and 17 civilians shortly after the Direction Center becomes operational. It appears that additional personnel may be required for the Power & Cooling equipment.

[redacted]

V638-2

3

1

14

[redacted]

359

Hq ADC, ADPRT-PA, Subj: (Unel) Manning Plan for SAGE System

7. Attached for your information (see Inclosure 7-8) are copies of correspondence on the SAGE System. Additional information, i.e., UMD's, etc., will be forwarded as they become available.

8. Request your headquarters take necessary action to prepare and forward a manning plan for the 26th Air Division (SAGE) as soon as possible.

BY ORDER OF THE COMMANDER:

R. E. PALMER
Major USAF
Asst Comd Adj

8 Incls:
1. Brunswick DC
2. McGuire DC
3. Stewart DC
4. Syracuse CC
5. Syracuse DC
6. Ft Lee DC
7. Ltr, Hq ADC, dtd 11 Aug 55
8. 1st Ind, Hq USAF, dtd 16 Sep 55

Info Cy:
Hq USAF
Comdr, ATC
Comdr, TTAF
Comdr, EADF
ADES Proj Off (AD Engr Svc)
ADES Op (Western Elec Co)

L-36 952/0364
M-3872/0169
R-7738/0105
A-78933/0425
E-3810
E-3813

[redacted]

V638-3x

3

0521

HEADQUARTERS
AIR DEFENSE COMMAND
ENT AIR FORCE BASE
COLORADO SPRINGS, COLORADO

360

1 DEC 1955

ADPRT-T-1

SUBJECT: Training Requirements for SAGE System

FILE NUMBER 107.10

TO: Commander
1620th Air Defense Wing (Exp SAGE)
Lexington, Massachusetts

1. Attached, as Inclosure #1, is correspondence from Headquarters USAF concerning ADC requirement for professional education and training-in-industry in Digital Computation for support of the SAGE System. [illegible] indicated in the 1st Indorsement, the training requirement for Digital Computation has been the subject of considerable study and discussion by ARDC and Headquarters USAF prior to the time that the ADC Staff became actively engaged in SAGE planning.

2. At the present time, this Headquarters anticipates a requirement for training as outlined in [illegible], Inclosure #1. However, we do not have sufficient information upon which to establish firm personnel requirements in the area of Digital Computation [illegible] training at this time.

3. Also attached, as Inclosure #2, is a copy of a disposition form concerning the problem of [illegible] progress [illegible] establishing a requirement for [illegible] training with IBM to meet this need. In this regard, we have [illegible] for the training of four (4) officers, AFSC 3016, who will [illegible] probably be assigned to the 1620th Air Defense Wing.

4. Your comments and/or recommendations concerning the requirement for professional education and training-in-industry to meet SAGE needs are solicited. [illegible] your recommended prerequisite requirements of personnel to receive training established in paragraph [illegible] above.

BY ORDER OF THE COMMANDER:

C. F. Humphreys

C. F. HUMPHREYS
Major, USAF
Asst Command Adj

2 Incls:
1. Ltr, [illegible]-11, subj: [illegible] for Lincoln Transition Sys, [illegible] with 1st & 2d Ind (SECRET)
2. (U) DF fr ADPTR, [illegible]

5 A 17

4-96-2

ADRC 314

[redacted]

COPY

360

8 Aug 1955

AFPMP-11

SUBJECT: Training Requirements for Lincoln Transition System

TO: Commander
Air Research & Development Command
P. O. Box 1395
Baltimore, Maryland

1. This headquarters has established the following training quotas in the FY 56 and FY 57 USAFIT Programs to support your requirements for personnel on the Lincoln Transition System.

a. Ten graduate level spaces in Digital Computation to be conducted in civilian universities.

b. Ten Training-in-Industry spaces in Digital Computation to be conducted at the Massachusetts Institute of Technology.

c. Ten Training-in-Industry spaces in Digital Computation to be conducted at the International Business Machines Corporation.

2. An Air Defense Command recommendation to cancel Wire Communications Course Number 4, which had also been established in support of this system, has been approved. Request therefore, that you reevaluate the need for the above listed training in terms of the present operational concept for the Lincoln Transition System.

BY ORDER OF THE CHIEF OF STAFF:

s/t GLEN R. BIRCHARD
Colonel, USAF
Chief, Personnel Requirements
& Analysis Division
D/Military Personnel

JAN 20 1955

COPY

[redacted]

K596-3

Incl 1

COPY

[redacted]

360

Ltr Hq USAF, Washington 25, D. C., Subject: Training Requirements for Lincoln Transition System

RDSPTS (8 Aug 55) 1st Ind 20 Sep 1955

HEADQUARTERS AIR RESEARCH AND DEVELOPMENT COMMAND, Post Office Box 1395, Baltimore 3, Maryland

TO: Director of Military Personnel, Headquarters USAF, ATTN: Personnel Requirements and Analysis Division, Washington 25, D. C.

1. Reference Headquarters ARDC letter dated 9 January 1953, Subject: FY 1954 Training Requirements for Project Lincoln.

2. Reference Headquarters ARDC letter dated 19 November 1953, Subject: FY 1955 Professional Training Requirements for the Lincoln Transition System (Unclassified).

3. Reference Headquarters ARDC second indorsement dated 21 January 1954 to letter outlined in paragraph 2 above and Headquarters USAF first indorsement dated 10 December 1953.

4. Reference Headquarters ARDC first indorsement dated 21 July 1955 to Headquarters USAF letter dated 12 July 1955, subject: Officer Educational Requirements.

5. Due to the long range planning and programming involved in whatis now known as the SAGE System the Air Research and Development Command in 1951 began a continuous study of the training requirements that needed to be established in support of Project Lincoln. This was culminated by the series of requirements letters referenced in paragraphs 1, 2 and 3 above.

6. Due to the fact that a four year leadtime is necessary in the establishment of requirements for professional education the professional education requirements were submitted first followed by industrial training requirements and special short course requirements.

7. The professional education requirements referenced in basic communication were formulated after conference and coordination with the Lincoln Laboratories, the Air Defense Command Liaison Office and the responsible staff agencies of Air Force Cambridge Research Center and this Headquarters. There was no AD[illegible] office in being at that time.

8. ARDC requirements for subject training were outlined in indorsement referenced in paragraph 4 above.

JAN 2

COPY

V596-4

[redacted]

[redacted]

COPY

360

Ltr Hq USAF, Washington 25, D. C., Subj: Tng Rqr for Lincoln Transition Sys (1st Ind Cont'd)

9. It is recommended that the Air Defense Command make the final recommendation as to the training outlined in basic communication. Due to changes in time phasing and operational concepts since these requirements were originally generated the Air Defense Command will of necessity need to bring the requirements for the SAGE System up to date. As outlinedin previously referenced letters the graduates of these training programs would eventually be assigned to the SAGE System.

10. Personnel from this Headquarters are available to discuss this subject further with representatives from the Air Staff and Air Defense Command.

FOR THE COMMANDER:

s/t CLAY D. ELLIS
Lt Colonel, USAF
Chief, Military Tng Div

[redacted]

1596-5

COPY

[redacted]

COPY

360

15

Basic ltr to ARDC, Subj: Training Requirements for Lincoln Transition System

AFPMP-11 2d Ind 4 Oct 1955

Dept of the Air Force, Hq USAF, Washington 25, D. C.

TO: Commander, Air Defense Command, Ent Airbase, Colorado Springs, Colo.

1. Professional education quotas established in support of the SAGE System have been listed in the basic communication. Request your comments on the continued need for this training in terms of the present operational concept for the Sage system.

2. Headquarters ARDC's Indorsement to our original request for this information indicates that the final recommendations concerning this training should rest with your command.

BY ORDER OF THE CHIEF OF STAFF:

s/t [redacted]
Colonel, USAF
Chief, Pers Mgr & Analys Div
D/Military Personnel

[redacted]

COPY

1506-6

UNCLASSIFIED

DISPOSITION FORM

SECURITY CLASSIFICATION (If any): 360

FILE NO.	SUBJECT		
	(U) Personnel [illegible] Requirement		
TO	FROM	DATE	COMMENT NO.
[illegible] SPTR-1 (In turn)	[illegible]	22 Sep 55	

1. [illegible] Chapter V, Section [illegible], paragraph [illegible], page 10 of "O[illegible] [illegible] Semi-Automatic Ground Environment System for Air Defense", dated 7 March 195[illegible] [illegible] manufacturer [illegible] the [illegible]-7 [illegible] the [illegible] of this [illegible] limited, [illegible] in [illegible]. In addition, [illegible] plan. [illegible] in 1955 [illegible] this condition of [illegible] rely on contractors for advice [illegible] to the Air Defense [illegible] deficiency in the [illegible] within the Air Force.

2. [illegible] above, [illegible] are not [illegible] field:

a. [illegible], when [illegible] are required?

b. What kind of training [illegible] and how long will it take?

Answers [illegible] unknowns on the [illegible] must eventually be developed within the Air Force. Within ADC these answers will undoubtedly come from the [illegible] Air Defense Wing.

3. [illegible] letter [illegible] from the Manager of Defense [illegible] Kingston Plan, a thirty-nine week "[illegible]" training course has been established at Kingston. It is believed [illegible] at least one officer in this course now. It is, therefore, requested that appropriate action be taken to assure one officer [illegible] to attend the "System [illegible]" course beginning 17 January 1956. Upon completion of this course the officer should be assigned to the [illegible] Air Defense [illegible] for a minimum of three years.

4. It is believed that the action requested herein will provide ADC with [illegible] establish answers to the basic unanswered [illegible] the applicability of this kind of training to ADC.

UNCLASSIFIED

K596-7

COPY

DD FORM 1 FEB 50 96 REPLACES NME FORM 95, 1 OCT 48, WHICH MAY BE USED.

Incl 2

SECURITY CLASSIFICATION (If any)

DISPOSITION FORM

360

FILE NO.

SUBJECT (U) Personnel Training Requirement

TO P&R
ADPRT-T
(In Turn)

FROM ADHPG

DATE 22 Sep 55

COMMENT NO. 1

5. Major Farmer, Systems Division, P&R, has shown strong initiative and personal interest in this overall problem area. He has solicited the available information concerning the course outlined above. The requested action above has been discussed with the Commander, 1620th Air Defense Wing, with specific reference to Major Farmer, and he concurs. I believe Major Farmer is highly qualified for this course and recommend he be released for attendance.

6. Request your concurrence.

1 Incl:
Ltr IBM Corp, 2 Sep 55,
w/1 Incl.

s/t [illegible]
Colonel, USAF
Director
Ext 21041/21043

JAN 2

W596-8X

COPY 2

[redacted]

360

Hq ADC, ADPRT-T-1, Subject: Training Requirements for SAGE System

ADW(MIT) (1 Dec 55) 1st Ind

HEADQUARTERS 4620th AIR DEFENSE WING (EXPERIMENTAL SAGE), Lincoln Laboratory
Lexington, Massachusetts 23 December 1955

To: Commander Air Defense Command, Ent Air Force Base, Colorado Springs, Colorado

1. Reference par 2 basic communication. It is suggested that the quotas outlined in inclosure 1 be concurred in by your headquarters. It is not believed that definitive justification can yet be provided for changing these quotas. Once Air Defense Command has gained operational experience in use of SAGE definitive information will exist on which to base education and training quotas for fiscal years 1958 and 1959.

2. Reference par 3 basic communication. It is recommended that the source AFSC's for computer-programmers be 8526 and 8626. Reference par 2, inclosure 2. This headquarters is studing the problem of the number of computer programmers that will be needed and the time they should be available. This information will be included in a suggested change to the UMD of this organization. The kind of training these personnel will require will be largely dependent upon the source AFSC from which they are drawn. It is believed, however, that either the long IBM course or those conducted here are mandatory prerequisite training courses.

HOUSTON W LONGINO JR.
Colonel, USAF
Deputy Commander

WHEN DETACHED FROM ENCLOSURE, THIS DOCUMENT SHALL BE DOWNGRADED TO Unclassified

DEC 28 1955

V5964

[redacted]

UNCLASSIFIED

[redacted]

FILE NUMBER [illegible]

13 DEC 1955

[illegible]

SUBJECT: (UNCL) Contractor Support for the SAGE System

TO: Director of Communications-Electronics
Headquarters United States Air Force
Washington 25, D. C.

1. Reference is made to your letter on this subject, file [illegible], dated [illegible] November 1955, requesting recommendations by this command on an Air Training Command proposal that the SAGE system be maintained and at least partially operated through contractual arrangements.

2. Air Training Command has contacted this headquarters directly on this same subject and has been asked to present the background and experience upon which General [illegible] proposal was based, together with a discussion of their capability to support SAGE requirements, at an early meeting. This information is required by this command before any workable recommendations on this proposal can be finalized.

3. Accordingly, this letter is considered an interim reply to your request referred to in paragraph 1, above. This command is fully aware of the importance of this subject and every effort will be made to furnish final recommendations as soon as possible.

FOR THE COMMANDER:

C. F. HUMPHREYS
Major, USAF
Asst Command Adj

[illegible] COPY
13 DEC 1955

A - 31129/0066

L/Col D.H.Higgins/mm
2441-3
7 Dec 55

UNCLASSIFIED

[redacted]

1560-1X

This correspondence is class[illegible] accordance with Par 24?, AFR 205-1, 15 Dec 53, or for the reason (s) stated.

[redacted]

FILE NUMBER 107-36

13 DEC 1955

SUBJECT: (U) Contract Support for the SAGE System

TO: Commander
Air Training Command
Scott Air Force Base
Illinois

1. Your letter on this subject, dated 18 August 1955, has been forwarded to this command by USAF for comments and recommendations. A preliminary study on your proposal has been made by USAF, and the results are attached here to for your information as Enclosure #1. In addition, a copy of our interim reply to the USAF request is attached as Enclosure #2.

2. As the responsible operator of the SAGE system, this command is vitally concerned that any program adopted, either for maintenance or operation, be consistent not only with operational requirements, but with the manpower and budgetary capabilities and limitations of all concerned. Accordingly, it is requested that representatives of your command familiar with the background material and experience which form the basis for General Myers recommendation, brief the Director level of this command on your proposal at a mutually acceptable date in the near future. Specifically, this briefing should cover ATC capabilities and limitations, and it would be helpful to have your comments on the USAF study, together with any explication which might be available through your own experience. This information will be required before this command can formulate final recommendations on expanded contract support for the SAGE system.

3. In order to allow preliminary study of your proposal prior to the requested briefing, it is requested that the following specific questions be answered in your reply to this letter:

a. Does the term "complete maintenance" include all maintenance of radars and related equipment, as well as such items as air conditioning and power equipment at SAGE Direction Center and Combat Center locations?

E-5824

UNCLASSIFIED

[redacted]

This correspondence is classified _____ in accordance with Per _____, AFR 205-1, 15 Dec 53, or for the reason (a) stated.

DEC 14 1955

1559-1

[redacted]

362

Hq ARC, ADCOM, Subj: (U) Contract Support for the SAGE System

b. In reference to operation of the SAGE system, is the term "SAGE System" used as defined on page 3 of the Operational Plan, Semiautomatic Ground Environment System for Air Defense, dated 7 March 1958?

4. In view of the importance of this matter, it will be appreciated if the proposed visit can be arranged for a week early in January 1956. However, with the realization that some preparation may be required and that other commitments may interfere, any date during that month will be acceptable to this headquarters.

FOR THE COMMANDER:

2 Incls
1. USAF Study
2. Ltr to USAF

HUMPHREYS
Adj

Incls not required for Comd Adj file

COMMAND COPY

13DEC 1955

Prepared by L/Col D.H.Higgins/mm
Telephone 2441-3
Date 7 Dec 55

DEC 14 1955

1559-2X

[redacted]

This correspondence is classified in accordance with Par 24g, AFR 205-1 [illegible] unless otherwise stated.

[redacted]

FILE NUMBER 107.1

HEADQUARTERS
AIR DEFENSE COMMAND
Ent Air Force Base
Colorado Springs, Colorado

363

CONFERENCE NOTES

PHASING OF MANUAL SYSTEM

TO

SAGE WITHIN EASTERN AIR DEFENSE FORCE

15 November 1955

[redacted]

[redacted] 363

1. A conference, "Phasing of Manual System to SAGE Within Eastern Air Defense Force," was held at Headquarters Air Defense Command on 15 November 1955.

2. Conferees:

Name	Rank	Office
Teschner, G. C.	Colonel	EADF
Looke, C. J.	Colonel	EADF
Hornby, D. A.	Colonel	ADOMO
Caples, J. S.	Colonel	ADMIS
Halley, O. T.,Jr.	Colonel	ADHPG
Erdman, O. L.	Lt Colonel	EADF
O'Dell, S.	Lt Colonel	ADHVP
McClung, T.S.L.	Lt Colonel	ADPRT
Anderson, H. K.	Lt Colonel	ADOCE
Hester, G. W.	Lt Colonel	ADOCE
Anderson, M. J.	Lt Colonel	ADOCE
Higgins, D. H.	Lt Colonel	ADHPG
Mertely, F.	Lt Colonel	ADHPG
Nichols, C. E.	Major	ADMIS
McAteer, R. F.	Major	ADMEL
Ashworth, C. V.	Major	ADMEL
Johnson, W. H.	Major	ADMEL
Shasky, E. N.	Major	ADMLO
Onila, J.	Major	ADOCE
Streamer, R. J.	Major	ADOCE
Kocel, E. P.	Major	ADOCE
Anderson, R. W.	Major	ADOCE
Shopa, M. J.	Major	ADOMO
Davison, F. R.	Major	EADF
Cook, W. E.	Major	EADF
Orndorff, N. J.	Major	EADF
Taylor, G.	Major	ADOOT
Brownfield, P. W.	Major	ADHPG
Evans, G. W.	Major	ADHPG
McGettrick, J. V.	Major	ADHPG
Schoonvel, J.	Major	ADHPG
Tappin, F. D.	Capt.	ADPRT
Ward, G. M.	Civ.	ADPRT

3. Colonel Halley opened the conference by explaining the purpose which was twofold: One, to review a draft of the EADF phasing plan for SAGE, and two, to assist EADF in obtaining information which they do not have readily available. Colonel Teschner, Headquarters EADF, reviewed the EADF phasing plan. The salient points of the plan are:

[redacted]

[redacted] 363

a. No project office was created at Headquarters EADF. The Office of Programming was made the focal point for SAGE phasing within EADF Headquarters.

b. The plan was developed on a uniservice level. The problems of joint SAGE organizations were not considered at this time.

c. The plan was developed from the ADC Operational Plan for SAGE with the following assumptions:

(1) The EADF area would comprise three sectors and 13 subsectors.

(2) The 4620th Air Defense Wing (Experimental SAGE) will be responsible for the preparation of Standard Operating Procedures and these will be available on schedule.

(3) SAGE buildings and associated equipment will be completed on schedule.

(4) AN/FSQ-7 and AN/FSQ-8 computers will be produced on schedule.

(5) Communication facilities will be constructed by commercial telephone companies.

d. Phasing of the SAGE system into EADF will be accomplished by 16 major phases (3 sectors and 13 subsectors).

e. Assignment of specific duties to various sections of the staff will be accomplished by several annexes to the basic plan. These annexes have not been completed but will assign responsibility as follows:

(1) Operations - Responsible for reorganization, activation and deactivation of units, monitor communication requirements, operational training, program objectives and mission directives.

(2) Personnel - Responsible for personnel manning actions and individual training.

(3) Materiel - Responsible for monitoring construction, joint tenancy agreements, logistic support and preparation of a UAL.

[redacted] 363

(4) Comptroller - Responsible for monitoring funds and reports as required.

(5) Subordinate Units - Responsible for assisting in the above and preparing plans for their role in implementing the overall plan.

5. The consensus of the conferees was that the plan, as presented, was sound and only minor changes in wording were suggested.

6. After this review, Colonel Hornby explained the ADC approved organizational and function arrangement for SAGE units.

7. At this time, specific questions which EADF had were discussed. Most questions were answered by ADC personnel at the conference. The main question not resolved was the organizational assignment of SAGE Wings prior to the time that their SAGE Division Headquarters become operational. Headquarters EADF proposed the following plan:

a. Embryonic SAGE Wings and SAGE Air Division Detachments (activation to operational date) would be assigned directly to EADF.

b. SAGE Wings that become operational prior to their Combat Center would report organizationally and operationally directly to EADF.

c. When SAGE Air Division Combat Centers become operational, those SAGE Wings that are operational would be assigned organizationally and operationally to the Air Division Combat Center. Embryonic Wings will remain under EADF.

d. As SAGE subsectors become operational, manual air division areas of responsibility would be adjusted to exclude the SAGE subsector. This may also require minor adjustments of adjacent air division areas.

e. Manual air divisions would be discontinued as soon as possible after SAGE is operational in the area.

Discussion which followed this proposal indicated that Headquarters ADC agrees with this proposal. However, further coordination within the staff is required before final approval.

[redacted] 363

8. Other questions presented were:

a. Question: Can the 32nd Air Division be deactivated at the time the Syracuse Subsector becomes operational?

Answer: It would be better to maintain the 32nd Air Division until the Topsham Subsector becomes operational so that a SAGE Air Division would not be required to operate SAGE and Manual air defense facilities simultaneously. The 32nd Air Division could be reduced in personnel to minimize the number of people at Syracuse AFS during this period.

b. Question: What is the purpose of the 30 day period between operational date of a subsector and the reduction of personnel at a radar site?

Answer: Reorganization of radar squadrons can occur on operational date of the subsector. In every case where radar sites are converted from Manual system to the SAGE system, there will be a surplus of personnel at the radar sites after the operational date of the SAGE Direction Center. These people will be available for training courses in SAGE procedures or for transfer to other manual radar sites. A period of 30 days after operational date will be available as planning factor to determine final assignment of these surplus people.

c. Question: What is the meaning and purpose of the cadre that will report to the 4620th Air Defense Wing upon activation date of the SAGE Wing?

Answer: This cadre would be formed from personnel of the Deputy for Operations staff. These personnel would assist in the adaptation of the master computer program for their subsector and then aid in the installation test and checkout of the program at the Direction Center. This small group would be the hard core of operating personnel who are thoroughly familiar with the operating aspects of the subsector and would supervise the team training during the last 30 days prior to becoming operational.

d. Question: Will EADF receive assistance from other Defense Forces for the manning of SAGE units?

Answer: Yes, manning of SAGE units will be accomplished by obtaining personnel from all Air Defense Forces.

[redacted]

[redacted] 363

e. Question: What will be the status of the Ground Observer Corps during the implementation of SAGE?

Answer: GOC squadron reorganization will be phased to coincide with SAGE phasing. Studies are in progress at ADC to determine exact methods of accomplishing this phasing. Future programming documents will reflect these changes.

9. As a result of this conference Headquarters EADF will prepare a final Phasing Plan for SAGE and submit it to Headquarters ADC for approval.

[redacted]

[redacted]

HEADQUARTERS
AIR DEFENSE COMMAND
Ent Air Force Base
Colorado Springs, Colorado

OPERATIONAL PLAN

SEMIAUTOMATIC GROUND ENVIRONMENT SYSTEM

FOR

AIR DEFENSE

ANNEX III AND IV

1 December 1955

Prepared by: Air Defense Command, United States Air Force

With the assistance of:

Western Electric Company
Lincoln Laboratory, Massachusetts Institute of Technology
Bell Telephone Laboratories
International Business Machines Corporation

Annex III outlines methods by which simultaneous operation of the SAGE and Manual Air Defense Systems can be carried on with the greatest economy and least interference between the two systems.

Annex IV outlines the emergency capability and methods of realizing this capability in the air defense system after the SAGE system is operational.

[redacted]

[redacted]

364

ANNEX III

SIMULTANEOUS OPERATION

A. PURPOSE

This annex outlines the policies and methods by which simultaneous operation of the SAGE and Manual Air Defense Systems can be carried on with the greatest economy and with the greatest degree of compatibility between the two systems.

B. DEFINITIONS

1. Simultaneous operation is described as that period of time when the Manual system is operational and performing the air defense mission and the SAGE system is undergoing checkout and testing.

2. Simplex operation is the period of time when SAGE will operate without alternate routing for critical communications circuits.

3. Duplex operation is operation of SAGE utilizing all planned alternate circuits.

C. GENERAL

1. During the time of SAGE installation a period of approximately eight to ten months will exist when both the Manual and SAGE Air Defense Systems will be operating in a given subsector. The SAGE system will be undergoing testing and checkout of computer programming and at times will require the use of all facilities available to both systems.

[redacted]

[redacted]

٣٥٤

2. Careful examination must be made of each item of equipment and each facility in the air defense system to achieve the greatest possible economy, assure the least interference between systems and insure that operational readiness is not affected.

3. All agencies must be fully aware that the Manual Air Defense System is the facility responsible for the air defense mission during the period of simultaneous operation and that this system will have pre-emptory control over all available resources in accomplishing the mission.

4. In order to achieve operational compatibility and economy consideration must be given to each of the following facilities which are affected by simultaneous operation:

a. Radar Operation

(1) Search and gap filler equipment

(2) Height finding equipment

(3) IFF equipment

b. Ground/Air Communications

c. Landline Communications

D. RADAR OPERATION

1. Search and Gap-Filler Equipment.

a. Equipment currently planned will permit simultaneous operation of search equipment with no interference between the two systems.

[redacted]

[redacted]

b. No additional equipment is required for gap-filler operation since SDV is provided two outlets, one for Manual and one for SAGE.

c. Close coordination will be necessary between the two systems and operational control of radars must remain with the Manual system for the purpose of prescribing antenna tilt, repetition rate and other operational procedures.

2. Height Finding Equipment.

a. Presently planned equipment permits simultaneous operation of either or both height finders at a radar site by SAGE or by the Manual system.

b. One height finder at a site will remain assigned to the Manual system at all times except for short test periods necessary for SAGE.

3. IFF Equipment.

a. Normal Mark X beacon assist for ADC interceptor aircraft (Mode III) will be utilized in both the SAGE and Manual systems. In SAGE no provision is made for automatic interpretation of Mode II and emergency, therefore, these modes will require operator interpretation as in the Manual system.

b. Initial installation of SAGE equipment will have no provision for SIF operation. It is not planned to provide for both Mark X and SIF; however, SAGE equipment will be modified to operate with SIF or a subsequent system at such time as a system is available. Conversion to an improved IFF system

[redacted]

[redacted]

+34

must be on a nationwide basis to eliminate confusion to SAGE operation.

E. GROUND/AIR COMMUNICATIONS

1. Simultaneous communications will be provided for operation of the AN/GPA-37 system and test of the SAGE system as follows:

a. Data Link - Frequency Division at each Transmitter Site.

(1) One frequency will be required for the data link.

(2) Information from the SAGE computer will be fed over wire systems to the data link transmitter site. The information will be converted to a suitable form and placed on subcarriers one through 15 of the frequency division data link equipment. This information will be transmitted by the data link equipment independent of information from the AN/GPA-37 system.

(3) Information from the AN/GPA-23 computers in the AN/GPA-37 system will be placed on subcarriers 16 through 25 of the data link equipment. This information will be transmitted by the data link equipment independent of information from the SAGE system. The

[redacted]

[redacted]

364

capability of the GPA-37 system will remain the same during separate or simultaneous operation as the same number of sub-channels will be available for either type of operation.

b. Voice - Tactical

(1) SAGE will use two tactical frequencies on a full time basis. During certain periods of simultaneous operation it will be necessary for SAGE to use many or all available frequencies for communications and flight testing. The Manual system will retain pre-emptory control over all communications for active air defense during this testing.

(2) Eighteen tactical voice channels will be divided between the radar AN/GPA-37 stations in a subsector. The number of channels allocated to each radar station will depend upon the number of AN/GPA-23 consoles assigned.

c. Voice - Emergency. Two common channels will be retained and guarded by the Manual and SAGE systems. One channel will be the air intercept control common and the other for emergency use.

2. It is necessary for a new frequency allocation to be

[redacted]

[redacted]

made on a nationwide basis prior to the time the first SAGE subsector is activated. This is due to frequency compatibility requirements within sites, between sites, between SAGE subsectors and between SAGE subsectors and adjacent manual operational areas. Frequencies for data link will not be repeated within approximately 800 miles. A family of tactical voice frequencies will not be repeated in subsectors closer than approximately 400 miles.

3. Adequate frequency assignments, to allow simultaneous operation of the two systems, will be published a minimum of 90 days prior to activation of the first SAGE subsector.

F. LANDLINE COMMUNICATIONS

1. The essential objective to be considered for simultaneous operation of the two systems is to assure, where possible, that the number of circuits used during the simultaneous operation phase do not exceed the ultimate number of circuits required for final SAGE and Manual emergency operation.

2. To achieve this objective, it will be necessary to initially install SAGE circuitry on a simplex basis; the Manual system will utilize as a communications net the circuitry now installed which will ultimately be used for the SAGE duplex communications system.

a. Manual Landline System. The existing circuits in the Manual system will be retained until such time as the

[redacted]

[redacted]

364

SAGE system is tested, declared fully operational and assumes the task of air defense. This procedure will insure that a full air defense capability is retained in the Manual system during the simultaneous operation period.

b. SAGE Landline System. The simplex operation method will involve use of approximately one half of the circuitry ultimately destined for SAGE usage. During the simultaneous operation period these circuits will be used for testing, transition and operation of this system, but will not provide the designed operational reliability until such time as the Manual system is phased out and the SAGE system has available for duplex communications the former Manual communications net.

3. These procedures will permit full simultaneous operation, the Manual system will not be denied any of its present or planned communications, and the greatest possible economy will thus be realized in the conversion from the Manual to the SAGE Air Defense System.

[redacted]

[redacted]

364

ANNEX IV

EMERGENCY CAPABILITY

A. PURPOSE

This annex provides an outline and definition of the emergency capability of the SAGE system. It will be necessary to formulate emergency operating instructions for each specific sector and subsector based on this annex but dealing with local conditions of terrain, weapons deployment and ground environment facilities.

B. DEFINITIONS

1. The phrase "Emergency Capability" is construed to be operation of the air defense system on a reduced scale of efficiency.

2. An emergency is considered to exist upon the loss of one or more Direction Centers or upon the loss of one or more heavy radar facilities which provide input data to a Direction Center or when communications between any of these facilities are lost. The degree of emergency generated by the loss of radar or communication facilities will be directly related to the amount of coverage the loss will deny to the system.

C. FACTORS

1. The primary consideration in establishing a system for emergency operation is the high degree of reliability that has been incorporated in the SAGE equipment by the duplex arrangement of Direction Center and Combat Center computers and the duplex alignment of communications.

[redacted]

[redacted]

+JE

2. Other considerations are the geographical placement of Direction Centers away from major target areas, the capability of Direction Centers to absorb portions of the air defense mission of adjacent Direction Centers and the capability for action of the local weapons defenses around major targets should the normal air defense system be incapacitated.

3. Together with the above there is retained and developed a limited degree of capability for manual operation at the individual radar sites. A necessary limitation is imposed on the quality and quantity of manual operations by manning restrictions, budgetary considerations and availability of equipment and facilities.

D. GENERAL

1. Emergencies may arise due to bomb effects, local damage, sabotage or equipment failure. The following emergency conditions are outlined in detail below:

a. Loss of a single Direction Center.

b. Loss of two or more Direction Centers.

c. Loss of one or more radar facilities in a sub-sector.

d. Loss of communications.

2. Each of these conditions is examined as to its effect on the system, corrective actions required and resulting emergency capability.

[redacted]

[redacted]

364

E. CONDITIONS OF EMERGENCY

1. Loss of a Single Direction Center.

a. Loss of a single Direction Center will terminate all communications and control facilities through the parent Direction Center. However, two major factors will remain to compensate for this condition. The first being the overlap coverage of radar and radio facilities in adjacent subsectors at all except low altitudes. In this situation subsectors located in and adjacent to low priority areas and along the Canadian and Mexican borders will experience considerable degradation in effectiveness due to lack of overlap coverage and input data from contingent areas.

b. The second factor is the data line tie-in feature provided from radars in the disabled Direction Center subsector to adjacent Direction Centers which provide additional interior radar coverage, especially at lower altitudes. The geographical location of each subsector will have a bearing on this capability as noted above. Display coverage of the adjacent Direction Center will be expanded so that these centers can assume responsibility for the subsector of the disabled Direction Center.

c. To realize this capability, required computer programming and emergency boundaries must be planned in advance and input data to adjacent Direction Centers must be controlled so that displayed information will be compatible

[redacted]

[redacted]

-425

with the capacity of the AN/FSQ-7 computers.

d. Gap-filler, height data and ground/air radio facilities from within the disabled subsector will not be available to the adjacent Direction Centers.

e. Data from seaward extension facilities will be diverted to adjacent Direction Centers by provision of alternate circuits and equipment.

f. Existing and planned scramble and cross-tell circuits will be utilized by the adjacent Direction Center to scramble manned interceptors within the disabled subsector.

g. Data circuits will be provided from the adjacent Direction Centers to selected priority air defense weapons sites within the disabled subsector to provide acquisition, launch and control data for these weapons. TALOS and NIKE sites not equipped with data link circuits will be provided a cross-tell circuit to appropriate radar facilities to provide acquisition data for limited operation.

4.2. Loss of Two Adjacent Direction Centers.

a. The loss of two adjacent Direction Centers will create, on an expanded scale, the same loss to the system, remaining capability and requirements for corrective actions as those outlined for a single Direction Center.

b. Under this condition a proportionate greater degree of degradation will take place in SAGE control capability due to lack of low altitude radar and radio coverage

[redacted]

[redacted]

364

by adjacent subsectors and the resultant greater loss of weapons control within the disabled subsectors.

c. Certain radar sites not having data circuits within the disabled subsectors will have no SAGE collection and control agency to which data can be relayed and utilized. Upon direction of the Sector or Subsector Commander these sites will be required to revert to manual operation.

d. Operating instructions must specify the exact responsibilities and prerogatives to be assumed by radar sites during manual operations in order not to interfere with the overall air defense mission.

e. These radar sites will be provided with scramble and cross-tell circuits to selected interceptor bases and adjacent radar sites and will be capable of limited manual operation with the overall responsibility for air defense of the disabled subsectors remaining under SAGE control through adjacent Direction Centers.

3. Loss of One or More Radar Facilities within a Subsector.

a. Corrective action required would be dependent on the degree of degradation experienced; the loss of a single radar site might require no corrective action other than to rearrange the display of data from adjacent radar sites which overlap. However, if enough radar sites in a subsector were concurrently disabled so as to deny operational input data

[redacted]

[redacted]

and radio facilities to the parent Direction Center it will then be necessary to initiate the corrective action prescribed for the loss of a single Direction Center.

b. Under a condition of this type the adjacent Direction Centers, although responsible for the air defense of the subsector, would be wholly dependent on input data from radar sites within their own subsectors and would lack the facilities normally available from cross-tied radar sites outside of its own boundaries. The denial of these facilities will result in the loss of some low altitude radar and radio coverage.

4. Loss of Communications.

a. Communications loss involves essentially the same problems of system degradation as loss of radar facilities. Dependent on the degree of communications lost and considering the duplex alignment of facilities this condition can range from a situation where no effect is felt on the system to the point where complete loss of SAGE control is experienced at the parent Direction Center.

b. Necessary corrective action would range from minor switching of facilities to that prescribed for loss of a single Direction Center.

[redacted]