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Colin Hinson
In the village of Blunham, Bedfordshire.

COPY No 41

H.Q. Signals Command.

AIR STAFF
SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE
AIR SIGNAL REPORT

AOC
S.A.S.O
~~SOA~~
~~G(Ops) RNAF~~
C.I.M
~~T.M.S~~
RNA PLANS
OPS (return to S.A.S.O)

on operation

OVERLORD

FROM THE ASSAULT TO THE CESSATION OF HOSTILITIES

JUNE, 1945

SECRET

MOD Form 4A

MEMORANDUM

To	Officer IC Tech Library	From	Org 1	
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Subject AIR STAFF SHAEF AIR SIGNAL REPORT ON OPERATION OVERLORD

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Rank/Appointment S.qn. Ldr. Name in block letters J.A.L. GRAWSHAW Signature J.A.L. Graw

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A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

O N

O P E R A T I O N 'O V E R L O R D'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

C O N T E N T S

SECTION I	... ...	INTRODUCTION
SECTION II	... ...	COMMISSIONED OFFICERS - ESTABLISHMENTS/ T.O. AND PERSONNEL.
SECTION III	... ...	PLANS
SECTION IV	... ...	PROVISION OF COMMUNICATIONS FOR H.Q. A.E.A.F. AND LATER AIR STAFF S.H.A.E.F.
SECTION V	... ...	THE ALLOCATION OF FREQUENCIES FOR AIR SIGNALS USE.
SECTION VI	... ...	A.D.L.S.
SECTION VII	... ...	SIGNALS SECURITY
SECTION VIII	... ...	TELEPHONE AND TELEGRAPH TRAFFIC PROBLEMS.
SECTION IX	... ...	USE OF V.H.F. R/T DUPLEX (RACEHORSE) CIRCUITS.
SECTION X	... ...	USE OF AMERICAN FREQUENCY MODULATED V.H.F. COMMUNICATION EQUIPMENT.
SECTION XI	... ...	DEVELOPMENT AND USE OF NO. 1 M.R.C.U. USING ARMY TYPE 10 COMMUNICATION EQUIPMENT.
SECTION XII	... ...	PROVISION OF COMMUNICATIONS FOR AIR TRANSPORT SERVICES AND FLYING CONTROL ORGANISATIONS.
SECTION XIII	... ...	PROVISION OF COMMUNICATIONS FOR MOVEMENT LIAISON SERVICES.
SECTION XIV	... ...	FORMATION OF THE FIRST TACTICAL AIR FORCE.
SECTION XV	... ...	WORK OF THE S.H.A.E.F. MISSION - FRANCE
SECTION XVI	... ...	AIR FORMATION SIGNALS ORGANISATION

/SECTION XVII....

C O N T E N T S (CONT'D).

SECTION XVII	... ...	LONG DISTANCE CONTINENTAL LANDLINE COMMUNICATIONS
SECTION XVIII	... ...	CROSS CHANNEL COMMUNICATIONS
SECTION XIX	... ...	LANDLINES FOR GROUND BASED R.C.M. (80 WING)
SECTION XX	... ...	AIRBORNE RADAR
SECTION XXI	... ...	GROUND RADAR
SECTION XXII	... ...	R.C.M.
SECTION XXIII	... ...	R.N.A.
SECTION XXIV	... ...	LANDLINES FOR R.N.A.
SECTION XXV	... ...	I.F.F.

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

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FROM THE ASSUALT TO THE

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15-16. D of Tels
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30. Sigs 4.
31. M I 8

Other Authorities (British)

32. Hq. Bomber Command
33. Hq. Coastal Command
34. Hq. Fighter Command
35. Hq. Transport Command
36. Hq. 26 Group
37-38. Hq. 38 Group
39-40. Hq. 46 Group
41. Hq. 60 Group

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42. Hq. Royal Navy (Germany)
43. Hq. B. A. F . O. (Germany)
44. Hq. 85 Group
45-46. Hq. C.O.
47-48. Hq. RCAF (London)
49-51. Hq. RAAF Overseas
52-54. Hq. Med ME
55. DCD MAP
56. B J C B
57. R A F D E L, Washington, D.C.
58. C-in-C Pacific Ocean Area
59. C-in-C Mediterranean Area
60. C-in-C Eastern Fleet

Other Authorities US

61-65. CG, U S A F E, APO #633
66-68. CG, Ninth Air Force, APO #690
69. CG, USFET, APO #757
70-71. The General Board, APO #408
72-81. CG, USAAF, Washington, D.C.
82. Special Consultant, CGAAF (Dr. Bowles), Washington, D.C.
83. C C B, Washington, D.C.
84. U S J S B, Washington, D.C.
85-86. Director of Naval Communications, Washington, D.C.
87-88. Chief Signal Officer, ASF, Washington, D.C.
89-90. Army War College, Washington, D.C .
91-92. C & GS, Ft. Leavenworth, Kansas
93-94. AAF School of Applied T actics, Orlando, Florida
95-96. Signal Corps School, Ft. Monmouth, New Jersey
97-98. Signal Corps School, Camp Crowder, Missouri
99-100. Infantry School, Ft. Benning, Georgia
101-102. Field Artillery School, Ft. Sill, Oklahoma
103-104. Coast Artillery School, Ft. Monroe, Virginia.
105-106. Air Technical Command, Dayton, Ohio
107-108. Historical Officer, Air Staff, SHAEF

Other Authorities

109. A F Hq., North Africa
110. Supreme Commander, Southeast Asia Command

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

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O P E R A T I O N 'O V E R L O R D'

FROM THE ASSAULT TO THE CESSATION OF HOSTILITIES

S E C T I O N I

I N T R O D U C T I O N

The first part of the Air Signal Report of operations on the continent was issued under the title "Air Signals Report Operation NEPTUNE-Planning and Assault Phase", and covered the period from the commencement of the planning stage until the completion of the assault on the beaches. This second and final part completes the report covering the period from the end of the assault on the beaches through VE day to the cessation of combined command. The first part was issued in sections as and when material was available for each section. This second and final part is being issued complete.

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

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O P E R A T I O N 'O V E R L O R D

FROM THE ASSUALT TO THE

CESSATION OF HOSTILITIES

S E C T I O N II

COMMISSIONED OFFICERS - ESTABLISHMENTS/T.O. AND PERSONNEL.

1. The Allied Expeditionary Air Force Headquarters was originally responsible for the administration and operational control of the R.A.F. Forces allotted to it, and for the operational control of the Ninth (Tactical) U.S. Air Force. The integrated establishment/manning table of the Air Signals staff was set up on that basis with the number of British posts being about fifty percent greater than the number of American posts. At the assault stage the establishment/distribution was as follows:-

R.A.F. Component (British)

1	A/Cdre	Signals (S)
2	G/Capt	Signals (S)
1	G/Capt	Signals Radar (Air)
4	W/Cdr.	Signals (G)
1	W/Cdr.	Signals Security.
2	W/Cdr.	Signals Radar (Air)
1	W/Cdr.	Signals Radar (G)
6	S/Ldr.	Signals (G)
2	S/Ldr.	Signals Security.
1	S/Ldr.	Signals Radar (Air)
1	S/Ldr.	Signals Radar (G)
1	F/Lt.	Signals (G)
1	F/Lt.	Signals Radar (Air)
2	F/Lt.	Signals Radar (G)

Air Formation Signals. (British)

1	Brigadier (Chief Air Formation Signals Officer)
1	Lt. Col.
1	Major
2	Captains

U.S. Signal Component

1	Col.	Deputy
1	Col.	Executive
1	Lt. Col.	Plans
1	Lt. Col.	Telecommunications
1	Major	" "
1	Captain	" "
1	Lt.	" "
1	Lt. Col.	Supply
1	Major	"
1	Captain	A.D.L.S.
1	Lt. Col.	Landlines

1	Major	Landlines
1	Lt.	" "
1	Lt. Col.	Radar
2	Majors	"
1	Lt.	"
2	Majors	Security
1	Capt.	"
1	Lt.	"
1	Major	Admin
1	Lt.	"

2. After planning had ceased, and when 2nd T.A.F. had become administratively responsible to the Air Ministry, A.E.A.F. being only responsible for operations and for the administrative policy for the R.A.F. Force, the amount of work decreased and reductions in the strength were made. However, with the majority of the Air Forces on the continent, a small signals staff had to be set up for general co-ordinati there until the main Headquarters moved across the channel. It was decided to attach this small staff to Advanced A.E.A.F. and to make it responsible for the general co-ordination of air signals within the theatre. The staff of this headquarters was not established separately but was taken out of the establishment/manning table of the Main Headquarters. The signals posts for Advanced A.E.A.F. were as follows:-

1	Group Captain Signals	(filled)
1	Lt. Col. U.S. Signals	"
1	S/Ldr. Signals	"
1	Lt. U.S. Signals Administrative	"

3. In September 1944, the majority of A.E.A.F. moved over to the continent and joined Advanced A.E.A.F. at Versailles. The staff of Advanced A.E.A.F. were then absorbed back into A.E.A.F. On 15th October 1944, A.E.A.F. was dissolved as a headquarters and absorbed into SHAEF a named Air Staff, SHAEF. Air Staff SHAEF was responsible for the general policy and co-ordination of the Air Forces allotted to the Supreme Commander. An Air Staff SHAEF (Rear) was set up in the United Kingdom and took on the responsibilities of Air Staff SHAEF there. The establis ment for the new conditions is given below. The Table of Distribution for U.S. officers was amended to provide eleven officers in the Air Signal Division.

R.A.F. Component (British)

1	A/Cdre	Signals (S)
1	G/Capt	Signals (S)
1	G/Capt	Signals Radar
2	W/Cdr	Signals (S)
1	W/Cdr	Signals Radar (Air)
1	W/Cdr	Signals Radar (G)
1	S/Ldr	Signals (G)
2	S/Ldr	Admin.G.
2	F/Lt	Signals (G)
1	F/Lt	Signals Radar (G)

Air Formation Signals. (British)

1	Brigadier	(Chief Air Formation Signals Officer)
1	Lt. Col.	
1	Major	
2	Captains	

U.S. Signal Component

1	Col.	Deputy
1	Lt. Col.	Plans
2	Lt. Cols.	Radar
1	Lt. Col.	RCM
1	Capt.	A.D.L.S.
1	Capt.	Admin.

4. Minor changes in establishment were made from time to time. The next change of importance, however, did not take place until January 1945, when it was agreed that too much detailed work was being done in R.A.F. Radar at Air Staff SHAEF, which, in accordance with directives, should rightly be done at 2nd T.A.F. The Group Captain Radar Post at Air Staff SHAEF was therefore transferred to 2nd T.A.F. The amount of Radar co-ordination work decreased still further and yet another radar pos was left unfilled in April 1945. The establishment at the end of hostilities was as given below. The increase of two U.S. officers had been effected in order to permit the co-ordination of all Air Force and cross channel and landline requirements on the continent.

R.A.F. Component. (British)

1	A/Cdre	Signals (S)
1	G/Capt.	Signals (S)
2	W/Cdr	Signals (S)
1	W/Cdr	Signals Radar (G)
1	S/Ldr	Signals (G)
1	S/Ldr	Signals Radar (G)
2	S/Ldr	Admin (G)
2	F/Lt	Signals (G)

Air Formation Signals. (British)

1	Brigadier	(Chief Air Formation Signals Officers)
1	Lt. Col.	
1	Major	
2	Captains	

U.S. Signal Component.

1	Col.	Deputy
1	Lt. Col.	Telecommunications
1	Capt.	" "
1	Lt. Col.	Plans
2	Lt. Cols.	Radar
1	Lt. Col.	RCM
1	Capt.	A.D.L.S.
1	Lt. Col.	Security
1	Capt.	Admin.
1	Lt. Col.	Landlines
1	Major	" "
1	Capt.	" "

5. The names of the personnel filling the posts at the various phases are given at Appendices 'A', 'B' and 'C'.

6. The main lessons learnt from the establishments side were as follows:-

(a) The U.S. system of providing a bulk allotment of personnel for the headquarters allowed adequate leeway to adjust position vacancies to meet requirements with a minimum of delay. The weakness in th system was in the matter of obtaining qualified personnel to fill the vacancies in the case of Signal Staff officers. Particularly in a high level headquarters, specialists are required in many positions. These positions cannot be filled by officers who have not specialised in the particular line of Signal activity that is involved. Delays were experienced both in obtaining officers who were already available in the Theater and, in obtaining officers who were only available from the States. Approximately two months were required to obtain officers available in the theater. In the case of officers furnished from the U.S., almost five months elapsed between the placing of the requisition and the arrival of these officers. Although word had been received within the theater as to the designation of the ship and the arrival date, these officers became entangled in a shipment of offic rs to a Ground Force organization and spent about a month within the forward areas of the theater passing along from one Ground Force headquarters to another before being located and

re-routed to the assignment for which they were intended. It is necessary that arrangements be made to locate quickly senior technical officers, to permit their rapid assignment where needed and to provide for their prompt delivery. While the personnel replacement system may operate in a highly satisfactory manner for the bulk of the personnel involved, it does not, at present, properly take care of some of the more critical classifications of personnel.

(b) The R.A.F. system of changing establishments worked well, and, generally speaking, it was always possible to get the establishment made and the post filled in time to meet new commitments. The Establishments Committee were always most helpful in approving changes which were inevitable when the headquarters, for example, split into three instead of the one for which it was originally established.

SECRET

SECTION II

APPENDIX 'A'

BRITISH ELEMENT SIGNAL STAFF (R.A.F.)

NAME	POST	DATE EFFECTIVE	DEPARTURE
A/Cdr. R.G. Hart	A.S.O.-in-C.	15 Nov 1943	
	C.A.S.O.	15 Oct 1944	VE
G/Capt. H. Watson	Head of Exec. Staff	15 Nov 1943	
	CSO AEAF Adv.	Aug 1944	
	D/C.A.S.O. 2.	15 Oct 1944	VE
G/Capt. D.R. Evans	Head of Plans	15 Nov 1943	Apr 1944
G/Capt. E.G. Stokes	G/Capt. Radar	15 Nov 1943	Dec 1943
G/Capt. R.L. Phillips	G/Capt. Radar	Feb 1944	Mar 1944
G/Capt. S. Lugg	G/Capt. Radar	Mar 1944	31 Jan 1945
G/Capt. M. Hendrick	G/Capt. Sigs.	Aug 1944	Oct 1944
W/Cdr. G. Keighley	Radar Plans	15 Nov 1943	16 Jan 1945
W/Cdr. A.G.P. Brightmore	Signals Plans	15 Nov 1943	VE
W/Cdr. W.B.S. Simpson	R.C.M.	15 Nov 1943	21 Nov 1944
W/Cdr. E.F. Drew	Radar I (Ground)	23 Dec 1943	Nov 1944
W/Cdr. H.R. Crowley	Radar II (Airborne)	15 Nov 1943	7 May 1945
W/Cdr. R.V. Fiddick	Signals I	15 Nov 1943	28 Aug 1944
W/Cdr. S. Conway	Signals II	15 Nov 1943	10 Oct 1944
W/Cdr. W.H. Garnett	Signals III	15 Nov 1943	
	Signals I	28 Aug 1944	VE
W/Cdr. M. McGougan	Signals Security	15 Nov 1943	Sep 1944
W/Cdr. C.I. Orr-Ewing	W/Cdr. Radar	Nov 1944	VE
W/Cdr. A. Pither	W/Cdr. Radar	Nov 1943	Jan 1944
S/Ldr. H. Tibbenham	Radar 1A (Ground)	15 Nov 1943	Sep 1944
S/Ldr. S.W.P. Henton	Radar 1B (Ground)	23 May 1944	16 Oct 1944
S/Ldr. F. Lilly	Radar 1B (Ground)	May 1944	VE
S/Ldr. A. Smith	Radar 11A (Airborne)	15 Nov 1943	16 Oct 1944
S/Ldr. K.A. Rowland	Signals 1.A.	Mar 1944	
	Sigs.1.(AEAF Adv.)	Aug 1944	9 Dec 1944
S/Ldr. W.G. Summers	Signals 2A	Mar 1944	
	S/Ldr. Sigs. (Rear)	9 Dec 1944	VE
S/Ldr. R.F.S. Patchin	Signals A.D.L.S.	Apr 1944	VE

/S/Ldr. D.J. Farquharson

SECRET

SECTION II

APPENDIX 'A'

NAME	POST	DATE EFFECTIVE	DEPARTURE
S/Ldr. D.J. Farquharson	Signals Security	Dec 1943	29 Apr 1945
S/Ldr. G.A. Davidson	Signals Security		
S/Ldr. S.E. Ellis	Signals Security	29 Apr 1945	VE
S/Ldr. C.E.G. Tomkins	Signals 1.A.	23 Oct 1944	VE
F/Lt. C.E. Brooks	Signals IV.B. Signals 1.B.	15 Nov 1943	 VE
F/Lt. A.F. Dye	Signals Security	30 Oct 1944	VE
F/Lt. S.J. Busby	Signals Security	25 Nov 1944	VE
F/Lt. W. Tansley	Signals III.B. Signals I.C.	May 1944 9 Nov 1944	 VE
F/Lt. C.C. McKinnon	Radar II.B.(Airborne)	Jan 1944	18 Oct 1944
F/Lt. B.A. Pettit	Signals 1.B.	Mar 1944	Oct 1944

APPENDIX 'B' to
SECTION II

C.A.F.S.O. BRITISH ELEMENT - HEADQUARTERS A.E.A.F.

Name.	Post.	Date Effective.	Departure.
Brig.J.H.Cameron Webb	CAFSO	15 Nov 1943	15 Oct 1944
Lt.Col.G.K.Hall	AFS 1	23 Nov 1943	15 Oct 1944
Maj.W.P.Chalmers	AFS 4	23 Dec 1943	15 Oct 1944
Capt.H.McBryde	AFS 8	11 Jan 1944	15 Oct 1944
Capt.R.Preston	AFS 6	23 Nov 1943	1 Jan 1944
Capt.L.F.Rixson	AFS 6	16 Apr 1944	15 Oct 1944

C.A.F.S.O. BRITISH ELEMENT - AIR STAFF SHAEF.

Brig.J.H.Cameron Webb	CAFSO	16 Oct 1944	1 Jul 1945
Lt.Col.G.K.Hall	AFS 1	16 Oct 1944	15 Jul 1945
Maj.W.P.Chalmers	AFS 4	16 Oct 1944	15 Jul 1945
Capt.H.McBryde	AFS 8	16 Oct 1944	15 Jul 1945
Capt.L.F.Rixson	AFS 6	16 Oct 1944	14 Dec 1944
Capt.L.V.Virgin	AFS 6	24 Dec 1944	15 Jul 1945

U.S. ELEMENT SIGNAL STAFF - HEADQUARTERS A.E.A.F.

	Assignment	Departure
Deputy Air Signal Officer In Chief		
Gen.A.W.Marriner	15 Nov 1943	18 Apr 1944
Col.B.Stern	18 Apr 1944	15 Oct 1944
Executive		
Col.C.J.King,Jr.	3 Dec 1943	15 Oct 1944
Plans		
Lt.Col.M.S.Orr	15 Nov 1943	14 Jul 1944
Lt.Col.R.V.Fite	24 Jan 1944	15 Oct 1944
Telecommunications		
Lt.Col.G.A.Price	20 Jun 1944	15 Oct 1944
Lt.Col.R.V.Fite	5 Dec 1943	24 Jan 1944
Major L.R.Jameson	7 Jun 1944	15 Oct 1944
Capt.M.E.Williams	24 Jan 1944	15 Oct 1944
Lt.C.W.Kirsch	16 Dec 1943	15 Jul 1944
Supply		
Lt.Col.M.A.Ramsey	15 Nov 1943	15 Oct 1944
Maj.E.W.McCall	20 Mar 1944	14 Jun 1944
Security		
Maj.E.P.Langbehn	5 Dec 1944	17 Aug 1944
Maj.L.M.Schoen	12 Jun 1944	10 Oct 1944
Capt.E.T.Gardiner	13 Apr 1944	27 Apr 1944
Capt.C.L.Rice,Jr.	1 May 1944	15 Oct 1944
Lt.J.A.Burritt	1 Apr 1944	17 Aug 1944
ADLS		
Capt.E.Davis	15 Dec 1944	14 Apr 1944
Capt.J.D.Stevenson	1 Sep 1944	15 Oct 1944
Radar		
Lt.Col.H.J.Crumly	22 Apr 1944	15 Oct 1944
Lt.Col.R.M.Osgood,Sr.	18 Nov 1943	15 Oct 1944
Maj.R.B.Johnston	3 Jun 1944	15 Oct 1944
Lt.E.Austern	21 Dec 1943	5 Jul 1944
Lt.S.H.Secleman	4 Feb 1944	9 May 1944
Administration		
Maj.C.L.Powell	15 Dec 1943	15 Oct 1944
Capt.D.Frank	18 Nov 1943	15 Oct 1944
Landlines, (CAFSO)		
Lt.Col.J.T.Quinn	10 Dec 1943	10 Jun 1944
Lt.Col.G.A.Price	20 Jun 1944	15 Oct 1944
Lt.Col.J.Crawford	27 Jan 1944	15 Oct 1944
Capt.C.L.Rice,Jr.	29 Nov 1943	30 Apr 1944
Capt.E.F.Weiss	16 Dec 1943	15 Oct 1944
Lt.H.E.Erickson	16 Dec 1943	26 Jan 1944

/over....

U.S. ELEMENT SIGNAL STAFF .. AIR STAFF SHAPE

	Assignment	Departure
Deputy Chief Air Signal Officer		
Col.C.J.King,Jr.	16 Oct 1944	VE
Telecommunications		
Lt.Col.W.H.West,Jr.	24 Jan 1945	VE
Capt.J.A.Kehoorn	12 Jan 1945	15 Apr 1945
Capt.F.W.Rhine	10 Nov 1944	VE
Plans		
Lt.Col.R.V.Fite	16 Oct 1944	VE
Radar		
Lt.Col.H.J.Crumly	16 Oct 1944	VE
Lt.Col.R.M.Osgood, Sr.	16 Oct 1944	VE
RCM		
Lt.Col.L.E.Tait	16 Oct 1944	VE
ADLS		
Capt.J.D.Stevenson	16 Oct 1944	VE
Security		
Lt.Col.G.Boller	30 Jan 1945	VE
Administration		
Capt.D.Frank	16 Oct 1944	VE
Landlines, (CAFSO)		
Lt.Col.R.Rouse	21 Apr 1945	VE
Maj.D.V.Flynn	21 Apr 1945	VE
Capt.E.F.Weiss	16 Oct 1944	VE

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION III

PLANS

1. The general Overall Air Plan for the liberation of German occupied North West Europe and the final conquest of Germany, under the code name of Operation 'OVERLORD'/'NEPTUNE' contained a Signals Outline Plan which covered the pre-invasion requirements of the Air Forces and their subsequent requirements up to approximately D plus 300, based on the Supreme Headquarters Allied Expeditionary Force Overall Plan for the Operation.

2. The Second Tactical Air Force and the Ninth Air Force, which were originally under the command and operational control, respectively, of the C-in-C Allied Expeditionary Air Force, produced their detailed plans based on the signals Policies, Plans and Organisation specified in the A.E.A.F. Signals Outline Plan.

3. No fundamental changes in the original A.E.A.F. Plan were necessary until the disbandment of the Allied Expeditionary Air Force and the absorption of the Air Signals Staff of that organisation into Air Staff, Supreme Headquarters Allied Expeditionary Force. Such alterations as then became necessary were made in the form of Signals Staff Instructions in order to clarify the system of Command and Control under the new organisation. Certain additional alterations became necessary on the formation of the First Tactical Air Force (Provisional) so that the policies covering 2nd T.A.F. and Ninth U.S.A.A.F. could be extended to include the First Tactical Air Force (Provisional).

4. As Operation 'OVERLORD'/'NEPTUNE' progressed it was necessary to re-write the Plan for Operation 'TALISMAN', under the new code name of 'ECLIPSE'. This Operation was planned as a military continuation of 'OVERLORD' and had for its objects, to conduct within the sphere of responsibility of the Supreme Commander A.E.F.:-

(a) The primary dis-armament and control of the German Forces, including para-military and Police Formations, thereby preventing a renewal of hostilities.

(b) The enforcement of the terms of surrender or (in the event of there being no formal surrender) the will of the Supreme Commander during the period of his responsibility, by the maintenance of strategic and tactical air threat and by the occupation of strategic areas on the Continent.

(c) The establishment of law and order, as far as the military situation permits.

/(d)

(d) The initiation of steps to complete the control and disarmament of the German Forces.

(e) The re-distribution of Allied Forces into their respective National Zones in Germany.

5. The 'ECLIPSE' Overall Plan contained a Combined Signal Plan, produced by Signal Division, Supreme Headquarters, A.E.F.; all the Air Signals aspects of this being co-ordinated with Air Signals Plans, Air Staff S.H.A.E.F. In addition to the Plan, a number of memoranda were produced from time to time, several of which had important telecommunications aspects. Notable among these were the following:-

Memorandum No.1. - Instrument of Surrender: Supreme Commander's Orders to the German High Command to supplement the Instrument.

Memorandum No.4. - Air Lift Plan.

Memorandum No.6. - Signals Communications and Radar.

Memorandum No.8. - Care and Evacuation of Prisoners of War.

Memorandum No.9. - Primary Disarmament and Disposal.

Memorandum No.10 - Primary Disarmament of German Air Forces opposing us and short-term disposal of Enemy War Material.

Memorandum No.15 - Psychological Warfare.

Memorandum No.16 - Public Relations - Considerations and Plan.

6. In order to amplify the Air aspects of Operation 'ECLIPSE' contained in the Supreme Headquarters A.E.F. 'ECLIPSE' Appreciation and Outline Plan, an Outline Air Plan was produced, which included as an Appendix an Outline Air Signal Plan, the object of the latter being to define the Signals policies to be followed under the special circumstances of Operation 'ECLIPSE' where they differed from those policies in force for Operation 'OVERLORD'/'NEPTUNE'.

7. Concurrently with the production of the 'ECLIPSE' Plan and Memoranda, planning was progressing with the various aspects of Air Disarmament, Ministerial Control, the Missions to liberated countries, the S.H.A.E.F. Special Mission, the Planning Directive to the Commander Berlin District and the Planning Directive to the Air Commander Berlin District and for Operation 'GOLDCUP'.

8. The necessity for the proper co-ordination of these Plans soon became obvious, since, although the Plan for 'ECLIPSE' should have formed the basis for most other planning requirements for the Post-surrender period, the plan itself was apt to change almost daily due to the speed at which events were progressing in the final stages of 'OVERLORD'/'NEPTUNE'; and the fact that the 'ECLIPSE' period overlapped 'OVERLORD' even more than had been anticipated. In order, therefore, to achieve some measure of co-ordination, a Board, responsible to the Combined Signal Board, was formed, under the name of the "Occupation of Germany, Signals Planning Board." This Board, being of a combined nature, was responsible for the co-ordination of all Signals Planning for Allied occupational purposes in Germany and was to refer cases of over-lapping in planning and any matters which could not be cleared and were holding up the Planners - such as Command and Control, which always has such a direct bearing on all Signals Plans - to the Combined Signals Board. In point of

fact, this Board was appointed rather too late, and the swiftly moving events, as ever, made it essential for Planners to rely upon personal contact with their opposite numbers in other Branches in order to keep themselves accurately informed of current policy in the maelstrom of rumours, fact and fiction, which would appear to be the inevitable accompaniment of the final stages of a major European War.

9. The Occupation of Germany Signals Planning Board was a step in the right direction, but, since we may now be permitted to be wise after the event, an important lesson has been learned - but has yet to be appreciated no doubt - that some central source of current up-to-the-minute information should be available to all bona fide Planners and that such an organisation is of sufficient importance as to warrant the establishment, in a Headquarters of the size of S.H.A.E.F., of a special Planning War Room in which the current trend of policy, up to the highest levels, could be kept up to date. This information would enable planners in all Branches to see ahead more clearly, and thereby reduce the amount of crystal gazing to which they have become so accustomed; although inevitable hitherto, but as often as not, incorrect. Such an organisation should hold copies of all drafts and final plans and their amendments, and would provide at least one certain source of accurate filed information and reference. A meeting, at Head Planners level, to include Planners from all Branches, held at not less than weekly intervals, would do much to clear the way to co-ordinated thought on problems where several branches of the Headquarters were producing Plans, Appreciations or Comments upon matters of mutual concern.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION IV

PROVISION OF COMMUNICATIONS FOR HEADQUARTERS A.E.A.F. AND LATER AIR STAFF SHAEF

S.H.A.E.F. (RAF) SIGNALS UNITS AND 18 A.F.S.

1. Speech, teleprinter and W/T communications for Headquarters A.E.A.F. and later Air Staff S.H.A.E.F. were provided by the S.H.A.E.F. (RAF) Signals Unit, backed initially by the 365 (U.S.) Signal Company and by No. 18 Air Formation Signals Unit. No. 18 Air Formation Signals Unit provided landline equipment and personnel to man the teleprinter room and the Air Operations switchboard and also provided D.R.L.S. The 385th Signal Co. (Avn) furnished the personnel and equipment for the American portion of the radio system, teleprinter system, traffic office and D.R.L.S. and for the American cryptographic installation of the Headquarters. The S.H.A.E.F. (RAF) Signals Units, which consisted initially of two high speed medium power and sixteen hand speed low power W/T terminals, provided personnel to man the W/T channels, cypher personnel and traffic officer personnel. The combination of these three units enabled communications for the Headquarters to be maintained always in the most expeditious manner. In the very early days of the move to the Continent the W/T channels were carrying the bulk of the traffic. This was particularly so during the advance through France during August, 1944. When, however, the situation became more static and landline teleprinter circuits became more plentiful, as much traffic as possible was carried on the teleprinter circuits, leaving the W/T channels to act as a standby in the case of failure of the teleprinter circuits. The standby W/T channels were maintained on a continuous watch at all times, but only traffic which could be cleared as expeditiously over W/T as by teleprinter was passed on them. This traffic consisted of messages encyphered, either as a result of originators' instructions or because a previous or subsequent link required that the message be encyphered.

2. The S.H.A.E.F. (RAF) Signals Units (or A.E.A.F. Signals Unit as it was then called) moved from the U.K. in several parties, to provide communications for the various echelons of A.E.A.F. which moved to the continent in separate phases. The first component comprised 2 hand speed channels which provided communications for an A.E.A.F. Command Post which was the Air C-in-C's Command Post with the C-in-C 21 Army Group's Tactical Headquarters. The second component comprised four hand speed W/T channels to provide communications for Advanced A.E.A.F. H.Q. which was concerned mainly with the co-ordination of the bombing effort. The third component comprised two hand speed W/T channels and served what was known as Group Captain Sugden's Party, which was a small administrative advanced party concerned with the preparation of accommodation for A.E.A.F. Main at Granville. The fourth component comprised four hand speed W/T

/channels

channels which augmented the A.E.A.F. Command Post and provided communications to the Tactical Air Forces under A.E.A.F. The fifth component comprised the remaining four hand speed W/T channels and the two high speed channels and this moved direct to Versailles where all the other components finally congregated to provide communications for the whole of A.E.A.F. With all these parties went a detachment of 18 Air Formation Signals to provide landline communications.

3. Personnel from the 385th Signal Company (Avn) went with each echelon of Headquarters A.E.A.F. moving from the U.K. The first detachment which went to H.Q. Advanced A.E.A.F., was very small and composed mainly of motor transport and drivers in the nature of a reconnaissance party. It was soon joined by a second component which included a radio unit and a cryptographic team from the 385th Signal Company (Avn). The third component to go to the Continent was a cryptographic team for the A.E.A.F. Command Post at Joullouville, all the signal facilities for which were furnished by the British Units. The remainder of the company moved to the continent about the 14th September, 1944, and by the 20th of the month the Company was reassembled at Versailles. The 385th Signal Company (Avn) continued to operate in conjunction with the two British units providing communications for A.E.A.F. and later Air Staff S.H.A.E.F. until 22nd October, 1944. At this time the Company left for Vittel, France to provide communications for the First Tactical Air Force (Prov). A small detachment of eight enlisted women and one officer remained with Air Staff S.H.A.E.F. to operate the American code and cypher installation.

4. The first component of the A.E.A.F. M.S.U. landed on the Continent on the 3rd August, 1944 and the whole unit was finally reassembled at Versailles on 9th September, 1944. The Unit remained intact at Versailles whilst A.E.A.F. Headquarters gave place to Air Staff S.H.A.E.F. and until S.H.A.E.F. Headquarters was divided into a Main and Forward echelon. The unit was then split, five hand speed W/T channels remaining at Versailles to serve the Main Headquarters, and ten hand speed channels and the high speed channel moving to Reims on the 20th February, 1945 to provide communications for Air Staff S.H.A.E.F. Forward. On the 26th May, 1945 Air Staff S.H.A.E.F. Forward moved from Reims to Frankfurt and the portion of the unit serving the Forward echelon moved with it to maintain communications.

5. On the 15th June, 1945 the Air Staff Personnel at SHAEF Main at Versailles were so reduced in number that it was no longer necessary to retain a separate Signal Centre and the Signal Centre closed down. On the termination of Combined Command SHAEF (RAF) Signals Unit became available for disposal and was handed over to 2nd T.A.F. for disposal. Straight line diagrams showing the W/T, Teleprinter and Speech communications provided at the various stages and for the various echelons of the Headquarters served by the R.A.F. and Air Formation Signals Units are included at the end of this Section. Appendix 'A'.

PROVISION OF OPERATIONS AND ADMINISTRATIVE TELEPHONES

6. It was decided in the very early stages of the move of the Headquarters to the Continent that separate speech communication facilities along the lines of the operational switchboards in the U.K. and in other theatres would be necessary to serve senior Air Force officers, Operations Rooms, and those officers directly concerned in day-to-day Operations and Flying Control. Headquarters A.E.A.F. and later Air Staff S.H.A.E.F. was always located alongside the appropriate echelon of Supreme Headquarters, A.E.F., therefore, the responsibility for the

/provision

provision of normal administrative telephone facilities for A.E.A.F. and Air Staff S.H.A.E.F. was assumed by the C.S.O. S.H.A.E.F. In the main, this administrative service was provided on a private automatic branch exchange basis. The only local telephone facilities that 18 Air Formation Signals had to provide were, therefore, the operational ones and this was done by using two 40 line F-F boards and Field Telephones. A list of extensions from this board, and their designations, is included at the end of this Section. Appendix 'B'. The principle of the provision of a special operations switchboard for Air Staff use was proved to be very necessary and the Air Ops. switchboards at the various echelons of the Headquarters provided a very satisfactory telephone service, which at all times met the strict requirements of Air Force control.

AIR STAFF S.H.A.E.F. SIGNAL CENTRE.

7. The Signal Centre handling signal messages, besides dealing with the facilities required by the Headquarters Staff, was used to a considerable extent as a 'clearing house' for traffic between British and American Units, and the amount of 'through' traffic dealt with by the Signal Centre was normally in excess of the total of 'in' and 'out' traffic. Representative traffic figures are included in the chapter on traffic problems.

8. An A.G. message registry was established in order to maintain a complete and accurate log of all incoming Air Staff S.H.A.E.F. traffic. The proper distribution and allocation of action and information copies was the responsibility of this Section.

SIGNAL FACILITIES DURING MOVES OF HEADQUARTERS TO NEW LOCATIONS

9. Both the R.A.F. Signals Unit and 18 Air Formation Signals Unit were large enough to enable the various moves of the Headquarters to be undertaken without any disruption in communication facilities. On the landlines side, sufficient equipment was available to instal a Signal Centre at the new site prior to the move of the Headquarters so that all that was required during the move was for the landline circuits serving the Headquarters to be switched from the old to the new location. In the case of W/T communications, arrangements were made for the new location to open watch on the W/T channels serving the old location a few hours prior to the move, and for the old location to close down when all traffic at the old location had been cleared. An example of a signal order for a move is attached at the end of this Section at Appendix 'C'.

ACCOMMODATION FOR SIGNAL CENTRE

10. One of the major problems in providing satisfactory communications during the various moves of the Headquarters, was the difficulty of obtaining accommodation satisfactory for laying out a well organised Signal Centre. This problem was so acute at Versailles that it was decided that huts should be built to hold the traffic office and message registry, around which were located W/T receiving vehicles, teleprinter room vehicles and cypher vehicles. On the move to Reims, firm demands were submitted to the Headquarters Commandant for adequate signal office accommodation, and the Air Signal Division found itself competing with an organisation running a snack bar, for the only accommodation at all suitable as a Signal Centre. Accommodation was finally allotted for use as an Air Staff Signal Centre, and, with the addition of two huts nearby for cypher and other offices, it was

/possible

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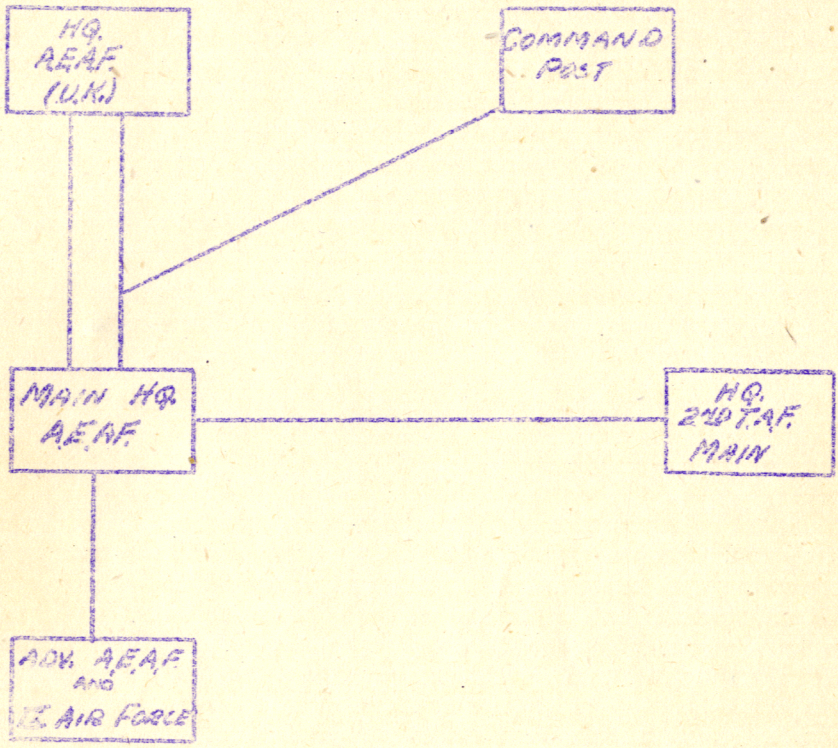
/possible

possible to set up a Signal Centre which approximated to the ideal layout of a traffic office in the centre with the teleprinter room, W/T receiving room and cypher officer on three sides of it. The Signal Centre established in the basement of the Headquarters building at Frankfurt also approximated to the ideal lay-out but, due to the size and shape of the building, the distances involved were somewhat greater than was desirable. The work undertaken by the Utilities Section of the Headquarters Command, once the desired accommodation had been allotted, was satisfactory and quick and the installation at Frankfurt was one of the most satisfactory Signal Centres set up for Air Staff S.H.A.E.F. so far as accommodation was concerned. Photographs of the Signal Centre at Frankfurt are included at the end of this Section, Appendix 'D'

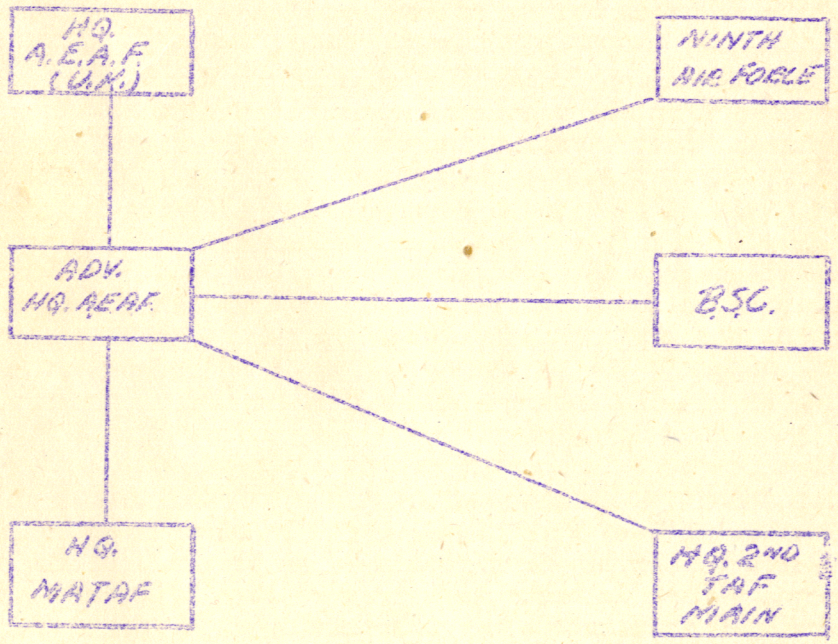
11. During the existence of Headquarters A.E.A.F. it was necessary for that Headquarters to retain its own Signal Centre, despite the fact that it was always likely to be located alongside Supreme Headquarters, A.E.F. On the conversion of Headquarters A.E.A.F. to Air Staff S.H.A.E.F. the question of closing the Air Force Signal Centre and relying on the S.H.A.E.F.Signal Centre for Air communications was proposed by S.H.A.E.F. Secretary to the General Staff. After the matter had been studied, it was decided by the Deputy Supreme Commander that so long as Air Operations in the theatre continued, it was essential for Air Staff S.H.A.E.F. to retain its own Signal Centre, in order that the special requirements in the handling of Air signal traffic could be met and to ensure that the responsibility for meeting this requirement was retained in the hands of Air Force personnel. This decision applied particularly to the Air Operations telephone switchboard. During March and April, 1945, when Air Staff S.H.A.E.F. Forward was located with S.H.A.E.F. Forward at Reims, the question of amalgamating the two Signal Centres again arose. SHAEF Forward Signal Centre was augmented by an organisation known as the Staff Message Control which co-ordinated the processing and distribution of incoming and outgoing signals. It was suggested that all S.H.A.E.F. Signal traffic, including Air Staff traffic, should be handled through this Staff Message Control, and in order that this might be effected, amalgamation of the two Signal Centres was proposed. The decision to retain separate Air Staff communications until active air operations in the theatre had ceased was confirmed, and the possibility of making use of the excellent facilities afforded by the Staff Message Control in the internal handling of signal messages, whilst at the same time retaining separate Signal Centres and communication links, was investigated. It was found that such a proposal was impracticable, due in the main to difficulties of divided responsibility, and it was proposed that any improvement in the internal handling of Air Staff signal messages should be effected by the setting up of an Air Staff organisation similar to the Staff Message Control. The distribution of signals had always been in the hands of a Message Registry run by the Air Staff Adjutant General, and proposals for effecting the desired improvement in the internal handling of signals messages centred round the expansion and re-organisation of the Message Registry. However, before this could be effected, active air operations in the theatre ceased on VE-Day, and immediate consideration was given to the possible complete amalgation of the two Signal Centres. Plans were drawn up for this amalgamation on the basis of a reduced number of Air circuits being provided to the S.H.A.E.F. Forward Signal Centre in order that they could handle Air Staff traffic. The reduction in circuits was possible in view of the greater facilities of the S.H.A.E.F. Forward Signal Centre from a point of view of alternative routing and W/T standby. However, due to the anticipated early termination of the Combined Command at S.H.A.E.F. (30th June) it was decided that the re-organisation required by the proposed amalgamation would not be worth while for such a short period.

MAIN HQ. A.E.A.F. JOULOUVILLE W/T LINKS

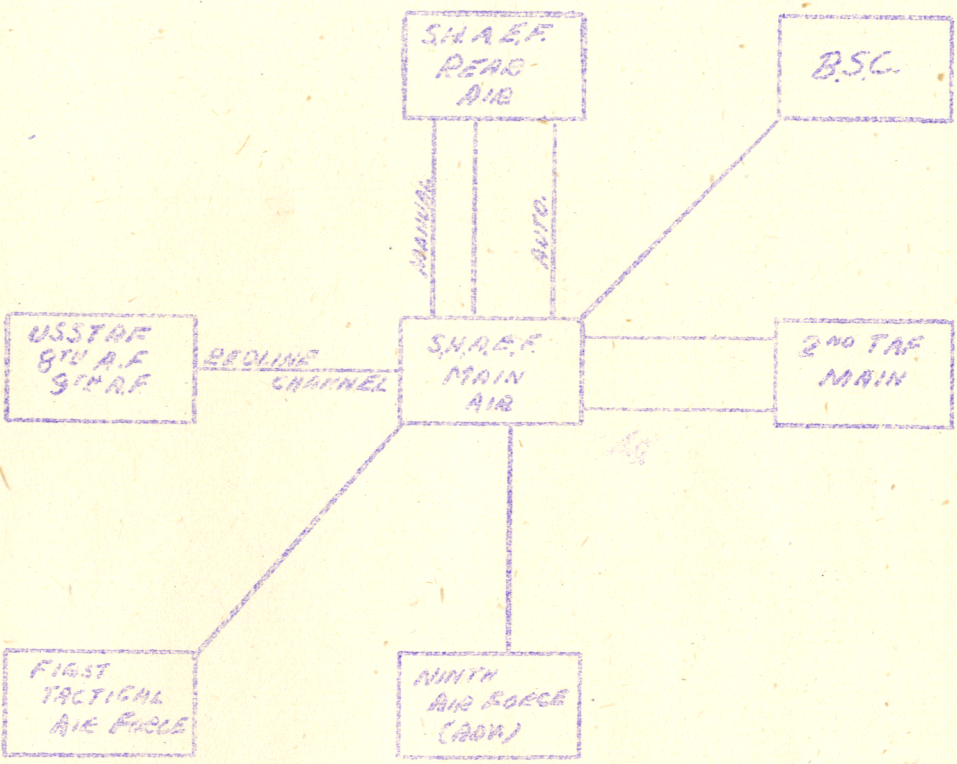
APPENDIX A - SECTION 4



ADVANCED A.E.A.F. VERSAILLES 6 SEPT. W/T LINKS

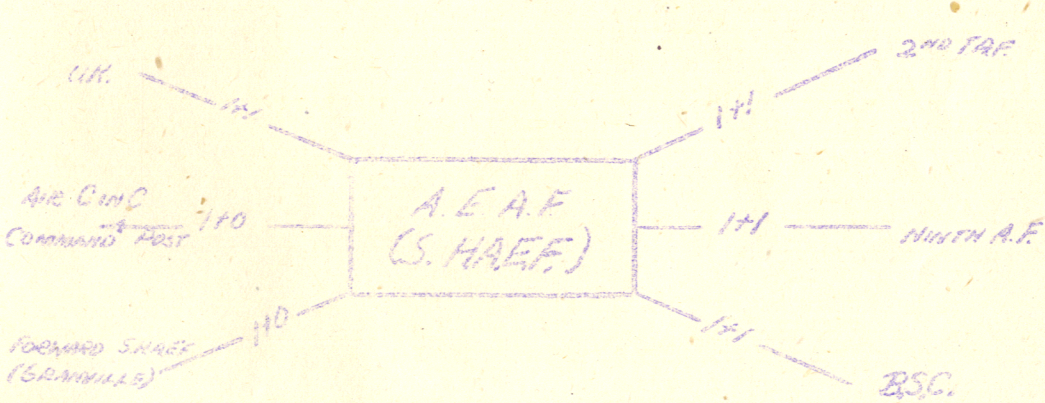


SHAEF MAIN AIR VERSAILLES 22 SEPT. W/T LINK

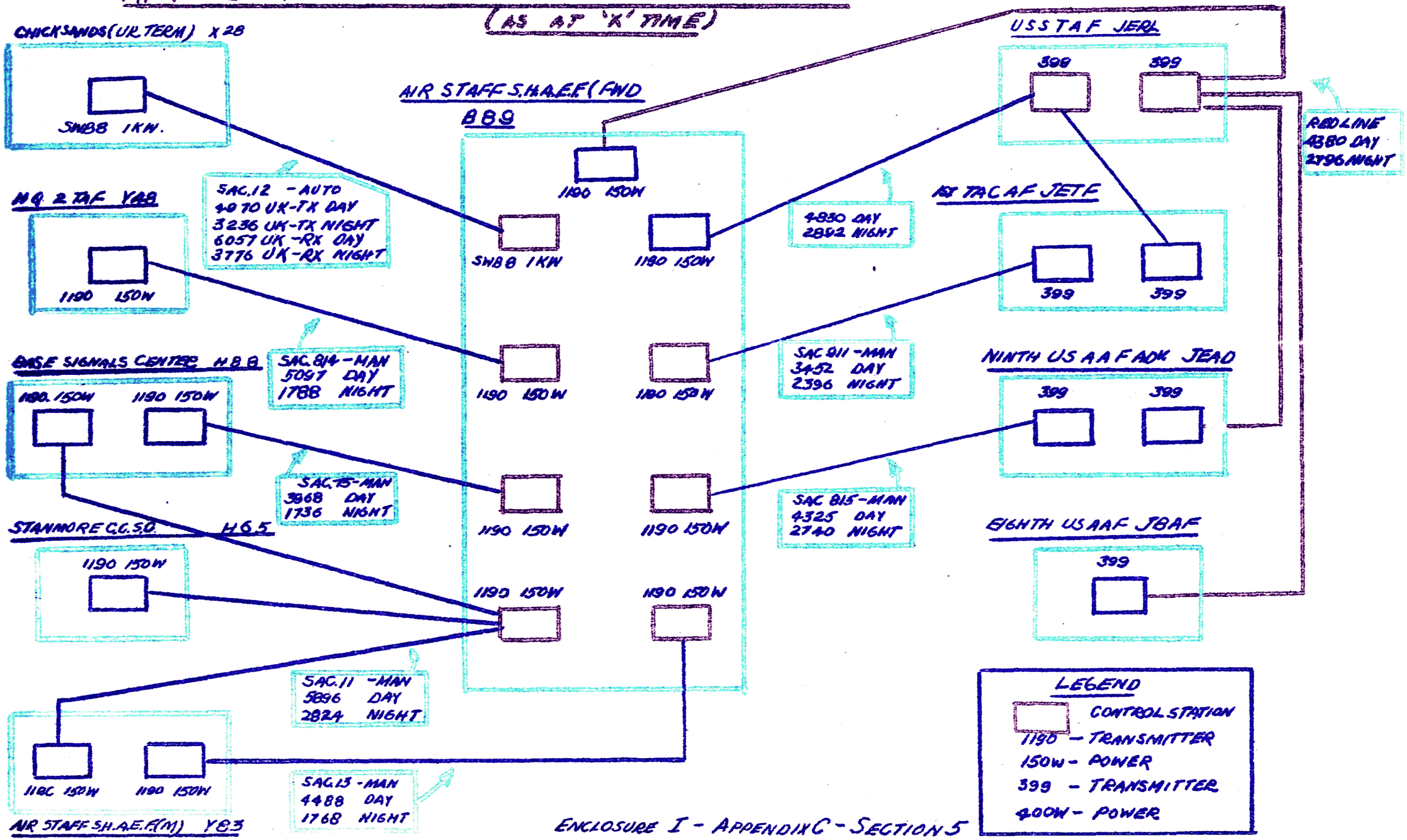


TELEPHONE & TELEGRAPH COMMUNICATIONS

AEAF (S.H.A.E.F.) (JULLOUVILLE SECTION 4 APPENDIX A



AIR STAFF S.H.A.E.F. - RADIO CIRCUITS
(AS AT 'X' TIME)

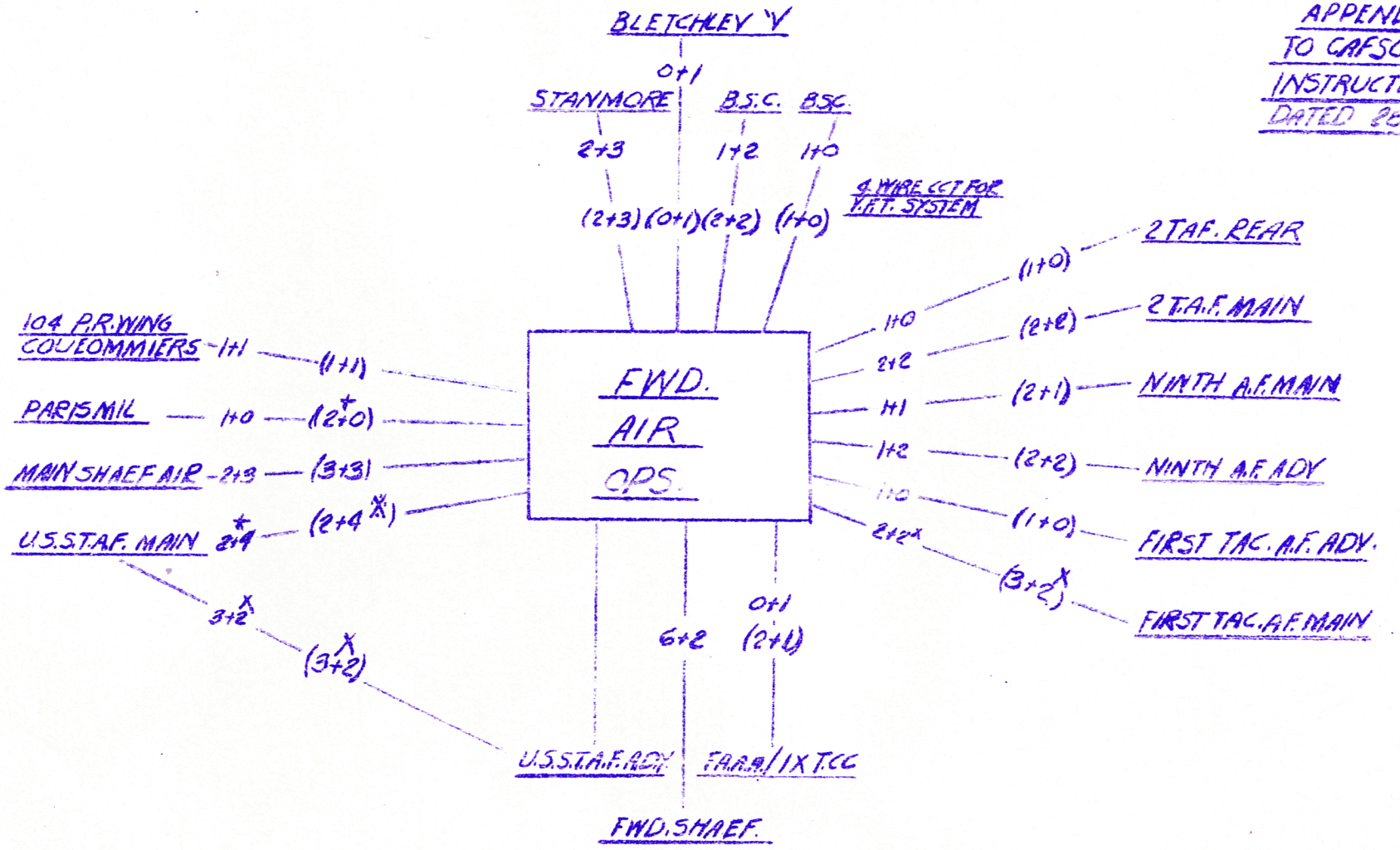


ENCLOSURE I - APPENDIX C - SECTION 5

INITIAL & (ULTIMATE) AIR STAFF LANDLINE REQUIREMENTS IN RESPECT OF FORWARD AIR OPS AT FRANKFURT

SECRET

APPENDIX "C"
TO CAFSO'S SIGNAL
INSTRUCTION No. 8
DATED 25 APRIL 45



ULTIMATE REQUIREMENTS SHOWN IN BRACKETS

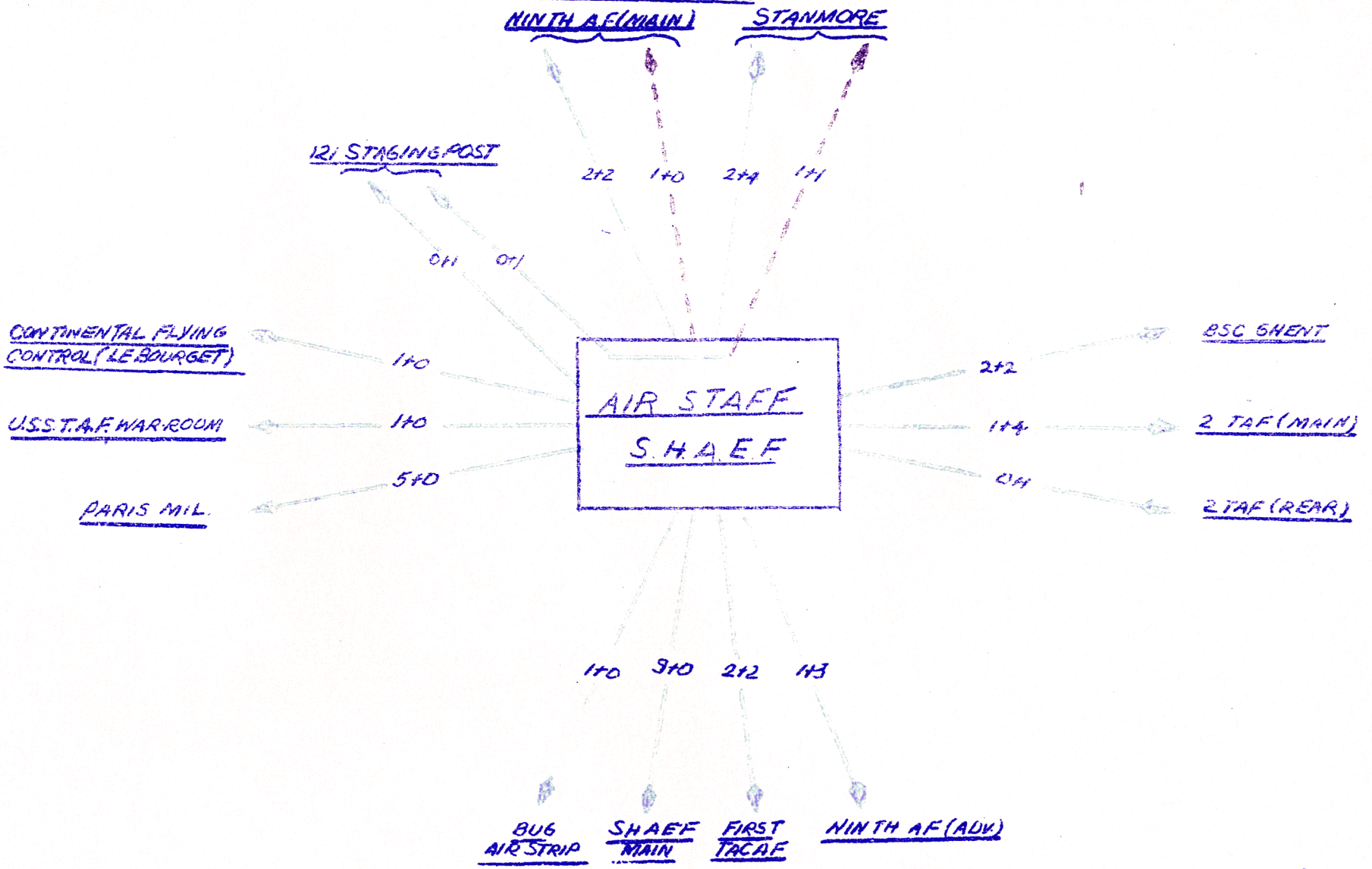
\+ IF NOT PROVIDED FROM AIR SWBD — THEN FIGURE GIVES AN ESTIMATED INCREMENT TO THE S.H.A.E.F. FWD - PARIS MIL. GROUP

X INCLUDES ONE SPEECH FOR FACSIMILE WORKING

X TWO TELEGRAPH CIRCUITS FROM U.S.STAF(M) TO THE FWD. SHAEF. LOCAL AIRFIELD FOR MET BROADCAS ARE INCLUDED

ULTIMATE TELEPHONE & TELEGRAPH COMMUNICATIONS AT AIR STAFF S.H.A.E.F (VERSAILLES)

DATED 2/2/45



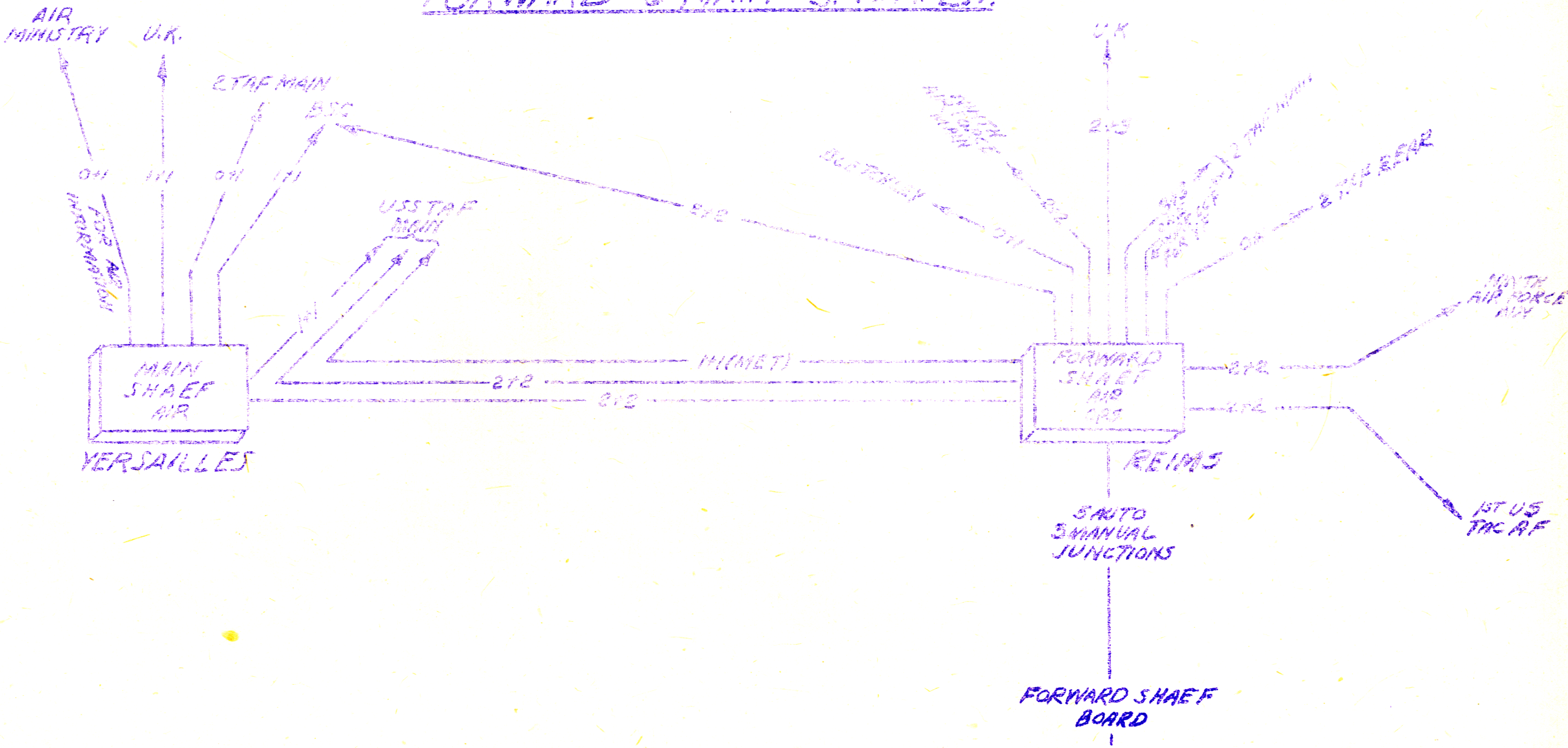
RADIO CIRCUIT

SECRET

APPENDIX 'C'

DATED 25 JAN 45

COMMUNICATIONS FOR AIR STAFF AT FORWARD & MAIN S.H.A.E.F



APPENDIX 'B'

SECTION IV

Local extensions to the SHAEF Air Ops telephone switchboard were installed to a standardised schedule. Certain staff appointments were assigned telephone numbers and these same numbers were retained in the various echelons of the headquarters.

The following list of staff appointments were served by the SHAEF Air Ops switchboard :-

Deputy Supreme Commander.

Chief of Air Staff (DCOS (Air).

Deputy Chief of Air Staff.

A.C.O.S., A-2

D/A.C.O.S., A-2

Signal Intelligence Section.

German Air Force Section.

Airfields Section.

Target Section.

Air Reconnaissance Section.

Joint Intelligence Section.

A.C.O.S., A-3

D/A.C.O.S., A-3 (Plans).

D/A.C.O.S., A-3 (Ops).

Airborne/Air Supply, C.A.T.O.R.

Flying Control (Airfields and Air Safety).

Air Operations Room.

Operations Records Section.

A-3 Air Plans Section.

Navigation Section.

A.C.O.S., A-4

D/A.C.O.S., A-4

A-4 Plans and Logistics.

Chief Air Signals Officer.

D/Chief Air Signals Officer I

D/Chief Air Signals Officer II.

/Signals 1 ....

APPENDIX 'B'

SECTION IV

Signals 1.

Radar Section.

Chief Air Formation Signals Officer.

Bomber Command (Adv).

U.S.G.C.C. (Air Division).

Other outside locals usually installed:-

Local Airfield Weather Office.

Local Airfield Flying Control Office.

Signal Intelligence Detachment (FLAPABLE).

~~SECRET~~
APPENDIX 'C'
SECTION (IV)

AIR STAFF SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

SIGNAL ORDER NO. 3

Move of Forward Echelon of Air Staff SHAEF to new location.
(Faben Industrie Building, Frankfurt)

INFORMATION.

1. The Forward Echelon of Supreme Headquarters A.E.F. will move from Reims to Frankfurt on or about 24th May, 1945.

INTENTION

2. The intention of this order is : -

(a) To lay down the communications to be provided at the new location.

(b) To detail the closing down of communications at the present location.

EXECUTION.

3. Time

The date and time for the opening of Air Staff SHAEF Forward at the new location will be furnished by signal. For purposes of specifying times in this order, it is referred to as "x", "x" representing a date time group.

4. W/T Call Signs

The W/T call signs for Air Staff SHAEF Forward at new location from "x" - 2 hours until "x", will be B09A. At "x" time, Air Staff SHAEF Forward at new location will become B09 and Air Staff SHAEF Forward at present location will be B09B from "x" until permission to close has been received from control station. Control station on all circuits except those to USSTAF will be station using call sign B09.

5. Teleprinter call signs.

The teleprinter call sign for the new location will be AFFA from "x" - 2 hours when watch is opened, until "x" time. At "x" time the new location will use AFF and the present location AFFB until closed.

6. Communications at new location.

Landline communications for Air Staff SHAEF Forward at new location are being arranged by CAFSO. Schedule of speech and teleprinter circuits is shown at Enclosure 1.

7. W/T Communications are to be set up by O.C. SHAEF (RAF) Signals Unit in accordance with Appendix "B". He will prepare for 1 Medium Power Auto channel and 8 Low Power manual channels to proceed as an advance party, to be ready to open watch at "x" - 2 hours. He is to utilize the accommodation selected in the Faben Industrie Building for the Signals Centre.

8. The following channels will open at the new location at "x" - 2 hours, S/C 11, 12, 13, 812, 814, 815, and 911. The remaining channels will be opened at a later date, as advised by signal.

APPENDIX 'C'
SECTION (IV)

9. The following channel will open at Air Staff SHAEF Main at "X" - 2 hrs. - SAC 13.

10. Providing communications are satisfactory at new location, the following channels will close at present location at "x" plus 4 hours, after obtaining permission from control station - SAC 11, 814, 815 and 911.

11. Channel SAC 812 will close at present location at "x" - 72 hours. (N.B. Channels SAC 615, 711 and 813 closed 0800B 10th May).

12. The American cryptographic staff associated with SHAEF (RAF) Signals Unit will move with SHAEF (RAF) Signals Unit to new location.

13. After all communication links have closed at present location, O.C. SHAEF (RAF) Signals Unit will arrange the immediate move of the portions of his unit still at the present location, to the new location.

A.D.L.S.

14. On 28th April an advance party from No. 7 ADLS (Fwd) Traffic Office move to Y.75 Frankfurt, and commenced operation. On 25th May the remaining ADLS Traffic Office personnel at A.62 Reims will proceed to Y.75. With effect from 25th May all SHAEF (Fwd) ADLS Traffic will be sent to Y.75. For the time being the ADLS Traffic Office at Le Bourget (A.54) will remain in situ.

ROUTEING OF SIGNALS TRAFFIC.

15. Signals traffic normally routed to or through Air Staff SHAEF Forward will be routed on communication links to the present location prior to "x" time. After "x" time all traffic for Air Staff SHAEF Forward will be routed over communication links to the new location, i.e. always routed to or via the Station using the W/T call sign B09 and teleprinter callsign AFH. Any signals on hand in the Signals Centre of the present location after "x" time, will be disposed of through the communication links still in operation; traffic for Air Staff SHAEF Forward at the new location being routed via Air Staff SHAEF Main.

16. During the period that SAC 812 is closed (i.e. "x" - 72 till "x" - 2) at this Headquarters. Ninth Air Force Advanced is to accept and relay Redline traffic for this Headquarters over channel SAC 815 or by direct teleprinter link.

SIGNALS SECURITY.

17. No radio transmissions are to be made from the new location for any purpose, prior to "x" - 2 hours.

18. The classification of all teleprinter circuits from the new location will be 'UNCLASSIFIED'.

(SGD.) W. H. GARRETT,
Wing Commander,
Signals 1.

15th May, 1945.

A/S/SHAEF/FWD/S.36091/Sigs. 1.

Copy on A/S/SHAEF/FWD/S.24927

/DISTRIBUTION.

~~SECRET~~
APPENDIX 'C'
SECTION (IV)

DISTRIBUTION : -

SHAEF Main.	3	copies.
SHAEF Forward.	3	"
Air Staff SHAEF Rear.	2	" (1 for Air Disarmament)
Air Staff SHAEF Main.	2	"
H.Q. 2 T.A.F. Main.	2	"
H.Q. 2 T.A.F. Rear.	2	"
H.Q. Ninth Air Force Main.	2	"
H.Q. Ninth Air Force Adv.	2	"
H.Q. 1st US TAC.F.	2	"
H.Q. 1st US TAC.F. Adv.	2	"
H.Q. USSTAF. Main.	2	"
H.Q. USSTAF Adv.	2	"
H.Q. Com Zone.	2	"
Base Signals Centre.	2	"
H.Q. 85 Group.	1	"
H.Q. Fighter Command.	2	"
H.Q. 26 Group.	2	"
A.H. W/T Station, Chicksands.	1	"
Air Ministry D of S.	2	"
" " D of Tels.	2	"
H.Q. Bomber Command.	1	"
H.Q. Coastal Command.	1	"
H.Q. 60 Group.	1	"
H.Q. 72 Wing.	1	"
H.Q. Transport Command.	1	"
H.Q. 46 Group.	1	"
H.Q. 107 Wing.	1	"
H.Q. 87 Group.	1	"
U.K. C.C.S.C.	1	"

Internal.

D/Chief of Staff (Air).	1	copy.
A/COS A-3.	1	"
A/COS A-4	1	"
Adj.Gen.	2	copies.
CATOR.	1	copy.
C.A.S.O.	1	"
CAFSO.	3	copies.
D/CASO 1.	1	copy.
D/CASO 2.	1	"
W/Cdr. Radar.	1	"
Sigs. 1	1	"
Sigs. ADLS.	1	"
Sigs.Sec.	1	"
O.C.SHAEF (RAF) Signals Unit.	3	copies.
History	3	copies.
File	1	copy.

SECRET
APPENDIX 'C'
SECTION (IV)

APPENDIX "A" to Air Staff SHAEF Signal Order No. 3.

Initial and Ultimate Landline Requirements being provided for Air Staff SHAEF Forward at new location.

From Air Staff SHAEF Forward To:-	Initial Target Date	Ultimately (as soon as possible)
FWD SHAEF	6 + 2	as required
MAIN SHAEF AIR	2 + 3	3 + 3
UKCCSC STANMORE	2 + 3	2 + 3
B.S.C.	1 + 2	2 + 2
BLETCHLEY Y	0 + 1	0 + 1
HQ 2 TAF MAIN	2 + 2	2 + 2
HQ 2 TAF REAR	1 + 0	1 + 0
104 P.R. WING	1 + 1	1 + 1
PARIS MILITARY	1 + 0	2 + 0
USSTAF MAIN	2 + 4 /-	2 + 4 /-
1ST TACAF ADV.	1 + 0	1 + 0
1st TACAF Main	2 + 2 ‡	3 + 2 ‡
F.A.A.A./IX T.C.C.	1 + 1	1 + 1
Ninth USAAF Adv.	1 + 2	2 + 2
Ninth USAAF Main.	1 + 1	2 + 1

‡ Includes one speech for facsimile working.

/- Two telegraph circuits from USSTAF (M) to the Forward SHAEF local airfield for Met broadcasts are included.

/APPENDIX "B" to
Air Staff SHAEF Signal
Order No. 3

~~SECRET~~
APPENDIX 'C'
SECTION (IV)

APPENDIX "B" to Air Staff SHAEF Signal Order, No. 3.

W/T Channels to be opened at Future Forward, Air Staff SHAEF and to remain open as channels for Air Staff SHAEF Forward (after "X" hour)

Circuit Number	Frequency	Terminals	Call sign	Remarks
SAC 812	4380 Day 2796 Night	USSTAF (c) Air Staff SHAEF Fwd. 8th USAAF 9th USAAF (Adv)	JERL B09 JBAF JEAD	Redline
SAC 814	5097 Day 1788 Night	Air Staff SHAEF Fwd.(c) HQ 2 TAF Main	B09 Y48	Low Power Manual
SAC 815	4325 Day 2740 Night	Air Staff SHAEF Fwd.(c) IX USAAF (Adv)	B09 JEAD	"
SAC 911	3452 Day 2396 Night	Air Staff SHAEF Fwd.(c) 1st TACAF (Adv)	B09 JETF	"
SAC 11	5896 Day 2824 Night	Air Staff SHAEF Fwd.(c) Air Staff SHAEF Main Stanmore C.C.S.C. B.S.C.	B09 V83 H65 H08	"
SAC 12	4970 UK Tx Day 6057 UK Rx Day 3236 UK Tx Night 3776 UK Rx Night	Air Staff SHAEF Fwd.(c) Chicksands	B09 X28	Medium Power Auto
SAC 13	4488 Day 1768 Night	Air Staff SHAEF Fwd.(c) Air Staff SHAEF Main	B09 V83	Low Power Manual
SAC 14	4075 Day 2476 Night	Air Staff SHAEF Fwd.(c)	B09	Low Power Manual
SAC 15	3968 Day 1736 Night	Air Staff SHAEF Fwd.(c) B.S.C.	B09 H08	"
	4830 Day 2892 Night	USSTAF (c) Air Staff SHAEF Fwd. 1st TACAF	JERL B09 JETF	"

W/T channels to be opened at Air Staff SHAEF Main.

SAC 13	4488 Day 1768 Night	Air Staff SHAEF Fwd.(c) Air Staff SHAEF Main	B09 V83

W/T channels to be closed at present location Air Staff SHAEF Fwd.

Circuit Number	Frequency	Terminals
SAC 814	5097 1788	Air Staff SHAEF Fwd. HQ 2 TAF Main.

/Contd.

Circuit Number	Frequency	Terminal
SAC 815	4325	Air Staff SHAEF Fwd.
	2740	IX USAAF (Adv)
SAC 911	3452	Air Staff SHAEF Fwd.
	2396	1st TAC AF (Adv)
SAC 11	5896	Air Staff SHAEF Fwd.
	2824	Air Staff SHAEF Main
		Stanmore CCSC
		B.S.C.

Teleprinter/
teletype Room

Apparatus Room
i.e. Main Frame
Ringers and S-D
Rack

Teleprinter
Switchboard

Telephone Switchboard

Radio Receivers

Registering and Routing of Messages

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCES

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION V

ALLOCATION OF FREQUENCIES

PRINCIPLES OF ALLOTMENT.

1. A tentative frequency allotment for the services taking part in Operation 'OVERLORD' was prepared by Sig Div. HQ SAC and presented for discussion at a meeting held at Norfolk House on 8th December, 1943. The allotment covered the band 1.5 to 8 mc/s, this being the most useful band for communication purposes, and that which it was apparent from the outset would present the greater problem.

2. Allocations were spaced at 5 kc/s intervals throughout, omitting only the most essential frequencies employed by the Admiralty, War Office and Air Ministry formations and Broadcast Stations. Zones were quoted in which the frequencies might by employed and maximum power limitations were listed against each registration.

3. Bids for the number of frequencies required had previously been requested from and supplied by the various services concerned. These far exceeded the number of frequencies available and a large amount of inter-service sharing had been resorted to. Of the 420 frequencies allotted to the Air Forces, 189 were shared with other services. This inter-service sharing was considered very undesirable in view of the large amount of co-ordination which it necessitated and the difficulties which were presented by this co-ordination. It was the considered opinion of all representatives that a smaller number of frequencies, all specifically allotted to individual services was preferable, each service undertaking the maximum possible amount of intra-service sharing.

4. The Ninth Air Force were at this time newcomers to the Theatre and had not been included in the original bid by the Air Forces. For the purposes of the tentative allocation it had been assumed that the Ninth Air Force was comparable to the 2nd Tactical Air Force. This assumption was incorrect, for the Ninth Air Force was considerably larger and, unlike 2nd TAF, included such organisations as A.A. and airfield engineers. The original Ninth Air Force request was for 431 unshared frequencies.

5. The deficiency of these frequencies required by the Air Forces was most marked, particularly in the 3 - 4 mc/s band, and a series of meetings was held at Norfolk House, Stanmore and St.Pauls Schools Hammersmith, at which various proposals to meet the deficiency were put forward and examined. It was ultimately agreed by the representatives of the Ground and Air Forces to reduce the spacing of all frequencies between 1.5 and 4 megacycles to 4 kilocycles. In addition, a mutual exchange was made between Air Forces and Army

/ Groups.

Groups, of certain allotted frequencies between 4 and 8 megacycles. This produced small blocks of consecutive frequencies allocated to the respective services, the spacing between frequencies in these blocks being reduced to 4 kilocycles.

6. The agreement having been approved by HQ Supreme Allied Command, the final allocation was concluded by mid-April, 1944. Approximately 385 frequencies were allotted to the Air Forces, all unshared by other services.

SUB-ALLOTMENT TO AIR FORMATIONS.

7. Estimated requirements were obtained from each of the following users and blocks of suitable frequencies allotted:-

H.Q. A.E.A.F.
H.Q. Ninth Air Force.
H.Q. 2nd Tactical Air Force.
H.Q. 85 Group.
H.Q. 46 Group (Transport)
H.Q. 38 Group (Airborne Troops)
H.Q. 60 Group (Radar)
H.Q. 80 Wing (R.C.M.)
H.Q. Ships.
'Y' Service.
R.A.F. Regiment.

Priority was given to frequencies for the H.Q. Ships because of their complex aerial systems. Various frequencies were tested over an extended period before the final selection was made.

8. Medium frequencies were specially selected and cleared for M.L.S. Broadcasts.

V.H.F. POINT-TO-POINT.

9. Blocks of frequencies in the V.H.F. Band 20 - 100 megacycles, were obtained for point to point working. Certain frequencies in this band were selected for cross-channel Racehorse circuits, these being specially cleared and protected against the possibility of interference.

V.H.F. AIR TO GROUND.

10. Frequencies for Ground to Air communications in the V.H.F. band 100-156 megacycles were agreed with Air Ministry, Headquarters Fighter Command and Eighth Air Force.

CONTROL OF FREQUENCIES ON THE CONTINENT.

11. The Frequency Allocation Sub-Committee of the Combined Signal Board was set up on the Continent in September, 1944. It was composed of representatives of the following:-

Signal Division SHAEF	(3)
Air Staff SHAEF	(2)
A.N.C.X.F.	(2)
Sixth Army Group	
Twelfth Army Group	
21st Army Group	
Com Z.	
Special Forces	(2)
U.S.S.T.A.F.	
First Allied Airborne Army	

/meetings.

SECTION (V)

Meetings were held fortnightly at the Chase Bank Buildings in Paris.

12. All requests for additional frequencies or for exchanges were presented at these meetings. Certain emergency requirements were cleared by direct contact with the services concerned and ratified at the following meeting.

13. Signal Division SHAEF set up a Radio Monitoring Terminal which was available for reference when dealing with reports of interference.

14. Frequencies for circuits having terminals in the United Kingdom and/or the Mediterranean theatre, were cleared with the B.J.C.B. or A.F.H.Q. as appropriate. All frequencies on which operation was to take place using power in excess of 500 watts no matter where their terminals were to be were cleared in same manner.

15. The reduction of frequency spacing from 5 to 4 kilocycles did not appear greatly to increase the amount of interference experienced. Transmissions were crystal controlled wherever practicable.

SUBSEQUENT REQUIREMENTS.

16. The frequency requirements of the First Tactical Air Force (Provisional), British and American Transport Commands, 72 Wing and other formations which came later under Air Staff control for frequencies, were met by sharing within the block Air allotment as far as possible and by obtaining a few additional frequencies from the Frequency Allocation Sub-Committee.

SUMMARY.

17. The congestion in the ether in Operation 'OVERLORD' has been greater than in any previous operation in the history of war. During the planning stage the Mutual Interference Sub-Committee of the Combined Signals Board formulated principles and prepared detailed advice on the siting of Communications and Radar equipment used by all services so that Units in the Field were fully advised on how to avoid, and, in some cases, eradicate, mutual interference. During the planning stage and until September 1944, Frequency Allocation was attempted without forming a Sub-Committee of the Combined Signals Board to fulfill this function. The need for a Sub-Committee became increasingly obvious as planning and frequency allocation proceeded and one was set up in September 1944. Throughout the entire operation the officers engaged on Frequency Allocation wrestled with a problem which at the outset appeared to be practically insoluble, and it is mainly due to their skill and dogged perseverance that the Services of the Allied Nations were able to derive so much benefit from Telecommunications, Radar and Radar Navigational Aids throughout all phases of the operation.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION VI

A.D.L.S.

1. After the initial inception of ADLS between Normandy and the U.K., the development of the service followed the build up in Normandy of the number of Headquarters entitled to ADLS services. By June 20th, 1944 the need for the internal London - Portsmouth - Plymouth links had disappeared, and these were accordingly ceased. During July arrangements were made for ADLS traffic to be diverted to travel by Naval Despatch Boat Service when clearance by air was not possible. For this purpose special authorisation cards were issued for ADLS couriers. August saw the expansion of the services to Normandy to give direct cross channel clearance to both 2nd T.A.F. and 83 Group, and to serve the American Tactical Headquarters. During this period the increase in the quantity of mail made it necessary for the British Hurricanes to be replaced on the main routes by Anson aircraft, and the American Thunderbolts by Dakotas.

2. At the beginning of September, 1944, ADLS services started to the advanced section of A.E.A.F. located at Juillouville. As the Headquarters moved over to the Continent, the service from their original U.K. location in the South of England became unnecessary, and the ADLS traffic office at Thorney Island was closed for other than emergency landing.

3. With the liberation of Paris, a special ADLS service began operation from Le Bourget to Northolt. By the end of September, ADLS services were including stops at Evreux, Laval, Verdun and Lyons. Considerable difficulty was experienced, especially on the American side, of obtaining and controlling ADLS aircraft services and standards of reliability. This was mainly because special aircraft and personnel were not allotted for this work and because passengers were carried on the flights. At the beginning of October, 1944, therefore, the Combined Air Transport Operations Room (CATOR) were made responsible for the provision and operation of all ADLS aircraft. It was decided to run the ADLS cross channel flight to two main offices, at SHAEF and 2nd T.A.F. respectively, from which the internal feeder connections should be made.

4. In November, 1944 a new policy letter defining the responsibilities of ADLS operation was issued. All ADLS services down to and including Army Group/Air Force level were to be known as SHAEF/ADLS and to be operated by CATOR to the requirements of CASO, SHAEF/ADLS services below Army Group/Air Force level were made the responsibility of the respective Air Forces. In order to enable night flying to start, the ADLS traffic terminal for Paris was moved from A.46 BUC to A.54 Le Bourget. A copy of the policy letter is attached at Appendix 'A'.

5. At the beginning of December, a new Signals Staff Instruction

/(No.5.)...

(No.5.) was issued, incorporating the amendments in policy effected since the previous issue in April. A copy is attached at Appendix 'B'.

6. A few days later, ADLS night services from Northolt to Paris and Brussels started, and H.Q. 46 Group took over the operation of all ADLS services between U.K. and the Continent. The policy of carrying British and American ADLS traffic only on 46 Group R.A.F. aircraft was found necessary when the American aircraft were no longer permitted to use Northolt, the airfield at which the U.K. terminal ADLS traffic office was located. The deterioration in weather conditions made it necessary for arrangements to be made to divert ADLS once again to NDBS - this diversion had been ceased when the distance of the ADLS user Headquarters from the coast became over 50 miles. Personnel and vehicles were established at the Paris and Brussels ADLS traffic offices and at Calais and Ostende to clear any ADLS traffic unable to be flown over the channel.

7. At the beginning of January, 1945 the problem of passengers delaying ADLS aircraft made it necessary to disallow any personnel but Air Ministry or ADLS couriers to travel on the aircraft and, to facilitate this, six couriers cards only were authorised. By the end of January the snow and ice made the roads impassable and diversion to NDBS was discontinued until the thaw set in about ten days later and roads became usable.

8. In January, 1945 it became apparent that SHAEF would split into two Headquarters echelons, Main and Forward, and the establishment of No. 7 ADLS traffic office was increased to allow it to be divided and serve these two Headquarter components.

9. The trend of operations in January made it necessary to prepare the ADLS plans for operation 'ECLIPSE' so that the extra aircraft required would be available, and all users of SHAEF/ADLS were accordingly asked to submit their expected requirements. These were co-ordinated into a draft plan mutually between the British and American interests, the general scheme being for British aircraft to operate the cross-channel and North Eastern European services, except for Bremen and the U.S. Enclave, and the Americans the central and Western European services.

10. At the beginning of March, Air Staff Policy Memorandum No.9 was issued. This incorporated the previously noted policy of SHAEF/ADLS Operation down to Army Group/Air Force level only and the responsibility of CATOR to arrange provision and operation of all aircraft as well as the promulgation of schedules to meet the requirements of the ADLS users, as passed to CATOR by the CASO. A copy of this Memorandum is attached at Appendix 'C'.

11. In March ALLIED Air Force Headquarters requested permission to extend their ADLS service through Dijon to Paris, thus freeing SHAEF/ADLS aircraft from the Paris - Dijon service, and enabling them to operate a new service Paris - Nancy. This was agreed.

12. By the middle of March, 1945, the 'ECLIPSE' planning for ADLS had been completed and a draft of the anticipated requirements were submitted to CATOR, who, on the grounds of aircraft economy, requested a reconsideration of the extent of the services necessary. Slight reductions were agreed with the ADLS users. It was further agreed that SHAEF/ADLS should be responsible for the operation of an ADLS link service between Northolt and the U.K. base of the U.K./Norway theatre ADLS service to be operated by Fighter Command.

13. In order to keep in close touch with the operation of the SHAEF/ADLS services, a system was devised whereby at the end of each day ADLS traffic offices at Northolt and Le Bourget notified SHAEF by

signal of details of the ADLS services flown, and traffic carried. This information was presented as a record of a signals communication link at every morning conference.

14. Early in April it was agreed with Headquarters Transport Command that they should take over the operation and administrative control of the ADLS traffic offices established on SHAEF, and also provide the additional traffic offices and handling staffs necessary for the operation of the 'ECLIPSE' ADLS Plan. The reliability of the ADLS cross-channel aircraft enabled all diversion of ADLS traffic to NDBS to cease and the ADLS traffic liaison sections at Calais and Le Bourget were accordingly put up for disestablishment.

15. During April, 1945 the ADLS services flew into Nancy, Luxembourg, Sandweiler, Mannheim and Wiesbaden, changing the airfields to correspond with the movements of the Headquarters being served. At the end of April, Headquarters 87 Group became an authorised user of ADLS. On the first of May a new ADLS schedule was issued having Continental stops at Paris, Verdun, Wiesbaden, Frankfurt, Mannheim and Reims. This service was operating at the time V.E. Day was announced.

16. The 'build-up' of ADLS services in Europe is indicated by the diagrams attached at Appendix 'D'.

17. The general lesson that has been learnt from the operation of ADLS during this period is that although the provision of a special ADLS Squadron makes for reliability of service, as shown in the distinction between the British and American services, it must also be directly under the control of one part of the Staff. If this is not so the staff work involved results in delays in changes of schedules, an inflexibility which has been one of the unsatisfactory sides of the ADLS organisation.

18. It was found that the clearing of changes in schedule through CATOR who in turn cleared them through CATOR (Rear) 46 Group, the ADLS Squadron or through Headquarters 302nd Wing, was a lengthy and inefficient business. As a result after almost every major change of schedule it took at least a week for the ADLS timetable to settle down to its normal degree of reliability. It is strongly recommended that in any future operations the Chief Air Signals Officer should have the ADLS Squadrons under his own direct control. This principle was adopted successfully in Headquarters 2nd T.A.F. in the services below Army Group/Air Force level.

~~SECRET~~
APPENDIX 'A'
SECTION VI.

SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE
AIR STAFF

POLICY MEMORANDUM)
NUMBER 9)

APO 757 (Main)
4 March 1945

AIR DESPATCH LETTER SERVICE

OBJECT.

1. The object of this instruction is to state the general policy for the operation of Air Despatch Letter Services (ADLS) between the United Kingdom and the Continent, and between the User Service Headquarters on the Continent, and to define the responsibilities of those concerned in implementing this policy. AEAF Air Staff Policy and Operation Instruction No. 9, "Air Despatch Letter Service", dated 26 February, 1944, is hereby rescinded.

GENERAL POLICY.

2. A schedule of air services will be provided for the conveyance of ADLS traffic to meet the requirements of specified Navy, Army and Air Force Headquarters engaged in operations. These Services will:

(a) Connect Headquarters of Army Group/Air Force level and above as detailed in Para. 7 below. These services will be controlled by Air Staff, SHAEF and will be known as SHAEF/ADLS Services.

(b) Connect Headquarters of Army Group/Air Force level with lower formations such as Armies, Army Corps, Air Force Commands and Groups and laterally between such headquarters. These Services will be controlled by Second TAF, Ninth Air Force, or First Tactical Air Force (Prov) as applicable, and will be known respectively as Second TAF/ADLS, Ninth AF/ADLS or First TACAF/ADLS. Second TAF, Ninth AF, and First TACAF are to make the necessary arrangements to operate these ADLS services below Army Group/Air Force level according to the needs of the User Services, and are to establish the necessary machinery and reserves for this purpose. Second TAF, Ninth A.F. and First TACAF are to issue instructions for their appropriate ADLS Services. These instructions are to be based upon those contained in this Instruction governing SHAEF/ADLS and copies are to be circulated to all concerned.

3. The paragraphs which follow relate to and will govern SHAEF/ADLS.

ORGANISATION AND CONTROL.

4. General responsibility for the organisation and control of SHAEF/ADLS services has been assumed by the Deputy Chief of Staff (Air), SHAEF and will be exercised through the Chief Air Signals Officer, Air Staff, SHAEF, who may call upon the assistance of an Advisory Committee of the User Services should he consider it necessary.

PROVISION OF AIRCRAFT.

5. The Combined Air Transport Operations Room (CATOR), Air Staff, SHAEF is responsible for arranging the provision of aircraft to

/operate....

SHAEF/ADLS Services.

PROVISION OF DRLS.

6. To connect Headquarters entitled to use SHAEF/ADLS and the airfield from which the services are to be operated, a schedule of DRLS (Despatch Rider Letter Service) will be run to an appropriate time table. This service will normally be operated by arrangement with DRLS of 21st Army Group, Com.Z., or Air Formation Signals. Arrangements will also be made to provide a link with the NDBS (Naval Despatch Boat Service) in the event of combat requirements or weather conditions interfering with the air services.

BASIS OF OPERATION.

7. The basis of operation will normally be as follows:

(a) Three services daily in each direction connecting the United Kingdom with SHAEF and the User Service Headquarters of Army Group and Air Force level on the Continent.

(b) Three services daily in each direction connecting Headquarters of SHAEF and the User Service Headquarters of Army Group and Air Force level on the Continent.

(c) Three services daily in each direction laterally between Army Group/Air Force Headquarters.

(d) Service as required between echelons of SHAEF.

INTRODUCTION OF ADLS SERVICES.

8. The final decision regarding Headquarters entitled to SHAEF/ADLS Services will rest with SCAEF.

9. The responsibility for approving and co-ordinating requests for the introduction, extension or alteration of schedules to meet the User Services requirements is that of SHAEF.

OPERATION AND TIMING OF AIR SERVICES.

10. The SHAEF/ADLS schedules will be promulgated with as much notice as possible by CATOR, Air Staff, SHAEF according to the requirements of the User Services passed to CATOR by the CASO, Air Staff, SHAEF.

NUMBER AND FREQUENCY OF SERVICES.

11. The number of services to be operated and the routes to be followed will be determined by the progress of operations and the movement of Headquarters on the Continent.

12. The frequency of the services may be varied from time to time to suit operational requirements, but the provisional basis of operation will be that given in Para. 7 above.

13. The number and frequency of the Services will at all times be subject to the availability of airfields and to the operational and weather conditions prevailing along the routes to be served.

14. Subject to combat requirements and weather conditions, SHAEF/ADLS services are to be run to a strict time schedule.

NATURE OF TRAFFIC

15. Traffic to be despatched by the SHAEF/ADLS is to be restricted to the following categories which, unless marked with a priority label, they are to be handled in the order shown.

(a) Despatches of the highest importance which, because of their nature or length, cannot be sent by signal.

(b) Messages normally sent by signal, which cannot be so sent owing to congestion, or other circumstances.

(c) Despatches or official letters too urgent to be sent by normal mail services, but not urgent enough to be sent by signal.

(d) Exposed publicity and psychological warfare or other official films.

(e) Urgent air freight indents or requisitions.

(f) Maps and target material of urgent operational importance.

16. SHAEF/ADLS bags, including press bags, will take priority over any other traffic on ADLS flights.

HANDLING OF TRAFFIC.

17. For the purpose of handling traffic at the airfields to be used by SHAEF/ADLS services a number of ADLS traffic offices is to be established, the functions of which will be as follows:-

IN THE UNITED KINGDOM

(a) Reception of SHAEF/ADLS traffic, other than that of the Air Forces, in bulk from the DRLS or courier services linking the SHAEF/ADLS traffic offices with the signal centres of the User Services, and the loading of this traffic on SHAEF/ADLS aircraft.

(b) Collection of ADLS traffic from incoming aircraft and arrangement of this traffic in bulk by DR, DRLS or courier services of User Services other than the Air Forces. Distribution of this traffic, with the exception of that of the Air Forces, will be done through the Signal Centres of these Services and not through the SHAEF/ADLS Traffic Offices.

(c) The reception of outgoing Air Force traffic by DR, DRLS, courier service or teleprinter channels, where provided, at the SHAEF/ADLS traffic offices and the sorting, bagging and loading of this traffic on SHAEF/ADLS aircraft.

(d) The collection of bulk Air Force traffic from the incoming SHAEF/ADLS Aircraft and the breaking down and sorting of this traffic for onward transmission by DR, DRLS courier services or teleprinter, where provided, as appropriate.

(e) The clearance of SHAEF/ADLS traffic which cannot be passed by air, through the Naval Despatch Boat Service and the conveyance and collection of SHAEF/ADLS traffic passed by NDBS services to and from the point of embarkation.

/ON THE CONTINENT...

ON THE CONTINENT.

(f) Receipt of SHAEF/ADLS traffic in bulk, including that of the Air Forces, from the DRLS or courier services linking the SHAEF/ADLS traffic offices with the Signal Centres of the formations served, and the loading of this traffic on SHAEF/ADLS aircraft.

(g) Collection of SHAEF/ADLS traffic in bulk from incoming SHAEF/ADLS aircraft and arrangement for collection of this traffic by DR, DRLS, or courier services of User Services, distribution being effected through the Signal Centres of these Services and not by the SHAEF/ADLS traffic office.

(h) The clearance of SHAEF/ADLS traffic, which cannot be passed by air, through the Naval Despatch Boat Service. Air Staff, SHAEF, will issue general instructions regarding the diversion of SHAEF/ADLS traffic to travel by NDBS. Headquarters 2nd TAF, Headquarters Ninth Air Force, and Headquarters 1st TACAF are to issue to their respective traffic offices such additional instructions as may be necessary.

NUMBER OF LOCATION OF TRAFFIC OFFICES.

18. In the United Kingdom there will be one main SHAEF/ADLS traffic office situated at Northolt.

19. On the Continent SHAEF/ADLS traffic offices or traffic handling facilities are to be established where necessary to meet the requirements of the User Services.

EMPLOYMENT OF COURIERS.

20. All SHAEF/ADLS traffic, while being conveyed by air, sea or road, between SHAEF/ADLS traffic offices, is at all times to be under the charge of a responsible person, who shall, while carrying such traffic, be designated as a SHAEF/ADLS courier. On SHAEF/ADLS aircraft, the pilot or co-pilot may be so designated. A SHAEF/ADLS courier is responsible for the SHAEF/ADLS traffic while it is in the aircraft and for its safe delivery to an accredited representative of SHAEF/ADLS traffic office.

ESTABLISHMENT AND CONTROL OF TRAFFIC OFFICES.

21. AOC 26 Group is responsible for the establishment, control and communications for the SHAEF/ADLS traffic office at Northolt, and for the arrangements necessary to convey SHAEF/ADLS traffic diverted to NDBS each way between Northolt and the United Kingdom NDBS terminals.

22. The establishment, control and communications arrangements for RAF SHAEF/ADLS Offices on the continent are the responsibility of Air Staff, SHAEF in the case of the traffic offices serving SHAEF, and of Headquarters 2nd TAF as directed by Air Staff, SHAEF in the case of all other RAF traffic offices. The Commanding Generals, Ninth Air Force, and 1st TACAF have similar responsibilities regarding the provision, control and communications arrangements of the ADLS traffic offices serving their respective areas.

23. SHAEF/ADLS traffic offices will be established at the nearest suitable airfield to the major Headquarters served.

/Para. 24 ...

24. Immediately a move of a User Service Headquarters is anticipated or a new SHAEF/ADLS requirement planned, the CASO, Air Staff, SHAEF should be notified. As soon as possible following this notification, the following information should be passed by signal to the CASO, Air Staff SHAEF.

(a) Formation to be served.

(b) The name and co-ordinates of the nearest suitable airfield capable of permitting SHAEF/ADLS aircraft to land.

(c) The date from which the service is required to operate.

(d) The daily service required by the User Services.

(e) The approximate extent of traffic likely to be passed.

25. The responsibility for starting the action necessary for arranging or diverting SHAEF/ADLS services rests with the Headquarters of the User Services concerned, by notifying the CASO, Air Staff, SHAEF, of their requirements in the manner indicated in Para. 24 above. Such requests are to be passed through the normal service channels.

PROVISION OF PERSONNEL FOR TRAFFIC OFFICES.

26. SHAEF/ADLS traffic offices will normally be manned by R.A.F. and/or U.S. Air Force personnel. Where necessary such office staffs may be augmented by the attachment of personnel of other allied armed services.

By direction of the Deputy Supreme Commander:

(Sgd.) D.M. SCHLATTER,
Major General, U.S. Army.
Deputy Chief of Air Staff.

APPENDIX 'A'
SECTION VI.

DISTRIBUTION	NO. OF COPIES
(Internal)	
Deputy Supreme Commander	1
Deputy Chief of Staff (Air)	1
Deputy Chief of Air Staff	1
A.C.O.S. A-2	2
A.C.O.S. A-3	2
A.C.O.S. A-4	2
SHAEF:	
Secretary General Staff	7
G-1	3
G-2	3
G-3	1
G-4	9
G-5	7
Air Defence Division	1
Adjutant General's Division	2
Ops Records (Ops 7)	2
Historian	1
Air Adjutant General (files)	3
Sparea	20
(External)	
H.Q. 2nd T.A.F.	5
H.Q. 9th A.F.	5
H.Q. 1st TACAF	5
H.Q. 21st Army Gp	5
H.Q. 12th Army Gp	5
H.Q. 6th Army Gp	5
H.Q. 1st AA Army	5
ANCXF (Includes copies for Admiralty)	5
Air Ministry	5
USSTAF	5
Com Z	3
War Office	3

APPENDIX 'B'
SECTION VI.

SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE
AIR STAFF

17th November, 1944.

Ref : SHAEF/17/A/S.14124/Sigs.ADLS.

To : Distribution List attached.

Subject : AIR DESPATCH LETTER SERVICE.

1. Pending the amendment and re-issue by SHAEF of AEAF Policy and Operation Instruction No. 9 'Air Despatch Letter Services', the arrangements given below will be put into force for the operation of ADLS.

2. The ADLS service, controlled by SHAEF (Main) Air, which is provided for the speedy carriage of specific priority traffic, will operate services as follows to connect Headquarters of Army Group/Air Force level and above:-

(1) Between U.K. and SHAEF (Main)

(2) Between U.K. and Army Group/Air Force level.

(3) Between SHAEF (Main) and Army Group/Air Force level.

(4) Between adjacent Army Group/Air Force level Headquarters.

3. Services below Army Group/Air Force level will be the responsibility of the Air Force working on a level with the Army Group. When referring to ADLS Services below Army Group/Air Force level, the title of the appropriate Air Force is to be prefixed, e.g. 2 TAF/ADLS, in order that there shall be no confusion between it and the ADLS Services controlled by SHAEF (Main) Air.

4. The basis of operation for the ADLS shown in paragraph 2. above will normally be three services daily in each direction.

5. With effect from 1st December, 1944, the responsibility for ADLS and Air Courier Services are to be as follows:-

(i) SHAEF (Main) Air will be responsible for the services shown in Para. 2.

(ii) 2nd T.A.F., Ninth Air Force and 1st U.S.T.A.F. will be responsible for operating ADLS services required below Army Group/Air Force level. These Air Forces are to make necessary arrangements for running services between flanking armies, etc.

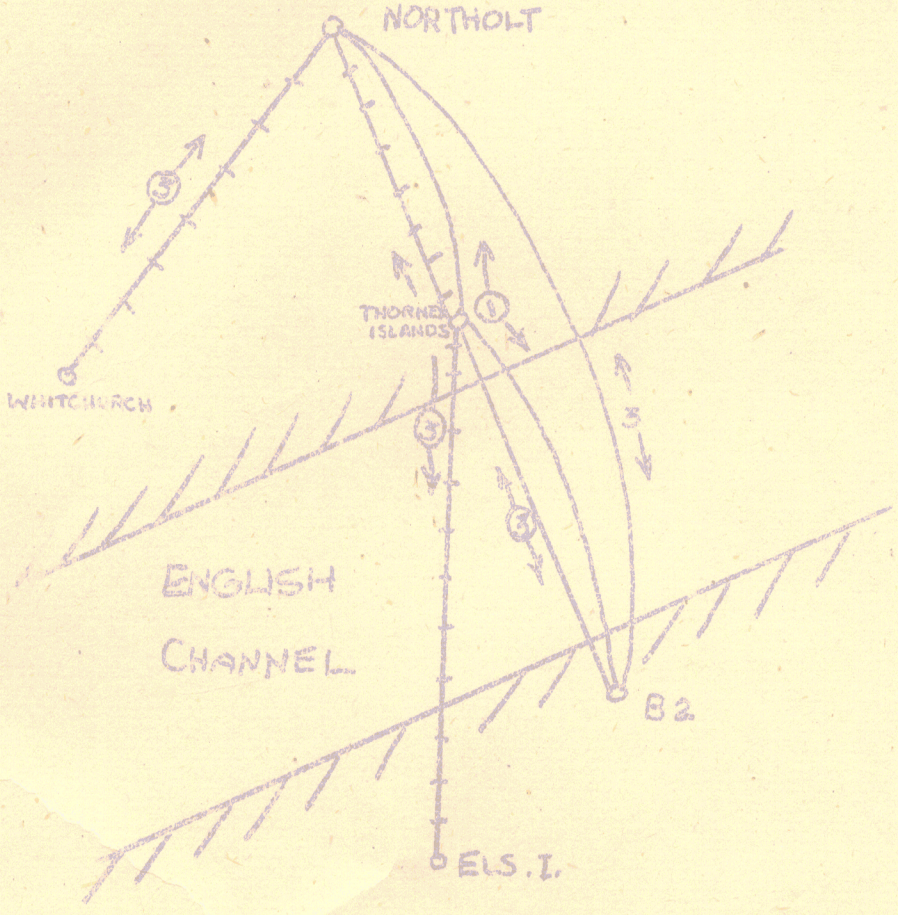
(iii) SHAEF (Main) Air (CASO) is responsible for the Ground Organisation and Operation of the ADLS.

(iv) SHAEF (Main) Air (CATOR) is responsible for the Air Organisation and Operation of ADLS.

(Sgd.) J.M. ROBB.
Air Marshal,
Deputy Chief of Staff (Air)

ADLS SERVICES

D 30



LEGEND:-

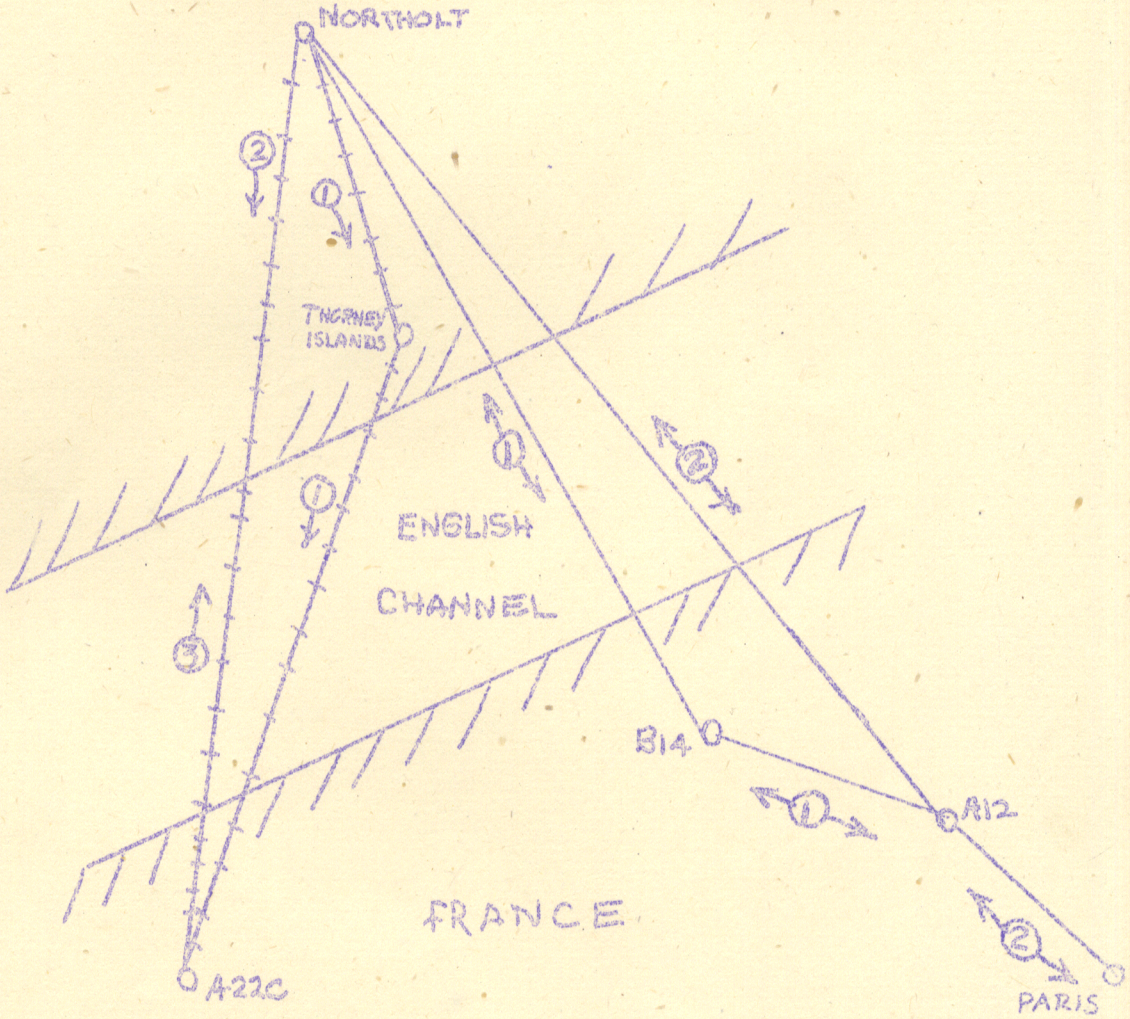
British Operated ADLS

American Operated ADLS

3 runs in each direction daily

ADLS SERVICES

29 August 1944



LEGEND:-

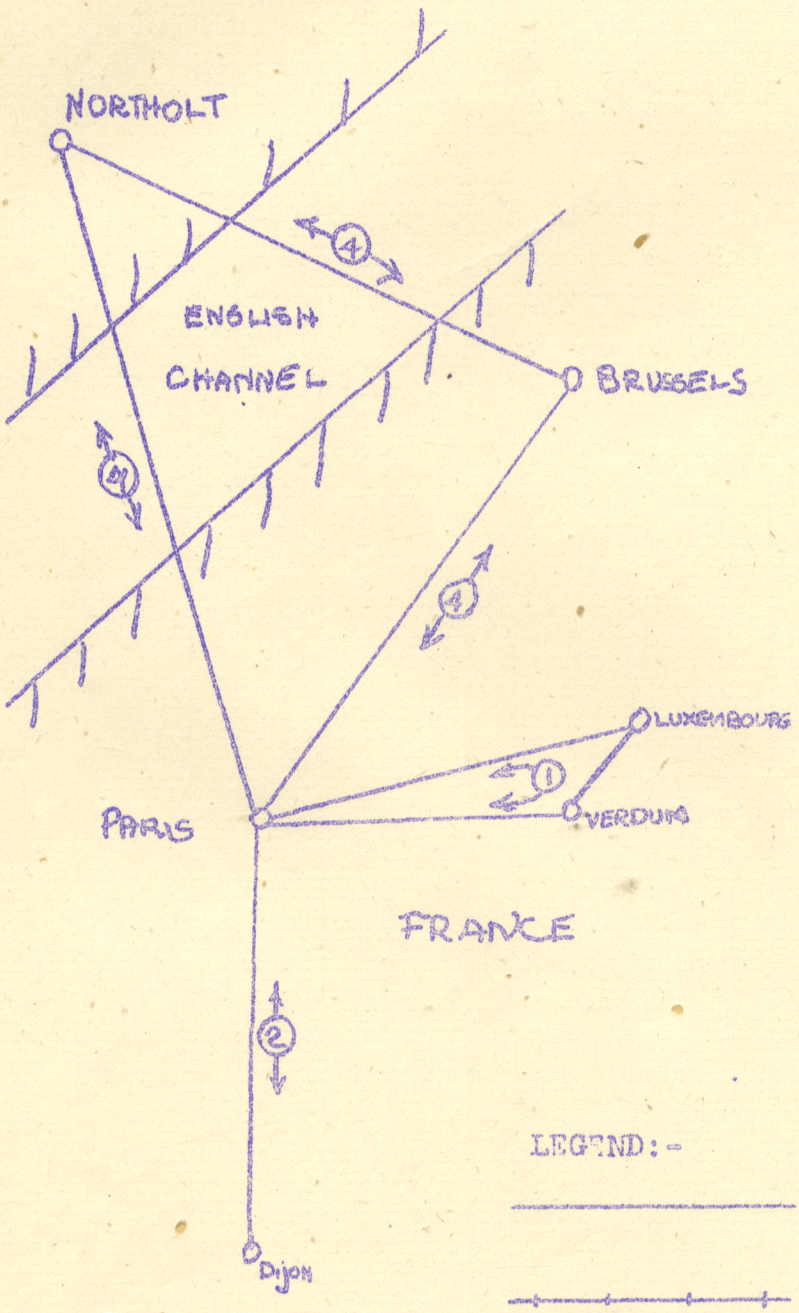
British Operated ADLS

American Operated ADLS

3 runs in each direction daily

ADLS SERVICES

January 8th 1945



LEGEND:-

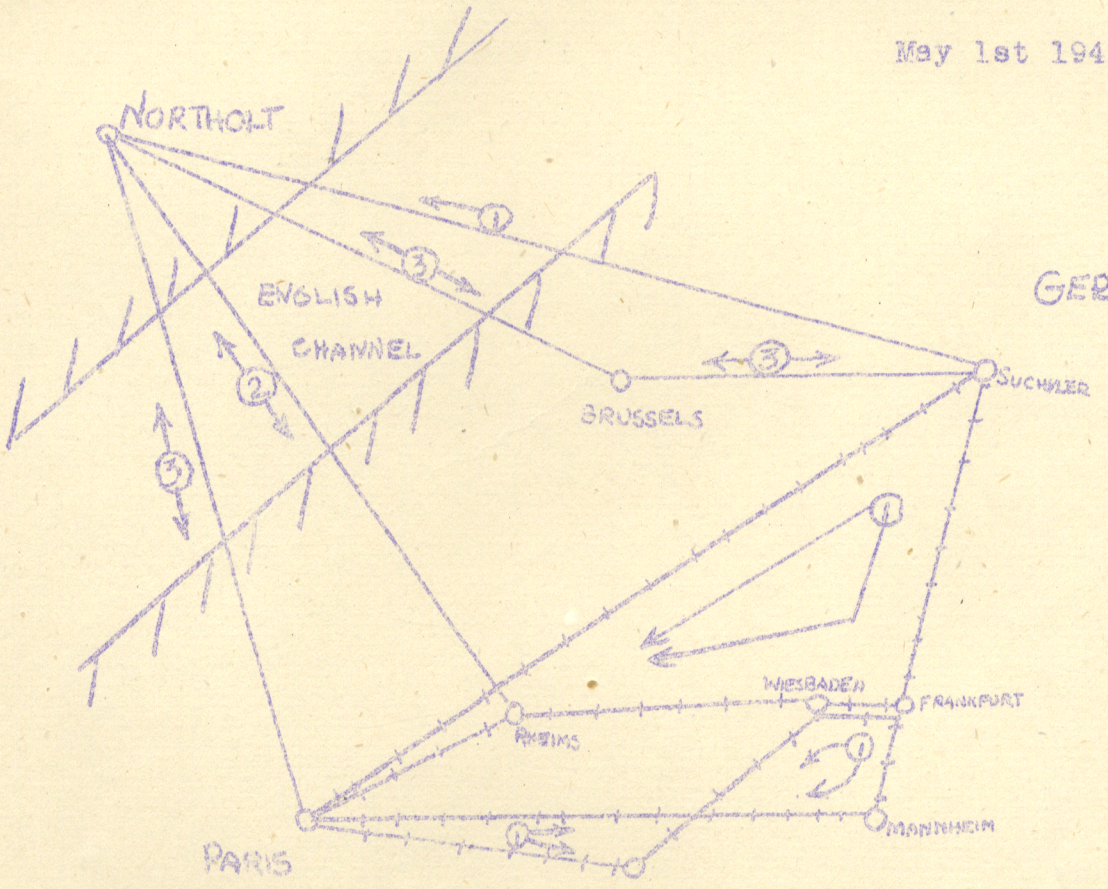
British Operated ADLS

American Operated ADLS

3 = 3 runs in each direction daily

ADIS SERVICES

May 1st 1945



LEGEND:-

British Operated ADLS

American Operated ADLS

(3) = 3 runs in each direction daily

~~SECRET~~

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

O N

O P E R A T I O N 'O V E R L O R D'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES.

S E C T I O N VII

SIGNALS SECURITY

1. The Signals Security policy prescribed and the measures in force for Operation 'OVERLORD' between D-Day and VE-Day are described below under the following headings:-

Transmission Security.
S & C Publications.
Cyphers.
Codes.
Authentication.
Call Signs.
Signals Deception.

TRANSMISSION SECURITY.

2. Steps were taken to ensure the security of telephone and telegraph transmissions on the Continent (whether by line or radio) and detailed instructions to this end are contained in Air Staff SHAEF Signals Staff Instruction No. 19. (See Appendix 'B' Section VIII).

3. Restrictions necessary before telegraph lines could be approved for the transmission in the clear of messages classified up to and including "Secret" were made, and a system was instituted whereby line classification returns were rendered and kept amended. The meeting of these conditions (particularly the requirement to patrol) became increasingly difficult as lines were extended and the Reich boundaries were approached and eventually crossed. This was especially so in the American Zone, where the rate of movement was so much greater. Consequently a large proportion of the landlines were unclassified.

4. While the rise in cypher traffic resulting from the above was considerable, it was not found necessary to augment cypher establishments, which had been provided with a view to traffic being passed by W/T in the absence of landlines, except in the 1st TAC/AF (Prov) which was notably short of all types of Signals personnel. It was found necessary to increase twofold the number of people assigned to this task.

5. The transmission security of VH/F and UH/F telegraph and telephone circuits was considered to be limited. The classification for transmission of messages in CLEAR by Type 10 was up to and including "CONFIDENTIAL" subject to the conditions that:-

(a) The messages were not the unparaphrased literal texts of cypher messages.

/(b)

(b) No terminal was situated less than 50 miles from enemy occupied territory.

The Land Forces always contended that this method of transmission was secure and not liable to interception. The Air Forces, on the advice of Air Ministry, ruled that these circuits were liable to interception and in considering the distance of 50 miles, account was taken of the possibility of an increased range where the equipment was set up at any exceptional point of vantage. (The distance limit was originally 100 miles but this was reduced to 50 miles in December, 1944).

6. VHF circuits were originally considered to be liable to interception if one or both of the terminals were within 100 miles of enemy held territory or of the Reich, whether occupied by Allied Forces or not, or of a neutral country, this classification was later emphasised by the withdrawal of the distance qualification of 100 miles.

S & C PUBLICATIONS.

7. The provisions made for the distribution, transportation and emergency destruction of Signals, Secret and Confidential Publications are covered in Air Staff SHAEF SSI Nos. 15, 16, 17, which are attached as Appendices 'A', 'B' and 'C'.

8. Distribution of British S & C Publications to British and American Air Forces and Combined Publications to the British Air Forces was effected by the Overseas Distribution Centre (O.D.C) originally established in No. 85 Group, Uxbridge. The method of distribution adopted was that the documents were packed for individual R/F Units and distributed down to R/F Groups and distribution to American Air Forces Headquarters was made in bulk, distribution to lower formations being carried out by these Headquarters. Shipment from the U.K. was initially by sea and later by air.

9. In the fall of 1944, the responsibilities of the O.D.C. had increased to include First Tactical Air Force (Prov), First Allied Airborne Army and Units of No. 46 Group (Transport Command) which were by this time located on the Continent. Owing to this expansion and to the rapid advance and consequent extended line of the Allied Forces, it was found necessary to create a forward distribution centre for units operating under 2nd T.A.F. This forward centre was established at Rear H.Q. 2nd T.A.F. and O.D.C. became the agency for bulk distribution of British S & C Publications to all the Air Forces in the European Theatre. This was effected in November, 1944, when the operational control of O.D.C. was transferred to Air Ministry. Throughout the entire operation the O.D.C. organisation proved to be satisfactory, and all distributions were made by the target dates.

10. Provision was made for the reporting of compromise by loss or capture and the restoration of security by the complete distribution and bringing into force of a subsequent edition of the document in question. (Details are contained in SHAEF 'OVERLORD' Signal Instruction Part I Section XII Item 4). All losses or suspected compromises of SECRET and CONFIDENTIAL Publications, systems, etc., were reported IMMEDIATELY to the following authorities.

(a) U.S.A.A.F.

(i) Limited Combined - To Air Staff SHAEF repeated O.D.C. and subsidiary Distributing Authorities (where applicable).

/ (ii) Other

(ii) Other than Limited Combined.- To Air Staff S.H.A.E.F. and S.I.D. Com. Z. repeated O.D.C. and subsidiary Distributing Authority (where applicable).

(b) R.A.F.

All Publications, etc. - To Air Staff S.H.A.E.F. and Air Ministry, Whitehall (D. of S) repeated O.D.C. and subsidiary Distributing Authorities (where applicable).

11. Distribution of High Grade American cryptographic material was made by S.I.D., ETOUSA direct to using organisations. Distribution of medium and low Grade American and Combined cryptographic material was made in bulk by S.I.D., ETOUSA to the respective Air Force Headquarters.

CYPHERS.

12. The Cyphers prescribed for Operation 'OVERLORD' were found to provide the necessary security. Schedules of Cypher Holdings are contained in Air Staff S.H.A.E.F. Signals Staff Instruction No. 16 which is attached as Appendix 'B' hereto.

13. The codes and cyphers especially provided for use during the assault phase (and in dangerous areas subsequently) and which were due to be replaced by normal cyphers on or about D plus 5 were, in fact, not so replaced until D plus 31 owing to the beach-head being restricted to such a small area.

14. During July, 1944, the Ninth Air Force, operating from the Continent and in the UK, found the task of encoding and decoding operational directives, mission reports, flak reports, and intelligence summaries to be retarding seriously the movement of operational traffic. As a consequence arrangements were made with S.I.D., ETOUSA for the release of SIGTOT and SIGCUM equipment to the Ninth Air Force. On 20 August 1944 a conference on this subject among representives of SID, Ninth Air Force and Air Staff, SHAEF resulted in the release of both SIGCUM and SIGTOT equipment on the following basis; Air Force Main to Air Force Rear, SIGCUM and SIGTOT; Air Force Main to Air Force Forward, SIGTOT; Air Force Main to Tactical Air Commands and Bomber Command. SIGCUM; TAC Main to TAC Forward, SIGTOT; TAC Main to Wings, SIGCUM. By September the installation of this equipment, plus additional SIGABA, had begun. The Operational results of the equipment under the fast moving tactical situation was not entirely satisfactory.

15. The SIGTOT equipment is designed to provide SECRET transmission on radio channels primarily. A SIGTOT system is capable of handling approximately 60,000 groups per day. The SIGCUM equipment is designed for CONFIDENTIAL transmission on radio channels and SECRET transmission on wire circuits. It likewise is capable of handling 60,000 groups daily and has much greater flexibility of use.

16. Both the SIGCUM and SIGTOT equipments are intended for installation under permanent conditions, with high quality wire and radiocircuit conditions. Efforts were made continually to adapt the equipment to mobile and semi-permanent conditions, but the inability to adapt the existing high speed equipment to the highly changing conditions in France caused the Air Forces to revert to the transmission of operational information in the clear by wire teletypes, where the need for speed required. SIGTOT equipment proved, in addition, too inflexible and too susceptible to the normal VHF channel interference and distortion. SIGCUM equipment proved highly satisfactory on high grade teletype circuits and moderately successful on high grade VHF circuits. The US Air Forces turned back to the

/SIGABA.

SIGABA, the basic cryptographic high speed device, and sought to perfect its operation and employment.

CODES.

17. The following prescribed by Air Staff S.H.A.E.F. were used during the campaign from D-Day to VE-Day.

(a) Operations Room Code (CD.0301). This Code, which was intended mainly for the passing by R/T of operational instructions and short intelligence summaries between airfields, Control Centres and Groups/T.A.C.'s, was not used to the extent anticipated, due to its lack of flexibility, limited vocabulary and time consuming nature. The Code was used in conjunction with R.A.F. Code Scramble recoding table (CD.0264) and the demand for these Scrambles for use with Aircraft Movements Code (see (b) below), coupled with the fact that the Code became so little used, led to the decision, at the end of January 1945 to use one Scramble indefinitely (with one Scramble in reserve), in place of new Scramble editions each month.

(b) Aircraft Movements Code (CD.0299). The Aircraft Movements Code was the Code most used during the period from D-Day to VE-Day. Its use was mainly by Movement Liaison Sections for the encoding of notifications of movements of friendly aircraft (operational or otherwise) between the UK and the Continent (and vice versa) and within the Continent. The Movement Liaison Centres set up at Hill House, Stanmore and later at Le Bourget, Paris, made extensive use of the Code, which was used in conjunction with monthly changing R.A.F. Code Scrambles (CD.0264) as in the case of the Operations Room Code. Separate editions of the Scrambles were used for messages relating to cross-channel movements and to movements within the British and American Zones. The necessity to ensure the absolute security of R.A.F. Bomber Command activities led to the decision to amend the Code in certain specific details (mainly by way of providing a greatly extended vocabulary) and to employ three separate editions of the Code Scramble, in place of the single edition originally used, for messages emanating from Hill House, Stanmore, and to establish at Hill House a Special Signals Security Section to control the proper encoding of messages and the transmission of dummy traffic. The Code was found to be satisfactory in operation and although it was slow, once staff were trained, delays due to the necessity to encode were reduced to acceptable limits.

(c) Ops/Tel Code - A requirement arose, as soon as Senior Headquarters became established on the Continent, for a code to preserve the security of operational telephone conversations between Operations Rooms at the various Air Headquarters (i.e. Air Staff S.H.A.E.F., 2nd T.A.F., Ninth Air Force and First TACAF). and between them and Command Headquarters in the United Kingdom. It was decided to employ an adaptation of Army Slidex Code comprising monthly changing special Code Cards and twice-daily changing cursor settings.

(d) Army Air Support Code. (CD 0263) The Air Support Code CD 0263 was used for giving acceptance or refusal to requests for Air Support for Ground Forces. It was used unless time (one hour or less) prevented this encoding. In August, 1944,

/reports.

reports were received that the enemy was breaking CD.0263 in sufficient time to deploy his forces. Consequently, this Headquarters ordered the re-encyphering table BX.715 to be used in conjunction with the Army Support Code. CD.0263.

AUTHENTICATION.

18. Four different authentication systems were prescribed, as follows:-

Point to Point	(W/T, R/T and T/P) - CCBP 0122.
Air to Ground	(R/T) (CD 0264)
Air to Ground	(W/T) SD 0182, superceded on 1st March, 1945 by CCBP 0127.
Point to Point.	(W/T) One Time Pad Authentication for airborne operations.

A detailed Instruction S.S.I. No. 18 covering their use is attached as Appendix 'D'.

(a) Point to Point - CCBP 0122 was held by all W/T, R/T and T/P point to point stations in both British and American air forces and was extensively used for the authentication of transmissions, particularly when opening or changing watches. The widespread distribution of this publication led to its frequent compromise, due to its constant losses by units in the front line. The reporting of loss and the supply and distribution of reserve editions proved cumbersome. The usual period between compromise and introduction of the revised edition was approximately one week, during which times no combined authentication system was available. Several of the Air Forces developed their own simple systems for intra-Air Force use during these periods.

(b) Air/Ground.

(i) R/T - Specific editions of the R.A.F. Code Scrambles (CD 0264) were adapted for use for R/T authentication by British and American air forces and proved entirely satisfactory in operation. While in the early stages the system was extensively used, the fact that the enemy made infrequent attempts to pass bogus messages to Allied aircraft (possibly on account of his knowledge that a system of authentication existed) led eventually to its being used only when specific instances of enemy attempts to deceive were suspected - as they were from time, in both British and American zones.

(ii) W/T - Although systems of W/T air-to-ground authentication were available(initially SD 0182H, superceded by CCBP 0127), the use for these was negligible, mainly on account of the fact that air/ground communication was almost entirely R/T.

(c) Emergency authentication with airborne forces - To meet the need for authentication between Airborne forces and ground, naval, or air forces during the initial stage of an airborne operation One Time Pads of serially numbered sheets, each sheet containing 125 four figure groups, were provided by First Allied Airborne Army and distributed down to, and including, division level in the ground forces and Group/TAC level in the air forces. This system remained in effect throughout the existence of the First Allied Airborne Army, and

was used for each operation until such time as normal authentication systems could be delivered to the airborne forces.

CALL SIGNS.

19. The principle of fixed callsigns for both ground stations and aircraft decided upon for operation 'OVERLORD' was maintained throughout the period under review with one major exception, viz. when Ninth Air Force in concert with the associated Twelfth Army Headquarters changed all major unit point-to-point and air/ground callsigns, to conceal the move of their Advanced H.Q. from Luxembourg to Namur.

2nd T.A.F. 83 GROUP -

The provisions made for the temporary allocation of new callsigns by lower formations, to achieve tactical deception in connection with aircraft sorties, were made use of on a number of occasions.

20. The system employed of listing both British and American callsigns in one book (R/T: CD 0270/AEAF. W/T: CD 0268/AEAF) proved in practice to be both cumbersome and wasteful. Cumbersome in that each individual requirement had to receive sanction of Air Staff S.H.A.E.F., thereby causing delays, occasional misunderstandings and unnecessary signalling and correspondence; and wasteful in that little or no use was made on the U.S. side, below Air Force H.Q. level, of the books provided. Instead, callsign lists were reproduced by the U.S. Air Forces and distributed in the form of Signal Operational Instructions.

SIGNALS DECEPTION.

21. In view of the overwhelming success of the ground forces, together with air supremacy throughout the whole campaign, it was not found necessary to put into operation any major deception schemes with the exception of the scheme planned and effected by First Allied Airborne Army to cover the airborne aspect of the Rhine crossing.

~~SECRET~~

APPENDIX "A" SECTION VII

AIR STAFF
SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE

SIGNALS STAFF INSTRUCTION NO. 16

HOLDINGS OF SIGNALS S. & C. PUBLICATIONS

1. The schedules of Holdings of Signals Secret and Confidential Publications contained in Tables 1 to 5A of this Instruction are to be regarded as a general guide and are subject to modification in accordance with the requirements of Chief Signals Officers.

(Sgd.) S.E.ELLIS
Squadron Leader
Signals Security

26th April, 1945

Distribution

SHAEF Signal Division (Main)	2 copies	Internal
" " " (Fwd)	2 "	Deputy Chief of Staff (Air)
" " " (Rear)	2 "	
HQ 2nd TAF (Main)	2 "	A/COS A-4
HQ 2nd TAF (Rear)	7 "	CASO
USSTAF	2 "	D/CASO.1
ETOUSA	2 "	D/CASO.2
HQ 1st TACAF (Main)	2 "	CAFSO
HQ 1st TACAF (Adv.)	2 "	S.R.O.
HQ Ninth Air Force (Main)	2 "	Operations Records.
HQ Ninth Air Force (Adv)	2 "	Signals 1
SHAEF Mission (France)	1 "	Signals 1A
HQ F.A.A.A.	2 "	Signals 1B
HQ 8th Air Force	1 "	Signals Plans (Main)
A.N.C.X.F.	1 "	Signals Security
O.D.C.	1 "	Signals A.D.L.S.
Air Ministry (Sigs.5)	1 "	
Base Signal Centre	1 "	
HQ RAF Fighter Command	1 "	
HQ RAF Transport Command	1 "	
HQ 46 Group	1 "	
HQ 60 Group	1 "	
HQ 26 Group	1 "	
HQ 38 Group	1 "	
HQ 72 Wing	1 "	
R.A.A.F. Overseas HQ	1 "	
Kodak House, 63 Kingsway WC2.	1 "	

List A Groups - All Groups in Bomber, Coastal, Fighter, Maintenance and Transport Commands (except 60 Group)

List B Groups - All Groups not in List A.

List C Stations -

Bomber Command	Chigwell	¤ Tompsford
Coastal Command	Gosport	St. Eval
	Calshot	St. Davids
	Mt. Batton	¤ Benson
	Thorney Island	
Fighter Command	Portreath	∅ Tilstock
	Biggin Hill	North Weald
	Castle Camps	Tangmere
	∅ Ashbourne	Odiham
	∅ Tarrant Rushton	
	West Malling	
Transport Command	St. Mawgan	Down Ampney
	Lyncham	Broadwell
	Hendon	Blakehill Farm
Maintenance Command	55 Wing	

¤ Denotes SD.0222(N) and (P) settings not held

∅ Denotes SD.0222(N) settings not held

NOTE - For cyphers held by Stations in U.K. not included in List C. see SD.0353.

TABLE NO. 1

"A" AIR STAFF S.H.A.E.F.

"B" OTHER R.A.F. COMMANDS ETC.

	CODES AND CYPHERS USED IN CYPHER ROOMS																																	MISCELLANEOUS CODES															SIGNAL PUBLICATIONS										
	1 MK 11 Hollow Drums	2 No. 8 Special Inserts	3 MK 11 Solid Drums	4 SD 0222-E	5 SD 0222-B	6 SD 0222-H (2)	7 SD 0222-N	8 SD 0222-P	9 SD 0222 I-S (3)	10 SD 0222 (4)	11 SD 0277-B	12 SD 0277-E	13 CCBP 0101	14 CCBP 0102	15 CCBP 0131	16 CCBP 0132	17 BX 824	18 SD 045/5	19 SD 0372 HOME	20 SD 0383 HOME	21 SD 0459/1	22 SD 0356	23 SD 0364	24 SD 0273/0274	25 SD 0275	26 CCBP 0121/0129	27 CCBP 0125/0126	28 SD 0319	29 SD 320	30 SD 0372 GENERAL	31 SD 0383 GENERAL	32	33	34 CD 0251 (FERRY)	35 CD 0256	36 CD 0263	37 CD 0264A	38 CD 0301	39 CD 0264-B	40 CD 0299	41 CD 0264-A (R/T AUTH).	42 CD 0250	43 CCBP 0122A	44 CCBP 0127	45 SP 02240	46 SP 02242	47 CD 0302	48	49 CD 0114/GEN	50 CD 0112	51 CD 0268	52 CD 0269	53 CD 0270	54 CD 0271	55 CD 0272	56 CD 0268/AEAF	57 CD 0270/AEAF	58 CD 0910	59
"A"																																																											
1 Air Staff SHAEF Rear	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x												x						x	x	x	x	x	x	x	x	x	x	
2 Air Staff SHAEF Main	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x														x						x	x	x					x		x	
3 Air Staff SHAEF Forward	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x														x						x	x	x	x	x	x	x	x	x	x	
4 Air Staff SHAEF CP.																																																											
"B"																																																												
5 Air Ministry Whitehall	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x																		x	x	x	x	x	x	x	x	x	x	
6 Air Ministry Kingsway	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x																			x						x		x	
7 Air Ministry Harrogate	x	x	x	x	x	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x		x	x	x	x	x																		x	x	x					x		x	
8 Leighton Buzzard	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x		x	x	x																				x	x	x	x	x	x	x	x	x	x	
9 Home Commands	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x												(a)	x	x	x	x		x	x	x	x	x	x	x	x	x	x	
10 List "A" Groups	x	x	x	x	x	x	x	x	x		x	x	x		x		x	x	x	x	x	x	x	x	x		x	x	x															x	x	x	x		x	x	x	x	x	x	x	x	x	x	
11 List "B" Groups																		x	x	x	x	x	x						x															x	x	x	x		x	x	x	x	x	x	x				
12 List "C" Stations	x	x				x	x	x			x							x	x	x	x	x	x					x	x															x			x		x	x	x	x	x	x	x	x	x	x	
13 List "D" Stations																																																											
14 38 Group	x	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x							x			x	x		x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	
15 46 Group	x	x	x	x	x	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x							x			x	x				x	x	x	x		x	x	x	x	x	x	x	x	x	x	
16 Air Div.Control Commission Germany	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x														x						x	x					x	x	x	x	
17																																																											
18																																																											
19																																																											
20 (a) denotes held by																																																											
21 Transport Command only																																																											

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TABLE NO. 2

HQ 2 T.A.F. & UNITS

Unit	CODES & CYPHERS USED IN CYPHER/CRYPT ROOMS																														MISCELLANEOUS CODES													MET CODES					SIGNAL PUBLICATIONS								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
	Mk II Hollow Drums No. 8 Special Inserts	Interservice Drums	SD 0222E	SD 0222F	SD 0222 Home	SD 0222N	SD 0222P	SD 0222 I's	SD 0277B	SD 0277E	SD 0277 Standard	SD 0319 Gen.	OCBP 0111	OCBP 0101	OCBP 0102	OCBP C131 & BX 824	S.C.F. 045	SD 0456	SD 0356	SD 0364	SD 0372	SD 0383	SD 0459	SD 0255/6/7/8	SD 0273/0274	SD 0275	SD 320	OCBP 0125/0126	OCBP 0121A/0129	BX 735	CD 0263	CD 0264A	CD 0264B	CD 0299	CD 0301	OCBP 0122	H 209	CD 0286	SD 066 (H)	CD 0296	CD 0303	SP 02440	SP 02442	CD 0115 (3)	CD 0277	CD 0278 (EUROP)	CD 0279 (SPECIAL)	CD 014/Gen.	CD 0268/Home	CD 0269	CD 0270	CD 0271	CD 0272	CD 0268/AEAF	CD 0270/AEAF	CD 0910	CD 0112/9
1 HQ 2nd TAF (Main & Rear)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x										x		x	x	x	x		x					x	x	x	x
2 HQ 2 Group	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x		x	x	x	x	x						x	x	x	x	x	x							x	x	x	x
3 HQ 83 Group	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x							x	x	x	x
4 HQ 84 Group	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x						x	x	x	x	x	x							x	x	x	x
5 HQ 85 Group	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x	x	x			x	x	x	x	x	x						x	x											x	x	x	x
6 HQ 87 Group																																																									
7 34 Wing	x	x	x		x	x	x	x	x	x	x	x						x	x	x	x	x	x		x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x							x	x	x	x
8 Wings in 2 Group	x				x		x		x		x	x						x	x	x	x	x	x				x		x	x		x	x	x	x	x						x	x	x	x	x	x							x	x	x	
9 Wings in 83 & 84 Groups	x				x		x		x		x	x						x	x	x	x	x	x		x	x	x		x	x		x	x	x	x	x						x	x	x	x		x							x	x	x	
10 Wings in 85 Group	x				x		x		x		x	x						x	x	x	x	x	x		x	x	x					x	x	x	x	x						x	x	x	x	x	x							x	x	x	
11 Base Signals Centre	x	x	x	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	x	x	x	x	x	x		x	x	x	x	[illegible]	[illegible]	[illegible]	[illegible]		x	x	x	x								x								x	x	x	x		x					x	x	x	x
12 G.C.C.'s	x				x		x		x		x	x						x	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x													x	x	x	
13 G.C.I's. A.M.E.S. etc.																															x	x	x	x	x	x	x	x	x	x	x	x													x		
14 A.S.P's. R.S.U's	x				x		x		x		x	x						x	x	x	x	x	x				x									x																		x		x	
15 S & T.C's. A.F.A.P's	x				x		x		x		x	x						x	x	x	x	x	x				x									x																		x		x	
16 M.F. Hos. M.T.L.R.U.	x				x		x		x		x	x						x	x	x	x	x	x				x									x																		x		x	
17 Group Support Unit	x				x		x		x		x	x						x	x	x	x	x	x				x					x	x	x	x	x																		x	x	x	
18 M.S.S.U's	x				x		x		x		x	x						x	x	x	x	x	x				x									x																		x		x	
19 A.L.G's	(a)				x		x		x		x	x						x	x	x	x	x	x				x									x																		x		x	
20 R & R.U's	x				x		x		x		x	x						x	x	x	x	x	x				x									x						x	x											x		x	

(a) denotes Mark VI Type X.

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TABLE NO. 5.

NINTH AIR FORCE

CODES & CIPHERS USED IN CRYPT. ROOMS

No.	Unit	1 Sigtot	2 Sigcum System 2203	3 Cryptonet 13	4 Cryptonet 14	5 Cryptonet 15	6 Cryptonet 22	7 Cryptonet 40	8 System 49	9 CCBP 0101	10 CCBP 0102	11 CCBP 0131	12 CD 045/5	13 SD 0364	14 SD 0459	15 CCBP 0121	16 CCBP 0129	17 CCBP 0125	18 CCBP 0126	19 M 209	20 Crypt. System 2207	21 Crypt. System 2227	22	23
1	HQ 9th Air Force			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
2	HQ 9th Air Force Adv.	X	X		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
3	HQ 9th Air Force Adv. CP.						X					X	X	X	X	X	X	X	X	X	X	X		
4	HQ IX, XIX, XXIX TAC (R)						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
5	HQ IX, XIX, XXIX TAC (A)	X	X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
6	HQ IX, XIX, XXIX TAC (Adv. CP)	X					X					X	X	X	X	X	X	X	X	X	X	X		
7	HQ IX AFSC				X		X			X	X	X	X	X	X	X	X	X	X	X	X	X		
8	HQ IX ADC						X			X	X	X	X	X	X	X	X	X	X	X	X	X		
9	HQ IX ADC Adv.						X					X	X	X	X	X	X	X	X	X	X	X		
10	HQ 9th Bomb Div.		X				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
11	HQ IX Eng. Cmd						X			X	X	X	X	X	X	X	X	X	X	X				
12	HQ IX Eng. Cmd. Adv.						X					X	X	X	X	X	X	X	X	X				
13	Fighter Wings		X				X					X	X	X	X	X	X	X	X	X				
14	Bomb Wings						X					X	X	X	X	X	X	X	X	X				
15	HQ AADA						X					X	X	X	X	X	X	X	X	X				
16	Air Depot Groups												X	X	X	X	X			X				
17	Service Groups												X	X	X	X	X			X				
18	Bomb Groups, Det. Sqdns. Pathfinder Force												X	X	X	X	X			X				
19	Ftr. Nite Ftr. Photo and T.C. Recce Gps. Det. Sqdns.												X	X	X	X	X			X				

MISCELLANEOUS CODES (24–36) / SIGNAL PUBLICATIONS (37–50)

No.	Unit	24 CD 0263	25 CD 0264A	26 CD 0264B	27 CD 0299	28 CD 0301	29 CCBP 0122	30 CCBP 0127	31 CD 0250	32 SP 02240	33 SP 02242	34 CD 0264A (R/T Auth.)	35	36	37 CD 0268/AEAF	38 CD 0270/AEAF	39 CD 0910	40	41	42	43	44	45	46	47	48	49	50
1	HQ 9th Air Force						X			X	X				X	X	X											
2	HQ 9th Air Force Adv.	X	X	X	X	X	X			X	X				X	X	X											
3	HQ 9th Air Force Adv. CP.	X	X			X	X								X	X	X											
4	HQ IX, XIX, XXIX TAC (R)						X			X	X				X	X	X											
5	HQ IX, XIX, XXIX TAC (A)	X	X	X	X	X	X			X	X				X	X	X											
6	HQ IX, XIX, XXIX TAC (Adv. CP)	X	X			X	X																					
7	HQ IX AFSC						X			X	X				X	X	X											
8	HQ IX ADC						X			X	X				X	X	X											
9	HQ IX ADC Adv.						X			X	X				X	X	X											
10	HQ 9th Bomb Div.	X	X	X	X	X	X	X	X	X	X				X	X	X											
11	HQ IX Eng. Cmd						X																					
12	HQ IX Eng. Cmd. Adv.						X																					
13	Fighter Wings	X	X			X	X			X	X																	
14	Bomb Wings	X	X			X	X	X	X	X	X																	
15	HQ AADA						X																					
16	Air Depot Groups						X																					
17	Service Groups						X																					
18	Bomb Groups, Det. Sqdns. Pathfinder Force		X			X	X	X	X																			
19	Ftr. Nite Ftr. Photo and T.C. Recce Gps. Det. Sqdns.		X			X	X																					

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TABLE NO. 3 cont.

NINTH AIR FORCE

		CODES & CIPHERS USED IN CRYPT ROOMS																					MISCELLANEOUS CODES												SIGNAL PUBLICATIONS														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
		Sigtot	Sigcum System 2203	Cryptonet 13	Cryptonet 14	Cryptonet 15	Cryptonet 22	Cryptonet 40	System 40	CCBP 0101	CCBP 0102	CCBP 0131	CD 0455	SD 0364	SD 0459	CCBP 0121	CCBP 0129	CCBP 0125	CCBP 0126	T.209	Crypt System 2207	Crypt System 2227			CD 0263	CD 02644	CD 02645	CD 0292	CD 0301	CCBP 0122	CCBP 0127	CD 0250	SP 02210	SP 02212	CD 02644A (R/T Auth)			CD 0268/AMWP	CD 0270/AMWP	CD 0910													
20	Flying Control (TAC) (EC & AESC)																																																	
21	Airdrome Sqdns																																																	
22	Ftr. Control Centres																																																	
23	BAW Battalion H.Q. (TAC)																																																	
24	BAW Battalion H.Q. (ADC)																																																	
25	G.C.I's, IEK's, IDP's, VHF/DF Stns. COR'd & MRU's																																																	
26	L.W. Sets & COP's																																																	
27	AAA Brigades																																																	
28	AAA Groups & Battalions																																																	
29	AAA Ops Rooms																																																	
30	Engr. Brigades																																																	
31	Engr. Regiments																																																	
32	Engr. Bns. Cam Bn. Maint. Regt.																																																	
33	Engr. Recce Parties																																																	
34	40th Mob. Con. Sqdns & Dets.																																																	
35	TAC Air Comm Sqdn. HQ MCS's Air Sup. Parties. ALO Parties																																																	
36	G-2 Air Met. Stations																																																	
37	MLC - Le Bourget																																																	
38																																																		
39																																																		
40																																																		

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TABLE NO. 4

FIRST TACAF

		CODES & CYPHERS USED IN CRYPT. ROOMS																						MISCELLANEOUS CODES												SIGNALS PUBLICATIONS									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
		Cryptonet 13	Cryptonet 14	Cryptonet 15	Cryptonet 22	Cryptonet 40	System 2203	System 363	CCBP 0101	CCBP 0102	CCBP 0131	SD 045/5	SD 0364	SD 0459	CCBP 0125/0126	CCBP 0121A/0129	M.209 with TACPAL	French Book Cypher	System 514	System 2207	System 2237	CD 0263	CD 0264A	CD 0301	CD 0243	CD 0299	CD 0264A (R/T Auth)	CCBP 0122A	CD 0250	SP 02440	SP 02442	CCBP 0127			CD 0260/AEAF	CD 0270/AEAF	CD 0910									
1	First TAC AF (Prov)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X				X	X				X	X	X									
2	XII TAC (Adv)		X		X			X	X	X	X	X	X	X	X	X	X		X	X	X							X							X	X	X									
3	XII TAC (Rear)		X		X			X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X		X	X				X	X	X									
4	64th Fighter Wing				X			X	X		X	X	X	X	X	X	X		X						X	X	X	X		X	X				X	X	X									
5	Fwd. Sector Ops & Control Centres				X			X	X		X	X	X	X	X	X	X		X								X	X		X	X				X	X	X									
6	TAC/R Group & Fighter Groups				X			X	X		X	X	X	X	X	X	X		X								X	X		X	X				X	X	X									
7	Night Fighter Sqdn.																										X	X		X	X				X	X	X									
8	42nd Bomb Wing				X		X	X	X		X	X	X	X	X	X	X		X								X	X	X	X	X	X			X	X	X									
9	Bomber Groups				X			X	X		X	X	X	X	X	X	X		X								X	X	X	X	X	X			X	X	X									
10	First French Air Corps				X			X	X		X	X	X	X	X	X	X	X	X			X					X	X		X	X				X		X									
11	2nd French Bomb Wing											X	X	X			X										X	X		X	X				X		X									
12	First French Fighter Wing																X	X										X							X		X									
13	Ftr/Bomber Groups (FAF)																X	X										X							X		X									
14	Bomber Groups (FAF)																X	X										X																		
15	French Air Forces of the West				X			X	X		X				X	X	X		X								X	X							X	X	X									
16	213th AAA Group							X				X	X	X	X	X	X											X		X	X															
17	54lst AA Groupement (Fr).																X	X																												
18	AAA Battalions																X																													
19	AAA Batteries																																													
20	86th Air Depot Group				X			X	X		X	X	X	X	X	X	X		X								X	X	X	X	X	X														
21	Air Service Groups							X				X	X	X		X	X											X																		
22	Fwd. Ftr. Control																X										X	X																		
23	2nd TAC Air Comm Sqdn.																X					X						X																		
24																																														
25																																														
26																																														

~~S E C R E T~~

TABLE NO. 5

ROYAL NAVY

		1 SD 0222 E	2 SD 0222 F	3 CCBP 0101	4 CCBP 0102	5 CCBT 0131	6 CCBP 0132	7 CCBP 0124/5/6	8	9	10	11	12		
1	Admiralty	X	X	X	X	X	X	X							
2	C in C Home Fleet	X	X	X	X	X	X	X							
3	C in C Western Approaches		X	X	X	X		X							
4	C in C Portsmouth		X					X							
5	C in C Rosyth		X	X	X	X		X							
6	C in C The Nore		X	X	X	X	X	X							
7	Admiral Cmdg. Iceland	X	X	X	X	X		X							
8	F.O.C. Orkney & Shetland	X	X	X	X	X		X							
9	Vice Admiral Cmdg. Destroyers Home Fleet		X	X	X	X		X							
10	Naval Cdr. Eastern Task Force							X							
11	Naval Cmdr. of Forces G.J.L.S.							X							
12	Assault Gp. Cmdrs. Force G.J.L.S.							X							
13	F.O. Dover	X	X	X	X	X	X	X							
14	F.O. Submarines	X	X					X							
15	..N.C.X.F.	X	X	X	X	X	X								
16	Flag Officers i/c Ashore							X							
17	" " Naval Air Stns.	X	X	X	X	X		X							
18	" " & Commodores Afloat		X	X		X		X							
19	Commodore Antwerp		X	X		X									
20	Assault Force HQ's Ships							X							
21	F.O.I.O Greenock	X	X	X	X	X		X							
22	" Harwich	X	X	X	X	X		X							
23	" Sheerness	X	X	X		X		X							
24	" Portland	X	X	X	X	X		X							
25	" Southampton	X	X	X	X	X		X							
26	" Southend	X	X												
27	" Milford Haven	X	X	X	X	X		X							
28	All other FCIO's at Home		X	X		X		X							
29	Sea going ships Cruisers & above		X	X		X		X							
30															
	UNITED STATES NAVY														
31	All Flag Officers			X	X	X		X							
32	Commandants Occupied Ports			X		X		X							
33	Force HQ Ships			X		X		X							
34	Destroyers and above			X		X		X							
35															
36															
37															
38															
39															

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TABLE NO. 5A.

ARMY (BR).

		1 SD 0222 E	2 SD 0222 F	3 CCBP 0101	4 CCBP 0102	5 CCBP 0132	6 CCBP 0132	7 BW 824	8 CCBF 0124-5-6	9	10
1	War Office	x	x	x	x	x	x	x	x		
2	Combined HQ Portsmouth	x	x	x	x	x		x	x		
3	GHQ Home Forces	x	x	x	x	x		x	x		
4	Scottish Command	x	x	x	x	x		x	x		
5	Southern Command	x	x	x	x	x		x	x		
6	Eastern Command	x	x						x		
7	Northern Command	x	x						x		
8	Western Command	x	x						x		
9	A.A. Command.	x	x						x		
10	Northern Ireland District	x	x						x		
11	London District.	x	x						x		
12	No. 5 HQ-Signals (SHAEF)	x	x	x	x	x	x	x	x		
13	First Allied Airborne Army	x	x	x	x	x		x	x		
14	All Corps HQ. [illegible]	x	x			x		x	x		
15	TAC HQ 21st Army Group	x	x	x	x	x	x	x	x		
16	All Corps HQ. 21st Army Group		x					x	x		
17	All other echelon HQ.21 Army Gp.	x	x	x	x	x	x	x	x		
18	First Canadian Army	x	x	x	x	x		x	x		
19	Second Army	x	x	x	x	x		x	x		
20	H.Q. L of C	x	x	x	x	x		x	x		
21	4 L of C		x					x	x		
22	11 L of C		x					x	x		
23	6 L of C		x					x	x		
24	15 L of C		x					x	x		
25	12 L of C		x					x	x		
26	9 L of C		x					x	x		
27	Bayeux Trunks		x					x	x		
28	7 & 8 Base Sub Area.		x					x	x		
29	1 Tk Transporter Column Brussels		x					x	x		
30	All Divisions								x		
	UNITED STATES ARMY										
31	HQ Army Groups			x	x	x			x		
32	HQ Armies			x	x	x			x		
33	HQ Corps					x			x		
34	HQ Divisions					x			x		
35	HQ Regiments								x		
36	HQ Base Sections								x		
37	Major Ports								x		
38	Sub Ports								x		
39	Major Depots								x		

SECRET.

SECTION VII.

AIR STAFF
SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE

SIGNALS STAFF INSTRUCTION NO. 16.

AMENDMENT LIST NO. 1.

Tables 1 to 5.	Delete CCBP 0131 Insert CCBP 0231
Table 5A	Column 5, delete CCBP 0132 Insert CCBP 0231
Table 2	Line 6, MQ 87 Group, insert "x" in following columns:- 1 to 3, 5 to 14, 16 to 23, 25 to 28, 31 to 36, 42 and 43, 54 to 57.

1st May, 1945.

(Sgd) S.J. Burby, F/Lt.
for S.E. ELLIS.
Squadron Leader,
Signals Security.

Distribution:

To all holders.

~~SECRET~~

APPENDIX "B"

SECTION VII.

AIR STAFF
SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE

SIGNALS STAFF INSTRUCTION NO. 16.

HOLDINGS OF SIGNALS S & C PUBLICATIONS.

1. The schedules of Holdings of Signals Secret and Confidential Publications contained in Tables 1 to 5A of this Instruction are to be regarded as a general guide and are subject to modification in accordance with the requirements of Chief Signals Officers.

26th April, 1945.

(Sgd) S.E. ELLIS,
Squadron Leader,
Signals Security.

Distribution.

SHAEF Signal Division (Main)	2 copies	Internal.	
" " " (Fwd)	2 "		
" " " (Rear)	2 "	Deputy Chief of Staff (Air)	
HQ 2nd TAF (Main)	2 "	A/COS A-4	
HQ 2nd TAF (Rear)	7 "	CASO	
USSTAF	2 "	D/CASO 1.	
ETOUSA	2 "	D/CASO 2.	
HQ 1st TACAF (Main)	2 "	CAFSO	
HQ 1st TACAF (Adv)	2 "	S.R.O.	
HQ Ninth Air Force (Main)	2 "	Operations Records.	
HQ Ninth Air Force (Adv)	2 "	Signals 1.	
SHAEF Mission (France)	1 "	Signals 1.A.	
HQ T.A.A.A.	2 "	Signals 1.B.	
HQ 8th Air Force	1 "	Signals Plans (Main).	
A.N.C.X.F.	1 "	Signals Security.	
O.D.C.	1 "	Signals A.D.L.S.	
Air Ministry (Sigs.5.)	1 "		
Base Signal Centre	1 "		
HQ RAF Fighter Command	1 "		
HQ RAF Transport Command	1 "		
HQ 46 Group	1 "		
HQ 60 Group	1 "		
HQ 26 Group	1 "		
HQ 38 Group	1 "		
HQ 72 Wing	1 "		
R.A.A.F. Overseas HQ Kodak House, 63 Kingsway WC2	1 "		

~~SECRET~~

SECTION VII.

List A Groups - All Groups in Bomber, Coastal, Fighter, Maintenance and Transport Commands (except 60 Group)

List B Groups - All Groups not in List A.

List C Stations -

Bomber Command	Chigwell	ǂ Tempsford
Coastal Command	Gosport	St. Eval
	Calshot	St. Davids
	Mt. Batten	ǂ Benson
	Thorney Island	
Fighter Command	Portreath	ϕ Tilstock
	Biggin Hill	North Weald
	Castle Camps	Tangmere
	ϕ Ashbourne	Odiham
	ϕ Tarrant Rushton	
	West Malling	
Transport Command	St. Mawgan	Down Ampney
	Lyncham	Broadwell
	Hendon	Blakehill Farm
Maintenance Command	55 Wing	

ǂ Denotes SD.0222(N) and (P) settings not held

ϕ Denotes SD.0222(N) settings not held.

NOTE - For cyphers held by Stations in U.K. not included in List C. see SD.0353.

~~SECRET~~
APPENDIX 'B'
SECTION (VII)

AIR STAFF SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE.

SIGNAL STAFF INSTRUCTION NO. 15.

EMERGENCY DESTRUCTION OF S & C PUBLICATIONS AND CYPHER DEVICES.

1. It cannot be too strongly emphasised that Secret and Confidential Publications MUST be destroyed if there is any risk of their falling into enemy hands. IT IS FAR BETTER TO DESTROY THEM TOO EARLY THAN TOO LATE.

2. Commanding Officers are responsible for the issue of emergency destruction schemes for the units they command and all detached units under their control. It is the responsibility of holders of S & C Publications and Cypher Devices to destroy them in an emergency. Any satisfactory scheme for destruction of cryptographic material must entail the adequate training of personnel and the provision of proper storage and facilities for destruction.

AUTHORITY FOR EMERGENCY DESTRUCTION.

3. British Component. The authority required for ordering the emergency destruction of Secret and Confidential Publications and documents is stated in SD 0461 para. 115 (1). The relevant passage is as follows : -

> "In War, Commanding Officers must issue orders to ensure that in an emergency all Cyphers and Registered Secret and Confidential Publications can be destroyed at short notice. The orders must make it clear that, if there is no time to refer to the Commanding Officer, every individual concerned must act on his own initiative in the matter, and that, even if events prove that destruction was unnecessary and subsequent messages have to be sent in plain language in consequence, this is a matter of minor importance compared with the possible loss of the cyphers and publications themselves".

4. American Component. The authority required for ordering the emergency destruction of classified material is stated in AR 380-5, para. 45b, which reads as follows : -

> "When it has become highly probable that cryptographic material will be subject to loss or compromise, all documents and translations of messages will be destroyed by burning, and the cypher machines or devices will be destroyed beyond use or repair, and if possible, beyond recognition".

RESPONSIBILITY FOR EMERGENCY DESTRUCTION.

5. (i) It is to be impressed upon all members of Cypher Staffs that the responsibility for the safety of Secret and Confidential Publications and Cypher Devices is shared by ALL CYPHER PERSONNEL, and in the absence, through any cause, of the Senior Officer, responsibility passes automatically to the next Senior Officer, N.C.O., or O.R/EM.

(ii) Cypher personnel are not to leave their posts in an emergency until either destruction of Secret and Confidential publications and Cypher devices has been completed, or until they are ordered to do so by the Senior member of the Cypher staff present, or a superior Officer.

/ Para. 6

6. It MUST BE MADE CLEAR to all cypher personnel that NO instruction can provide for ALL contingencies and individual initiative and common sense are required to deal with circumstances as they arise

METHODS OF DESTRUCTION.

7. Typex Drums.

(i) Hollow drum inserts are to be destroyed by breaking with a hammer. After the ebonite has been broken up the wire connections exposed are to be cut and if time permits the inserts are to be further destroyed by fire and the resulting debris scattered.

(ii) Solid Drums are to be destroyed by placing them in a flanged metal ring, (which is supplied for the purpose), which permits the ebonite centre to be hammered out of the drum. After the ebonite has been knocked out, all wire connections exposed are to be cut. If time permits, the ebonite and cut wiring are to be further destroyed by fire, and the resulting debris scattered.

(iii) C.C.M. Drums are to be destroyed by breaking with a hammer. After the ebonite has been broken the wire connections exposed are to be cut, and if time permits, the pieces further destroyed by fire, and the resulting debris scattered.

8. Typex Machines.

(i) All plugs are to be removed from plug boards and fixed scrambler heads on the machine, together with the plugboards. These are then to be smashed to prevent the wiring from being reconstructed. Further destruction, if time permits, to be carried out by fire, and the resulting debris scattered. Machines to be throughly smashed.

(ii) The C.C.M. Adaptor is to be thoroughly smashed and the parts scattered.

British Documents.

9. All schemes for destructionsare to provide for the full use of existing local facilities for the rapid and complete destruction of books and papers.

10. Document Destructor.

(i) A destructor (Stores Ref: 16B/3145) is provided for Cypher Vehicles Types 370 and 372, and is to be used in case of emergency for the destruction by fire of Secret and Confidential Publications and Documents. The Destructor will be kept in the Storage Container (Stores Ref: 16B/3415) which will be fixed under the body of the vehicle. The open end of the storage container is provided with a hinged flap which when closed will keep the destructor in position when put away.

(ii) The Destructor has been designed for use with compressed air cylinders, capacity 750 litre (Stores Ref: 6D/130) two of which are to be kept on the shelf under the front cross table of each vehicle. The compressed air materially accelerates combustion of the paper and helps to prevent it from becoming a charred mass which clogs the grid. Compressed air is passed through a tube in which a

number of small holes are pierced, the air escaping in a series of fine jets into the Destructor.

11. The Destructor comprises : -

(i) The Body. Welded inside the body under the grid is the tubing through which the compressed air is passed. The upper part of the body has ½ inch air holes; a one inch hole is provided through which the poker will be used.

(ii) The Connector. The connector is provided with two winged nuts at either end for attaching the compressed air cylinder to the Destructor.

(iii) The Grid. The grid rests upon brackets inside the body.

(iv) The Cowl. Asbestos wrapped handles are provided. When not in use the cowl is inverted and placed chimney down in the body, the rim of the cowl resting on the rim of the body.

(v) The Poker. The poker fits into slots welded to the outside of the body.

12. Use of Document Destructor.

(i) Remove the cowl and poker. Connect the compressed air cylinder firmly to the tubing by means of the connector, taking care to screw the winged nuts firmly in position. Do not yet turn on the compressed air.

(ii) Prepare the books by removing all stiff covers. The inside pages of the books should then be torn up into thin sections and well crumpled. Thick closely packed masses of paper only clog the Destructor and destruction will not be effective.

(iii) Place a few loose sheets of paper in the Destructor and set alight. Turn on the compressed air very slightly. Add up to 1½ lbs of paper and cover the Destructor with the cowl. Increase the flow of air slightly and keep the paper well stirred with the poker. Add further quantities of paper as necessary but not more than 1½ lbs at any one time.

(iv) Practice is necessary to obtain the best results and particularly in regulating economically the flow of air which should be kept as low as possible, otherwise the capacity of the cylinders will soon be exhausted. Cylinders are to be charged with AIR, NOT WITH OXYGEN. Petrol or paraffin oil does not promote the rapid combustion of paper in the Destructor and is NOT to be used.

(v) Holders of larger numbers of S & C Documents than normal are to make suitable arrangements for the destruction of their larger holdings, bearing in mind the small capacity of the destructor described above.

American Equipment, Documents and Devices.

13. At Appendix "A" to this Signals Staff Instruction is reproduced War Department letter A. G. 386.1 (4-13-43) OB-S-B-M, dated 15th April, 1943, on the Destruction of Classified Matter in Emergencies. Extracts from this are quoted below.

14. SIGABA. In order effectively to destroy Sigaba rotors and

index rotors, remove them from Cypher Unit (SIG IVI) and completely remove all wiring by cutting with snip-nosed wire cutters. Replace Cypher Unit and place wire and all rotors on top of Cypher Unit. Do not replace glass cover. Place rotors in such a manner that they lie flat and not on top of one another. Place Incendiary Safe Destroying Bomb, Type M-1, on top of the rotors with approximately the same length extending over each end. (Attention is drawn to Change No. 2 to SIG KKK-1 for detailed instructions on the installation and use of Incendiary Safe Destroying Bomb, Type M-1).

15. M.209. To effectively destroy the Converter M.209, place all keying elements in neutral positions by changing all plug settings to zero and moving all key wheel pins to the left position. Render the machine unserviceable to the enemy by stamping with the boot heel, striking with rock, hammer, axe, or by firing into it with rifle or pistol.

American Documents.

16. (i) Each destruction unit will consist of a five gallon can of kerosene or gasoline, two braziers, two small pieces of wire netting and two metal rods or pipes. A sufficient number of units should be supplied to accomplish destruction of all classified matter within a reasonable time. These units will be kept near the storage place of classified materials.

(ii) Kerosene should be used instead of gasoline whenever possible. It burns paper more thoroughly and is less of a fire hazard. Containers filled with kerosene should be kept away from inflammable material and not exposed to rifle fire.

(iii) Braziers can be made by piercing sides (not bottoms) of metal drums or containers. A convenient size is about one and one-half feet in diameter, and two feet in height.

(iv) Wire netting will be shaped for easy placing over brazier when papers are being burned. Any metal rod or pipe suitable for stirring the fire and ashes can be used.

17. Procedure.

(i) Tear covers off books. Tear or crumple contents, separating pages as much as possible. Soak papers with kerosene or gasoline from time to time as they are placed into brazier. Place wire netting over top to prevent paper from blowing away during burning.

(ii) Ignite by tossing a lighted match into the brazier from arm's length. Stir when nearly burned to ensure that all papers are separated. Remember that pages pressed together are not burned even in a big fire.

(iii) As an alternative method of burning, Sodium Nitrate ($NaNO_3$) may be used if available. A supply of ($NaNO_3$) equal in weight to one-half that of the material to be destroyed, should be kept available near the incinerator to be mixed with material to be burned.

ALTERNATIVE METHODS OF DESTRUCTION.

18. (i) Units not equipped with R.A.F. Cypher Vehicles Types 370 and 372 and not issued with Destructor 16B/3145 should procure an oil or petrol drum.

/ sub-para. (ii)

(ii) About 6 inches from the base, wire netting should be fastened by means of wire through some six to eight holes punched in the body of the drum. A piece some 6 inches square should be cut out of the body from base to wire netting to allow entry of air. The top of the drum should be cut round the rim for three quarters of its circumference and detached from the remainder to which it can be re-attached by wire ties to form a flap. This allows paper to be fed in, and when closed prevents paper escaping. A further modification is the addition of a chimney through the fixed top portion. This can be made with petrol tins cut and fashioned for the purpose.

(iii) Failing a destructor as elaborate as the above, an oil or petrol drum, the sides of which have been well pierced with holes to allow air inlet, will make an efficient brazier. A wire netting cover should be made to prevent paper blowing away.

19. (i) The same procedure as described in para. 12 (iii) should be followed, but complete destruction will take longer in the absence of compressed air.

(ii) It should be noted that destruction of paper is quicker and more effective if petrol, paraffin or oil is NOT used. The judicious use of a metal rod to keep the burning papers well stirred will improve results.

(iii) Petrol, paraffin or oil is intended for use ONLY when weather conditions make it difficult to start a fire.

DESTRUCTION DURING DARKNESS.

20. An emergency arising during the hours of darkness may preclude the possibility of destruction by fire. In such circumstances S & C Publications should be buried. All signs of disturbance on the surface should be obliterated as far as possible. The site of a slit trench should NOT be used for concealment of documents as an advancing enemy may use the site again. In daylight, the hidden books should be recovered if possible, and if the state of emergency still exists, destruction by fire should be carried out.

CLASSIFICATION OF DOCUMENTS.

21. The classification of documents set out below is to be observed in determining priority in destruction. In all cases, tables, documents and devices NOT YET IN FORCE, are of greater importance than the current editions of the same tables, documents and devices, and amendments are of equal importance to that of the document to which each refer. Navy, Army and Combined Publications, documents and devices, though not specifically mentioned below, should be destroyed with the Air Force documents of comparable importance. Editions of tables, documents and devices, which have been used and are superceded, rank for priority in destruction equally with the current edition of the same item in each case.

22. British Priorities.

(i) First Class.

All Typex Drums, plug boards and scrambler heads together with all Typex publications.
All C.C.M. Drums and C.C.M. publications.

(ii) Second Class

R.A.F. Book Cypher Vocabularies, Inter service vocabularies, stencil frames and tables. All "In" Groups and P/L of cypher messages. All "Out" Groups and P/L of cypher messages.

(iii) Third Class.

Remainder of S & C Publications including letters and files.

23. American Priorities

(i) Recognition key lists and memoranda.

(ii) General purpose cryptographic systems : -

(a) Cypher machines and key lists.
(b) Strip alphabets and key lists.
(c) Joint recyphering and recoding table.

(iii) Secret Communication files and operation orders.

(iv) Special purpose operational systems.

(v) Call sign cyphers and key lists.

(vi) Other code and signal publications.

24. Every effort should be made to inform the next senior formation of the unit concerned when emergency destruction has been carried out, and to what extent. If circumstances prevent a signal from being sent, as many people as possible are to be informed to increase to the maximum the chances of reliable information reaching the Headquarters concerned. This information is VITAL as its absence necessitates the assumption that documents have been compromised by capture.

25. The provisions of this Instruction are to be brought to the notice of all departments which are likely to use or have S & C Publications in their possession.

For Deputy Chief of Staff (Air),

(Sgd.) D.J.FARQUHARSON,
Squadron Leader,
Signals Security.

16th January, 1945.

DISTRIBUTION:

SHAEF Main. Sig. Division.	2 copies.	F.A.A.A.	6 copies.
SHAEF Rear. " "	2 "	Eighth Air Force.	2 "
Air Staff SHAEF (Rear)	1 "	A.N.C.X.F.	1 "
H.Q. 2nd T.A.F. (Main)	6 "	O.D.C.	1 "
H.Q. 2nd T.A.F. (Rear)	2 "	Internal : -	
H.Q. Ninth Air Force	4 "		
H.Q. First U.S.TACAF.(Prov)	6 "	D/COS Air.	Ops. Records.
H.Q. Fighter Command.	2 "	A/COS A-3	Sigs. 1A
H.Q. R.A.F.Transport Cmd.	2 "	A/COS A-4	Sigs. 1B
H.Q. 46 Group	2 "	CASO.	Sigs. Plans.
H.Q. 60 Group	2 "	D/CASO 1.	Sigs.Security.
H.Q. 72 Wing.	2 "	D/CASO 2.	Sigs. A.D.L.S.
Air Min.Whitehall(Sigs.5)	1 "	CAFSO.	
Com. Z.	2 "	G/Cpt., Radar.	
U.S.S.T.A.F.	4 "	Signals 1.	

APPENDIX 'B'
SECTION (VII)

DESTRUCTION OF CLASSIFIED MATTER
IN EMERGENCIES ON LAND, SEA AND IN THE AIR.

(APPENDIX "A" TO S.S.I. NO. 15)

SECTION 1 AMERICAN COMPONENT.

1. Purpose.

It shall be the direct responsibility of any person charged with transmission or supervision of classified matter to take all steps necessary to keep such matter out of the hands of the enemy.

For the guidance of such persons, the procedures outlined herein prescribe general means of destruction applicable to the various classified documents and equipment subject to capture or abandonment.

2. Priority of Destruction.

(a) Classified documents. Attention should be concentrated on secret or registered documents. In general, when destruction of such items is assured, remaining classified material will be destroyed in order of decreasing importance. Destruction of all copies of one document is more important than destruction of portions of several documents.

(b) Material.

1. Restricted equipment will be destroyed beyond possibility of repair or reclamation of parts.
2. Secret and confidential equipment will be destroyed beyond recognition. Such destruction may be limited to those portions of a secret or confidential device which shows secret principles or design. Other components will be destroyed to an extent that would prevent future use or reclamation.

(c) In all cases, documents or devices not yet in force are considered of greatest importance.

(d) The following is precedence of destruction : -

1. Recognition key lists and memoranda.

2. General purpose cryptographic systems : -
   (a) Cypher machines and key lists.
   (b) Strip alphabets and key lists.
   (c) Joint reciphering and recoding tables.

3. Secret communications files and operation orders.

4. Special purpose operational systems : -
   (a) Signal cyphers.
   (b) Contact codes and cyphers.
   (c) Authenticator systems.

5. Call sign cyphers and key lists.

6. Other code and signal publications.

(e) Classified material of highest importance should be marked in a clearly distinctive manner, i.e. with red marking in an obvious place. This should be done locally in pursuance of the destruction plan; and will be in addition to

the regular classifying stamp or marking.

3. Destruction scheme.

The Commanding Officer of each station, ship, or plane is responsible for issuing a practical emergency destruction scheme which should include allocation of responsibility to specific officers and other personnel.

(a) Because of possibility of enemy action by day or night, such allocation of responsibility at stations should be by duty rather than by name. Alternates should be designated in every case.

(b) Training periods should be designated for instruction of personnel in execution of destruction duties. The Commanding Officer may require reports stating such training procedure has been observed.

Authority for emergency destruction. Where time does not permit communication with the Commanding Officer, every individual concerned must act on his own initiative. The importance of beginning the destruction scheme sufficiently early cannot be over emphasized. Destruction of any item is of small importance compared with its possible capture.

Reports on Destruction. Accurate information concerning extent of emergency destruction is considered as second in importance only to the destruction of the material itself. Such reports shall be made to higher authority as soon as practicable.

4. General Policy.

Destruction by fire is preferred to any other type. Tests indicate destruction of radio equipment by fire is more complete than destruction by explosives.

SECTION II.

Destruction of Classified Matter at Land Installations.

A. Post, Camp or Station.

1. Responsibility. It shall be the responsibility of each cryptographic officer to put into force the destruction scheme issued by the Commanding Officer and to train personnel in its execution.

2. Destruction scheme. The Commanding Officer, in establishing the scheme in pursuance of Section 1, para. 3, will be guided by the following considerations : -

(a) Scheme must be practicable and simple. Avoid use of incinerators in open spaces where personnel might be exposed to enemy fire. For example, in extreme cases it may be necessary, in order to avoid drawing enemy fire at night, to accomplish the most complete destruction possible by whatever means are at hand

(b) Secret and Confidential documents should be sorted for easy access. A list should be kept of exact locations where such documents are held elsewhere on the station.

(c) Duplication keys and other means of access may, under proper security arrangements, be kept in selected positions. The security officer will prepare duplicate lists of locations of classified documents, persons responsible for various duties in

the destruction scheme, and the recommended place and method of destruction. These duplicates are for use in absence of custodian personnel, and will be destroyed along with classified material.

3. Methods.

(a) Use of Kerosene, Gasoline or Sodium Nitrate.

1. Materials.

Each destruction unit will consist of a five gallon can of kerosene or gasoline, two braziers, two small pieces of wire netting and two metal rods or pipes. A sufficient number of units should be supplied to accomplish destruction of all classified matter within a reasonable time. These units will be kept near the storage place of the classified materials.

(a) Kerosene should be used instead of gasoline whenever possible. It burns paper more thoroughly and is less of a fire hazard. Containers filled with kerosene or gasoline should be kept away from inflamable material and not exposed to rifle fire.

(b) Braziers can be made by piercing sides (not bottom) of metal drums or containers. A convenient size is about one and one-half feet in diameter and two feet in height.

(c) Wire netting will be shaped for easy placing over brazier when papers are being burned. Any metal rod or pipe can be used which is suitable for stiring the fire and ashes.

2. Procedure.

(a) Tear covers off books. Tear or crumple contents, separating pages as much as possible. Soak papers with kerosene, or gasoline, from time to time as they are placed into the brazier. Place wire netting over top to prevent paper blowing away during burning.

(b) Ignite. For safety, a lighted match may be tossed into the brazier from arm's length. Stir when nearly burned to ensure that all papers are separated. Remember that papers pressed together are not burned even in a big fire.

(c) As an alternative method of burning, Sodium Nitrate ($NaNO_3$) may be used if available. A supply of $NaNO_3$ equal in weight to one half of the material to be destroyed should be kept available near the incinerator to be mixed with the material to be burned.

(b) Explosive and Manual Destruction.

1. Materials.

Axe, Sledge Hammer, Crow Bar, Thermite Bomb and other suitable explosives.

2. General.

Use axe or sledge hammer on wooden and metal devices and equipment; shearing and tearing off knobs, dials or wires, smashing panels and otherwise wrecking the material beyond possibility of repair. Place wrecked items in a pile and soak with kerosene or gasoline then burn. If time permits, bury burnt remains of secret and confiden-

tial equipment in secluded spot or bed of stream.

3. Attention is invited to the fact that many types of devices such as CSP-889 (SIGABA) and M209 a (Hagelin) carry special destruction instructions.

B. Field Conditions.

1. The requisite characteristics for a device for destroying classified matter in the field are : Light weight for easy transportation, speed in destruction under field emergency conditions. The British "Destroyable Correspondence Carrier" combines these features in a metal tube lined with combustible materials. It weighs 42 pounds and has a capacity of 16 pounds of classified matter. Ignited either electrically or mechanically, combustion is complete in four or five minutes, at which time a shotgun shell explodes and breaks up the ashes. An adaptation of this device would serve for use by field commanders.

Mechanical cypher devices should be smashed beyond recognition and, if CSP-889 (SIGABA) is present, completely destroyed by thermite bombs of the type now required for this purpose.

2. In circumstances where other means of destruction are not available, resort to the general instructions set forth herein, making use of gunfire, rocks, etc.

C. Routine Instructions.

The volume of classified material which would require destruction in event of emergencies should be kept at the minimum. Thus it is important that all routine destruction be completed promptly, following existing instructions.

(a) It shall be the duty of the security officer to check periodically on routine destruction of obsolete classified material, message files, and other correspondence. All personnel shall be cautioned against tendency of permitting papers to accumulate in files.

SECTION III.

Destruction of Classified Matter in Aircraft.

(a) Documents.

If plane is forced down at sea, all classified material will be sunk by most practical method. If weighted pouches are not provided, use musette bags or other containers. Weight usually can be found in the plane, and holes can be cut easily through the bag with a pocket knife. Whenever available, planes flying over water will be provided with cryptographic aids printed on destructable paper or on paper coated with a special gelatinous substance which dissolves in water taking the printing with it.

(b) If plane is forced down in enemy or neutral territory all classified documents and cryptographic material will be destroyed by burning. The magnesium in Verry pistol cartridges provides a good incendiary medium for burning documents on the ground.

2. IFF Equipment.

For pilots of aircraft equipped with IFF installations: in case of forced landing in enemy or neutral territory, or abandoning ship in any circumstances where the enemy might gain access to the aircraft, the pilot will destroy the internal portion of the equipment by simultaneous depression of the two destructor switches.

3. Other Special Equipment.

Attention is called to the fact that many types of aircraft will carry other special secret or confidential equipment, such as RADAR units, ASV, AI, and the like, requiring the greatest effort in accomplishing destruction under distress conditions for which there is as yet no specially designed means of destruction. Personnel will give priority, utilizing all means which ingenuity may suggest, for carrying out the destruction of such communications equipment and prevention of its falling into enemy hands.

4. General.

If time permits, members of the crew will destroy other communication equipment beyond possibility of repair or reclamation of parts. Follow destruction scheme previously issued in accordance with paragraph 2 and 3 of Section 1.

SECTION IV.

Destruction of Classified Matter on Ships at Sea.

Mechanical cypher devices should be thrown overboard when in deep water. In shallow water, the wiring should be punched out, and the wheels, wiring and machines smashed beyond recognition of repair before being thown overboard.

All alphabet strips, key lists, and other printed cryptographic aids issued to ships assigned to hazardous duty should be printed on paper coated with a gelatinous substance which will take printing ink satisfactorily, but which will dissolve in water, taking the ink with it. Message blanks for ships' use should also be supplied using this special coating.

In circumstances where time does not permit burning in the usual manner, whether in deep or shallow water, all classified printed matter and dispatches should be thrown overboard in weighted bags with holes in them to ensure sinking. Books should be opened up before insertion in the bags. However, until such time as all publications carried on board are printed on the specially prepared paper, arrangements should be made to burn those publications not so prepared, in case of emergency.

Implements necessary : Sledge hammer, weighted bags with holes in them.

16. 1. 1945.

APPENDIX 'C'.
to SECTION VII.

SECRET

AIR STAFF SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

SIGNAL STAFF INSTRUCTION NO. 17.

CARRIAGE OF SECRET AND CONFIDENTIAL PUBLICATIONS ON REGISTER CHARGE.

1. The procedures given below are to be used for the carriage of British and American Secret and Confidential Publications and Cypher devices on the Continent.

BRITISH COMPONENTS.

2. The following procedures are to be strictly carried out in all cases when Registered Secret and Confidential Publications including Typex drums, Inserts and C.C.M. drums are carried.

3. All such documents on charge to units which require to move will be carried either in Strong Boxes or Canvas Bags, properly sealed. Such containers will be carried under personal supervision of the Officer appointed under K.R. & A.C.I. para.2240 (1) accompanied by an armed guard.

4. Documents on loan to individual Officers will, if practicable, be called in by the Officer detailed under K.R. & A.C.I. para.2240 (1) and re-issued on arrival at new distination.

5. If it is found necessary to carry documents other than in Cypher Vans under guard, the containers of such documents are to bear a label with directions for the containers, if found unattended, to be returned to the Distributing Authority through the nearest R.A.F. or American Headquarters.

6. Documents in transit between stationary units will at all times be in charge of an Officer, who will be responsible for the safety thereof and their delivery personally to the addressee.

7. All strong boxes or canvas bags in transit are to be numbered and a list of the contents recorded so that Air Ministry and the Distributing Authority can be immediately informed of the contents in the event of loss.

8. When Secret and Confidential Documents are carried in dangerous areas, such precautions as are practicable are to be taken to ensure their destruction in an emergency.

9. The following extract from A.P. 3086, Para. 28, is to be strictly observed :-

> "Air Officers Commanding are authorised to grant permission for the transportation of Registered Secret and Confidential Publications by Air at their discretion, but it is emphasised that the factors of urgency, safety, economy and practicability must be carefully considered, and due weight given to the circumstances of the journey and territories over or near which the aircraft will travel, and the seriousness of any loss or compromise of the documents in question.

The Air Ministry will, if necessary, direct that particular documents are never to be carried by air".

AMERICAN COMPONENTS.

10. British Codes and Cyphers as used in Code Rooms, and which are on charge to units, are to be carried under personal supervision of the Cryptographic Security Officers of such units, who will be responsible for the documents while in transit.

11. American Cryptographic systems and small cryptographic devices of each unit, are to be carried under the personal supervision of the Cryptographic Security Officer and/or Officer(s) appointed for the transfer of such documents and/or devices. The Officer to whom documents etc. have been entrusted is responsible to the Cryptographic Security Officer for their safety, while such are in transit.

12. British and American Registered Secret and Confidential Documents, other than those used in Code rooms, on charge to units, are to be carried under personal supervision of the Cryptographic Officer of such units. In cases where no such Officer is established, they will be carried under the personal supervision of the Officer appointed, to whom the documents are on charge.

13. All documents are to be carried in Canvas Bags which, when filled, are not to exceed 25 lbs. weight. Bags are to be properly sealed and bear a label with directions for the bags, if found unattended, to be returned to the Distributing Authority through the nearest American or British Headquarters. A list of the contents of each bag, which is to be given a serial number, is to be recorded, so that the Distributing Authority can be immediately informed of the contents in the event of loss.

SECURITY PRECAUTIONS.

14. Cryptographic material and associated equipment is always highly vulnerable to capture by the enemy or compromise during transit irrespective of geographical location. All responsible personnel must be constantly alert to protect cryptographic equipment from capture by the enemy and loss through careless handling. The following security measures should be observed by all concerned.

WRAPPING AND PACKING.

15. (a) All secret and confidential cryptographic documents and material normally handled by the U.S. Army Postal Service, Headquarters Messenger, Courier Service, or Officer Courier Service, will be securely wrapped with an inner and outer cover. The inner cover will contain the classification clearly stamped with the words "For Signal Security Officer", in addition to address that appears on the outer cover. The outer cover will show no classification and should be addressed to the Commanding General, Commanding Officer, or Signal Officer and in no case will be the term cryptographic, code, cipher or equivalent term appear on the outer cover.

(b) A numbered package receipt attached to the outside of the inner cover and an original and duplicate document receipt stating contents, indicating short titles, copy numbers and quantity of each item should be included in each package.

(c) Heavy cryptographic equipment, such as SigABA, SigCUM or SigRINO, not normally transported by U.S. Army Postal or Courier Service will be properly packed or crated to withstand the particular means of transportation to be used. The following protective measures will be observed in preparing the SigRINO, SigABA for any means of transportation.

(i) Securely bolt the SigABA to base of wood box. (Use 4 packing bolts and wood packing strips.)

(ii) Clamp top of box to base and waterproof connecting edge with hot tar or wax. (The latter will be done only when machine is to be transported by water.)

(iii) Place box in top half of CH 76 Chest and lock combination.

(iv) Place all rotors, Secret and Confidential written material, codes, ciphers, etc. in lower half of CH 76 Chest and lock combination. (The above items will be sealed with a waterproof material when transported by water.)

(v) Mark top and bottom halves of chest with special identifying markings without indicating contents.

(vi) Protect combination chest locks with soft material to act as a cushion. These locks become inoperative with little misuse.

(vii) The Incendiary Safe Destroying Bomb, "M-L" should be installed in lower and upper halves of CH 76 as indicated in para.4 Change No. 2 (Sig KYK-1).

(viii) Under no circumstances will SigRINO/SigABA be transported without an authorised armed Officer courier and an armed guard. The SigRINO/SigABA will never be left unattended while in transit.

16. In the event of a convoy movement to a new Headquarters, the code room vehicle should be located towards the front of the convoy to ensure immediate cryptographic service at the forward command post. Armed cryptographic personnel should occupy the vehicle immediately following the code room van or truck. At least one armed guard (cryptographic) should be placed in the code room van or truck itself. Armed guards will protect the immediate area surrounding the mobile code room during periodic and overnight convoy halts.

PERMISSION TO MOVE CRYPTOGRAPHIC MATERIAL.

17. British and American Secret and Confidential publications and cipher devices may not be transferred from one Air Force Headquarters/Unit to another without by Field Order of appropriate Command.

18. The following security precautions are equally applicable to the transportation of SigRINO/SigABA and SigCUM, and will be vigilantly observed by all organisations and individuals responsible for transporting cipher devices. All instructions outlined in para. 15 (c) above apply to the safe keeping of the SigRINO, SigABA and SigCUM when transported by any means.

TRANSMISSION BY ROAD.

19. (a) Adequate care should be taken to ensure that the above mentioned equipment is carefully loaded in the vehicle and the tail gate is locked in the upright position.

(b) Periodic checks should be made to determine security measures during transit.

(c) Under no circumstances will anyone be allowed to ride in the equipment vehicle as a casual passenger.

TRANSMISSION BY SHIP.

20. (a) The most secure room on larger vessels, preferably the ship's strong room if one exists, will be used to safeguard the SigABA/SigRINO and SigCUM.

(b) The most secure and accessible location in channel craft or larger landing ships will be chosen for safeguarding this equipment. An armed guard (cryptographer) will be posted with the devices 24 hours a day.

TRANSMISSION BY AIRCRAFT.

21. The SigRINO/SigABA and SigCUM with rotors may be transported by American military aircraft provided that :-

(a) Aircraft will not be flown over enemy occupied territory.

(b) Aircraft will not be flown over neutral territory.

(c) Aircraft will not be flown over water from which, in event of forced landings or crash, the enemy could capture the equipment.

Note: Attention is invited to Para. 19 (5) AR 380-5 for information and guidance concerning destruction of cryptographic equipment in the event of a forced landing being made in enemy territory or neutral territory.

for Deputy Chief of Staff (Air),

(Signed)
D.J. FARQUHARSON,
Squadron Leader,
Signals Security.

16th January, 1945.

APPENDIX "D"

SECTION VII

AIR STAFF SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

SIGNAL STAFF INSTRUCTION NO. 18.

SIGNAL AUTHENTICATION AND VERIFICATION.

1. The following systems of transmission and/or message authenitcation are to be employed when necessary by the Air Forces of the Allied Expeditionary Force.

(a) Point-to-Point.

(i) Normally:- CCBP 0122 - A series.
(ii) Initially with Airborne Forces:- One Time Pad system.

(b) Air/Ground R/T. CD 0264 - A and B series as specified.

(c) Air/Ground W/T. S.D. 0182. H.1. to be superceded on 1st March, 1945, by CCBP 0127.

2. The above Authentication Systems are to be used ONLY when it is necessary to ensure that the stations concerned are "bona fide" and are not to be considered standard for all transmissions (but see paras. 5 and 28). In no case is the initial absence of authentication to be deemed to indicate a bogus message. The best means of authentication for the more secret type of traffic is provided by a correct use of the codes and cyphers in force.

POINT TO POINT. (W/T, R/T and T/P) AUTHENTICATION.

3. The system for authenicating R/T, W/T and teleprinter point-to-point transmissions for combined, joint and inter-service use for all operations except with Airborne Forces during the initial stage of an Airborne operation is the "Combined Authentication System - CCBP 0122 - A series". This publication is for use other than between air and ground, and ONLY for authentication of plain language or low grade cyphers.

4. CCBP 0122 - A Series will be held down to and including the following levels:-

(a) Air Forces. W/T, T/P and R/T point-to-point links; it will not be held in aircraft.

(b) ANCXF. Each major war vessel and shore stations as ordered. May also be held by certain minor war vessels if especially ordered.

(c) Army Group.

(i) U.S. - Divisional Headquarters.
(ii) BR. - Divisional Headquarters for combined and joint use.
Army Headquarters for inter-service use.

(d) Communications Zone - Base Sections, Ports, Regulating Stations and Beach Commands.

5. Authentication will be carried out:-

(a) When any doubt exists as to the authenticity of a station or message (including P/L messages on VH/F links).

(b) When executive orders regarding operations or communications are received via a communication transmitted in clear, (excepting R/L messages on VH/F links, (see (a) above).

6. A new serial in the series CCBP 0122 - A.1, A.2 et seq. will be brought into force at monthly intervals, normally on the first day of each calendar month. When, owing to compromise or other cause, a new series is brought into force during the currency of a calendar month, the page for the day when it is brought into force will be used and succeeding pages each day until the end of the month. Thereafter users will revert to the page for "Day 1" and continue with subsequent pages until a new series is brought into force.

7. For authentication of transmissions within the Air Forces, (i.e. intra-service and limited combined) the Challenge and Reply - 1st Method only - is to be employed.

8. The Combined Authentication Systems are NOT to be used within the Air Forces for authentication of messages until instructions to this effect are issued by this Headquarters. Nevertheless, Authentication of Messages - 1st Method only - must be known by all concerned in order that combined, joint, and inter-service authentication of messages may be accomplished when occasion arises.

9. Compromise of CCBP 0122 through loss or capture is to be reported immediately through normal channels as laid down in Air Staff S.H.A.E.F. Signals Staff Instruction No. 12. Provision is to be made by issuing agencies to hold spare serials for emergency issue as ordered by the Supreme Commander.

AUTHENTICATION WITH AIRBORNE FORCES.

10. The following system for authentication with airborne forces will be used during the initial stages of an Airborne Operation whereby Airborne Forces can obtain effective radio authentication from any non-airborne headquarters with which it is anticipated they will require radio communication.

11. Cryptographic equipment carried by Airborne Forces must be assumed to have been compromised by capture during the initial stages of any airborne operation. The distribution of reserve cryptographic equipment to Airborne Forces cannot be satisfactorily effected until such time as the Airborne Forces have made contact with the Ground Forces with which they are co-operating.

12. The authentication system prescribed in this Instruction is to be held by the Air Forces of the Allied Expeditionary Force down to the level of, and including the equivalent level of Army divisional headquarters. The system may, however, be distributed below that level for authentication during a particular Airborne Operation by arrangement as necessary between the C.S.O. First Allied Airborne Army and the Senior Signal Officer of the non-Airborne formation/unit concerned.

13. Normal authentication systems will be used by Airborne Forces as soon as such systems can be distributed to the Airborne Forces without abnormal danger of compromise through capture. The distributing authority will be responsible for notifying all concerned directly the Airborne Forces are in possession of normal authentication systems.

14. Pads of serially numbered sheets, each sheet containing about 125 four figure groups, will be held in readiness at each of the non-airborne headquarters specified in paragraph 12 above in case authentication should be required by that headquarters with an Airborne Headquarters during the initial stages of an airborne operation. Each of these pads will bear a distinctive copy number and will contain different four figure groups from any other pad issued to a non-airborne headquarters.

15. Duplicate copies of the pads held by the non-airborne headquarters referred to above will be issued to the C.S.O. First Allied Airborne Army. As soon as possible before the mounting of an airborne operation, C.S.O. First Allied Airborne Army will distribute to each Airborne Headquarters, down to and including Divisional headquarters level, pages from the pads held by those non-airborne headquarters with which authentication may be required. In this way, each non-airborne headquarters will hold a pad, different pages of which are for authentication with the various Airborne Headquarters; each Airborne Headquarters will hold several sheets from different pads for authentication with the non-airborne headquarters concerned.

16. Authentication will be effected by demanding a particular group on the appropriate sheet (e.g. "Give third group on line twenty"). The reply should be the group demanded (e.g. The third group from the left on the twentieth line from the top of the sheet). When a group has been used it will be crossed off the sheet to ensure that it is not used a second time.

17. Some of the sheets carried by the Airborne Forces may have fallen into enemy hands. C.S.O. First Allied Airborne Army is therefore responsible for notifying all concerned, as soon as possible, which sheets carried by the Airborne Forces have arrived safely and are to be used. Until such notification has been received, non-airborne headquarters will be unable to obtain completely secure authentication from Airborne headquarters; Airborne Headquarters will, however, be able to obtain secure authentication from non-airborne headquarters at all times.

18. To enable the user headquarters to determine which sheet is to be used, each sheet carried by the Airborne Forces may be cross-referenced with the extracted list of other necessary signal data carried; in no circumstances will the sheets carried by Airborne Forces be marked 'in clear' with the designation of the non-airborne headquarters with which it is to be used.

19. In the event of an Airborne Headquarters being unable to ascertain the sheet which is to be used for authentication with a non-airborne headquarters with which it has established communication, authentication will be carried out in accordance with the following examples:-

For R/T.

Airborne headquarters..... "Give authentication pad number"
Non-Airborne Headquarters .. "3267"
Airborne Headquarters ..... "sheet eight line five group two"

For W/T

Airborne Headquarters ..... "QPA Pad"
Non-Airborne Headquarters .. "QPA 3267"
Airborne Headquarters ....., "QPA 8-05-2"

20. The pads referred to in paragraph 14 above will be issued to all non-airborne forces concerned through the normal channels for the distribution of cryptographic equipment. The War Office (Signals 6 will issue to the C.S.O. First Allied Airborne Army duplicates of all pads which have been distributed to the non-airborne headquarters.

21. As soon as possible after distribution of the pads has been effected, the C.S.O. of each Air Force is to notify the C.S.O. First Allied Airborne Army, of the copy number of the pad held by each non-airborne headquarters within his Air Force.

22. As soon as possible before the mounting of an Airborne operation, the C.S.O. First Allied Airborne Army will:-

(a) Ascertain the copy number of the pad held by each non-airborne headquarters with which the Airborne Forces may require radio communication.

(b) Arrange for as many sheets as may be deemed necessary from each of the pads referred to above to be carried with each radio set which is to be used for communication between Airborne Headquarters and non-airborne Headquarters down to the levels specified in para. 12 above.

(c) Notify each of the non-airborne headquarters concerned of the sheet numbers that are being carried at each of the Airborne Headquarters.

AIR TO GROUND R/T AUTHENTICATION.

23. Specific editions of the R.A.F. Code Scrambles, (CD 0264), Series "A" and "B", are provided for use by Fighter aircraft for Air to Ground authentication, Series "A" being reserved for the American Air Forces and Series "B" for British Air Forces. The Code Scrambles are issued in monthly editions of each series.

24. This Authenticated System is to be used by pilots of Fighter aircraft, whilst airborne, to challenge any ground station from which a suspicious message is received. Provision is not made for Ground Stations to challenge aircraft.

25. All ground R/T stations in the Allied Expeditionary Force communicating with fighter aircraft, are to hold a current copy of either the "A" or the "B" Series of the R.A.F. Code Scrambles, according to whether they normally communicate with American or British aircraft respectively. Ground stations requiring or likely to communicate with both American and British aircraft are to hold current copies of both "A" and "B" Series. Copies of the appropriate Code Scrambles will be held for briefing purposes by all airfields despatching fighter aircraft.

26. Detailed instructions on the use of this Authentication System are contained in Appendix "A" to this Instruction.

AIR TO GROUND, GROUND TO AIR R/T AUTHENTICATION.

27. Pending the introduction of the "Combined Air-Ground Authentication Signals - CCBP 0127A" and "CCBP 0128 (Instructions)" which provides systems of challenge and reply for D/F service and of message authentication, the procedure laid down in SD 0182.H.1. is to be used for challenging the identity of an aircraft requesting a D/F service or of a Ground Station, the authenticity of which is in doubt.

SECRET.

SECTION VII.

APPENDIX 'D'

28. Detailed instructions on the use of SD. 0182 H.1. are printed on the cover to the cards. It is to be noted that, since the use of Verification Tables inevitably slows down the service given to aircraft, H/F D/F stations are not to challenge an aircraft which gives its correct call sign and aircraft letter, unless they have good reason to suspect the authenticity of the call.

29. It is to be noted that the Verification Tables now come into force at 1201 hours daily, commencing with line "12/13" for 1200 - 1300 hours and continuing up to line "23/24". The same table is then used for the day following, using lines "0 - 1" up to "11 - 12", whereupon the subsequent table is taken into force.

30. The security of the tables is dependent upon use being made of the full range of columns provided. Ground and air operators are therefore not to make consistent use of only the first and last columns on which to interrogate.

31. The "Combined Air - Ground Authentication Signals, CCBP 0127", is being introduced, world wide by all services, and the target date for its introduction in this Theatre is 1st March, 1945. Instructions for the use of the above authentication system are contained in CCBP 0128.

for Deputy Chief of Staff (Air)

(Sgd.) D.J. E. RICHARSON.
Squadron Leader,
Signals Security.

16th January, 1945.

SECTION VII

APPENDIX 'D'

Distribution:-

SHAEF Main. Signal Division.	2 copies
SHAEF Rear. Signal Division.	2 "
Air Staff SHAEF Rear.	1 "
H.Q. 2nd T.A.F. (Main)	6 "
H.Q. 2nd T.A.F. (Rear)	2 "
H.Q. Ninth Air Force.	4 "
H.Q. First U.S. TACAF (Prov).	6 "
H.Q. Fighter Command.	2 "
H.Q. R.A.F. Transport Command.	2 "
H.Q. 46 Group	2 "
H.Q. 60 Group	2 "
H.Q. 72 Wing	2 "
Air Ministry, Whitehall (Sigs.5)	1 "
Com Z.	2 "
U.S.S.T.A.F.	4 "
First Allied Airborne Army	6 "
Eighth Air Force	2 "
A.N.C.X.F.	1 "

Internal:-

D/COS Air	Signals 1.
A/COS A-3	Operations Records.
A/COS A-4	Sigs. 1A.
CASO	Sigs. 1B.
D/CASO.1	Sigs. Plans.
D/CASO.2	Sigs. Security.
CSFSO.	Sigs. A.D.L.S.
G/Cpt. Radar.	

APPENDIX "A" TO S.S.I. NO. 18.

AIR TO GROUND R/T AUTHENTICATION.

INSTRUCTIONS.

INTRODUCTION.

1. Certain issues of the R.A.F. Code Scrambles (CD 0264) Series "A" and "B" are provided for air to ground R/T Authentication by aircraft. Series "A" is for use by American aircraft and Series "B" by British aircraft.

2. The scrambles are issued in monthly editions of each series. Each monthly edition contains 31 daily tables, but in a month of less than 31 days the tables for the extra day or days will not be used.

3. The daily table in each Series consists of a series of index numbers from 1 to 500, to each of which is allowed a code group of three letters. The code groups so allotted to each index number change every day.

OBJECT OF SYSTEM.

4. The object of the code is to enable pilots of Fighter aircraft, whilst airborne, to challenge any ground station from which a suspicious message is received. It is important to emphasise that the practice of challenging a ground station is not intended to be a routine procedure, but is to be employed only if the pilot entertains real doubt as to whether or not a message is genuine.

USE OF SYSTEM.

5. The American Air Forces will be allocated blocks of index numbers in Series "A" and the British Air Forces blocks of numbers in Series "B" of the Code Scrambles. The Air Forces will, in turn, allot blocks of 4 or 5 index numbers to each squadron. This may be done by a suitable bulk allocation of index numbers to each group/wing concerned, who will, in turn, allot specific index numbers to each squadron.

6. Each squadron will retain the index numbers allotted to it during the period in which the edition of the scramble is in force, but a re-allocation of index numbers should be made with each successive edition as it comes into force, so that each squadron has a different sequence of index numbers every month.

7. All the pilots in a squadron taking part in a mission (sortie) are to be issued with 1 index number, (common to the squadron) together with the 3-letter code group for the day belonging to that index number, for each sortie. If, on return from the sortie, the pilots report that they have used the challenge, that challenge and answer is to be eliminated, and is not to be used again. A different index number, (with its code gooup) is to be allotted for subsequent sorties, to which the same rule must apply. So long as no challenge has been made, (making use of the index number and code group), and no aircraft has failed to return, it may continue to be carried during the day.

8. It is important to remember that once used, the combination of index numbers and code groups may be compromised, and is

/therefore

therefore a source of danger and should on no account be used a second time.

9. If experience shows that aircraft require to make more than one challenge per sortie, it is permissible to issue two index numbers, (with their code groups) for each sortie.

METHOD OF CHALLENGE.

10. A pilot who, whilst airborne, receives a message from a ground station which he suspects to be false, (i.e. originated by an enemy ground station with intent to mislead) may challenge the ground station by giving his index number with the prefix "A" in the case of an American pilot, or with the prefix "B" in the case of a British pilot. The ground station, if genuine, is in possession of all code groups in either or both the "A" and "B" series, and replies to the challenge by giving the 3-letter code group for the day allotted to the index number in the appropriate series.

EXAMPLE.

A British aircraft (callsign Tiger 15), has requested a ground station (callsign Rocket), for a homing, and has received a course to steer (e.g. 250) which he suspects. He will transmit as follows:-

British aircraft:-

"Hello Rocket, this is Tiger 15, index Baker 166, I say again, Baker 166 - who are you - over".

Ground Station:-

"Hello Tiger 15, index Baker 166, this is Rocket, Sugar Mike Baker (SMB), I say again, Sugar Mike Baker - Steer 250 - over".

11. If the reply to the challenge does not correspond with the code group given to him with the index number, the pilot will at once cease communication with the ground station, and will ignore any information or directions passed to him.

12. Under no circumstances is a ground station to challenge an aircraft by this procedure, or request the aircraft to give its index number. The initiative in obtaining authentication must always be with the pilot of the aircraft.

DISTRIBUTION OF R.A.F. CODE SCRAMBLES.

13. All ground R/T stations in the A.E.F. communicating with fighter aircraft will hold a current copy of either the "A" or the "B" series of the R.A.F. Code Scrambles, according to whether they normally communicate with American or British aircraft respectively. Ground stations requiring or likely to communicate with both American and British aircraft will hold current copies of both "A" and "B" series. Copies of the appropriate Code Scrambles will be held for briefing purposes by all airfields despatching Fighter aircraft.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION VIII

TELEGRAPH AND TELEPHONE TRAFFIC PROBLEMS

TELEGRAPH

CROSS CHANNEL TRAFFIC.

1. Until the provision of submarine cable circuits, all traffic between the U.K. and the continent was routed by W/T, thus causing unavoidable delay due to encyphering and decyphering. The provision of submarine cable circuits eased the situation, but initially these circuits were not too reliable due to faults while continental cables were being rehabilitated, and the movements of the continental terminations.

2. Traffic from the U.K. formations was passed to the Cross Channel Signals Centre at Stanmore in plain language. This not only avoided the U.K. formations having to hold all the cyphers in use on the continent, but avoided the useless encyphering of messages which would be routed via the cable circuits, Stanmore being the only Centre knowing the minute to minute serviceability of the channels necessary to determine the routing.

3. After the move forward in autumn 1944, communications between the U.K. and the major Air Force headquarters, and between those headquarters and their lower formations became very unstable and considerable difficulty was experienced in disposing of traffic by normal means and frequent diversions to A.D.L.S. had to be made. Extensive re-arrangements and extensions of the U.K. Cross Channel Signals Centre, Stanmore, combined with the increased serviceability of the existing, and the provision of additional cable circuits, however enabled this critical period to be overcome. No further major difficulty was experienced in handling cross channel traffic after this period.

ROUTING.

4. One of the major difficulties in the handling of signals traffic was the lack of knowledge of the locations of units. Routing was done by means of formations rather than locations, i.e. traffic was routed to the superior headquarters of the unit required, irrespective of the location of the unit, so that if a small unit (A) within (B) happened to be located very close to Group Headquarters (C), traffic for (A) was circulated to its Group headquarters (B) for them to dispose of. This method of routing has the disadvantage that some signals may take a circuitious route, but has the advantage that no wide spread dissemination by a Traffic Control of the locations of

/units

units, and consequent changes in routing as a result of units moving, is involved, as is the case when routing by locations. Formation routing did cause a certain amount of confusion however, during the transition period, when some units of a major formation, e.g. an Air Force, were on the continent and some in the U.K., a factor which contributed to the critical period referred to above, but which gradually eased as units were called forward to the Continent.

CONFERENCES ON SIGNALS TRAFFIC HANDLING AND PROCEDURE.

5. Various minor difficulties were found to exist between the major Air Force Signal Centres, mainly due to different interpretations of instructions and lack of knowledge of the composition of some of the organisations. It was decided that these difficulties could best be overcome by holding conferences of the officers dealing with traffic handling at the major headquarters and Signal Centres. The first conference was held at Air Staff SHAEF Versailles on the 8th February, 1945; subsequent conferences being held -

Headquarters 2nd T.A.F. Brussels	8th March, 1945.
Headquarters Fighter Command, Stanmore	9th April, 1945.
Headquarters U.S.S.T.A.F. St.Germain	11th May, 1945.

Not only did these conferences enable any difficulties to be discussed and settled, but also enabled the officers concerned to become personally familiar with each other and to study the different lay-outs of the Centres visited and incorporate any useful ideas picked up, within their own lay-outs. There is little doubt that traffic was handled more efficiently as a result of the difficulties settled and the information obtained at these conferences.

COMPARISON BETWEEN SWITCHING OF TELEPRINTER/TELETYPEWRITER CIRCUITS AND TAPE RELAY SYSTEM.

6. The large amount of 'through' traffic which was being handled at the major SHAEF Signals Centres, coupled with the possibility of cable circuits becoming unclassified when routing through Germany, made it desirable to introduce some scheme to reduce the time taken to handle messages at intermediate centres. This could be accomplished in two ways ; -

(a) Switching of teleprinter/teletypewriter circuits
(b) Using a tape relay system.

SWITCHING OF TELEPRINTER/TELETYPEWRITER CIRCUITS.

7. To enable such a system to work satisfactorily, it is essential that the speed of all the machines be identical. Switching was carried out to a limited extent on an intra Air Force basis, but owing to the difference in speeds between the British teleprinter and the American teletypewriter, could not be introduced throughout the theatre. A recommendation that American teletypewriters be adjusted to work at the British speed was made by U.S.S.T.A.F. This recommendation was agreed by Air Staff SHAEF and was forwarded to SHAEF Signals Division for further consideration. The British speed not only has the advantage that switching could if necessary be made with the U.K., but is also the speed of the German machines. The other essential of an efficient switching scheme is that there should be sufficient circuits to prevent calling stations being given 'engaged' every time they ask to be switched during traffic peaks. In practice it is found that insufficient margin exists on the circuits to enable more than one intermediate switchboard to be used. The advantages of such a switching scheme are that the time taken by the intermediate station to re-transmit is cut out, thus not only speeding up the transmission of the message, but saving line and operating time and

reducing the possibility of transmission errors. It has the disadvantages that -

(a) All machines in the area must work at the same speed.
(b) A slight increase in the provision of circuits is necessary
(c) Switching can only be carried out via one intermediate centre.

TAPE RELAY SYSTEM

8. This system involved the receipt at the intermediate station of all 'through' messages on a re-perforator, and obtaining a punched tape which can be fed through an auto-transmitter to the next station. This system was also used to a certain extent but mainly by the American forces, as shortage of the necessary equipment prevented its introduction to any great extent within the R.A.F. Once again, British and American equipment is not fully interchangeable. To work such a system to the best advantage, it is desirable to set up a tape relay network similar to the Army Command and Administrative Network (ACAN) - see brief description in Appendix 'A' attached.

9. This system has the advantage that no increase in the number of circuits is required to cater for peaks, as during these periods traffic can build up and be disposed of in turn, but had the disadvantage as far as British Units were concerned, of requiring special equipment which was only available in limited quantities.

SECURITY CLASSIFICATION OF TELEGRAPH CIRCUITS.

10. Within the U.K. the teleprinter channels in the D.T.N. were regarded as secure to carry classified material in P/L, as the possibility of interception by the enemy was highly improbable. On the continent however, the situation was rather different as the enemy had had sufficient time at his disposal to prepare plans for intercepting our land line channels.

11. Signals Staff Instruction No. 19 laid down the conditions which had to be fulfilled on the continent regarding the classification of circuits. Until circuits commenced to be routed through Germany this meant that the majority of teleprinter channels were classified as secure for Secret traffic. A copy of this instruction is attached at the end of this Section, Appendix 'B'.

12. To ensure that originating signals centres encyphered any traffic which was to be routed over an unclassified channel on any part of its route, and thus prevent a bottle neck at the cypher offices at the terminals of such a channel, some machinery should have been set up to disseminate the classification of all the channels in the network. Attempts were made to introduce some such machinery but due to the numerous commands concerned with the authorisation and provision of circuits, together with the fact that circuits were routed via cables maintained by many different formations, none of these attempts met with any success. Fortunately there were very few cases of individual circuits changing their classification, as in the main the majority of the circuits on the continent remained secure until one of the terminals moved into Germany.

CROSS CHANNEL TELEPHONE SERVICE

GENERAL

13. With the provision of cross channel cable circuits, the radio circuits on the 'Radio' PBX at Headquarters No. 11 Group, Uxbridge, were gradually replaced until practically all the circuits except for a small number of Standby 'Racehorse' (VHF duplex R/T)

circuits, were routed via cables. The name of the PBX was changed at this stage to the "Air Force Cross Channel PBX". Later the PBX at Uxbridge was too small to cope with expansion and it was decided to move the Air Force Cross Channel PBX to Stanmore, rather than to attempt to increase the size of the PBX at Uxbridge.

ROUTING.

14. It became evident after a time that a routing directory for use at the Cross Channel PBX would be desirable as an increasing number of calls were being made to smaller and lesser known units. A routing directory was drawn up giving details of the units to which calls were frequently received, only those units being included to which it could be assumed that a satisfactory connection could be made i.e. without having to route through more than 2 intermediate switchboards.

SECRET
SECTION (VIII)
APPENDIX 'B'

SSI 19-3, 17 May 1945

APPENDIX A

HQ ----------

ROUTE SECURITY REPORT Correct to----hours----45

Route between and	Classification authorized for transmission in CLEAR	Remarks

APPENDIX B

HQ ----------

TELEGRAPH TRANSMISSION SECURITY REPORT Correct to----hours----45

Telegraph facilities between HQ and HQ	Classification authorized for transmission in CLEAR	Remarks

BRIEF DESCRIPTION OF ARMY COMMAND AND ADMINISTRATIVE NETWORK (ACAN)

GENERAL

1. A world wide tape relay network of telegraph channels - radio and line - has been set up by War Dept. Washington to cover all the theatres of the present world war, the majority of the main signals centres - down to Armies and Air Forces, being included in the net.

PROCEDURE

2. The originating centre, on receipt of a signal to be routed via the 'net' punches a tape, the preamble being included as if a direct circuit existed to the call station. This tape is then sent by means of an auto transmitter to the appropriate first intermediate centre. This centre receives the message on a tape off a re-perforator - the tape being overprinted to enable operators to read the preamble. The tape is then re-transmitted via other centres as necessary, until the final centre is reached, where the tape is run through an auto head and teletypewriter to obtain a "hard" copy for the message distribution centre. Any intermediate centre en route which is responsible for any of the addressees runs off a hard copy in addition to re-transmitting the tape to the next centre.

3. All circuits are worked full duplex - the channel message number (NR) being transmitted by a small separate tape preceeding the main tape. This message number has to be deleted and substituted by a new number before re-transmission by each station. In and out check sheets are kept on each channel, checks being made at intervals to ensure that all messages have been received. No 'R' is given for individual messages.

4. Radio channels are specially marked to ensure that no classified material is transmitted over these circuits in P/L.

ROUTING

5. No fixed routings are laid down, but operators with practice learn the general lay-out of the net as it affects them, and route messages via the most appropriate route according to the serviceability of the circuits and the traffic on hand. Due to the numerous inter-connections on the net many alternatives are generally available should any link become unserviceable or over loaded, thus reducing the tendency for traffic to build up in peaks at bottle necks.

CONCLUSION

6. Although the scheme appears to be rather extravagant as far as terminal equipment is concerned, e.g. auto transmitters and re-perforators etc., it is very economical from the line and operating point of view and is a very efficient method of handling a large volume of traffic between major signal centres, especially where long distances are concerned.

SIGNAL STAFF
INSTRUCTIONS
Number 19-3

SECTION VIII
APPENDIX "B"

APO.757
AIR STAFF, SHAEF
17 May, 1945.

TRANSMISSION SECURITY

(Destroy SSI 19-2, dated 5 Feb 1945).

PART I - TELEPHONE SECURITY

1. All land line, Type 10, and VHF telephone communications are subject to interception. Matters of CONFIDENTIAL or higher classification may be discussed on the telephone only if the conversation can be so framed as to convey no information to an unauthorised listener, or in cases of emergency, when the loss of security, which may result in the compromise of operations, must be carefully weighed against the need for speed.

2. Telephone scramblers are not to be considered to afford protection against deliberate interception.

3. Special codes are prescribed by this Headquarters (e.g. Operations Room Code, Ops/Tel Code) for the secure transmission, by land line or R/T, of classified material. The use of unauthorised codes is forbidden.

4. VHF telephone circuits are to be connected to the land line system by means of specially marked cords and jacks on the switchboards concerned. Callers are to be informed by the switchboard operator that they are being connected to radio circuits and that such circuits are liable to interception.

5. Arrangements are to be made to monitor land line and VHF radio telephone circuits from time to time. Any breaches of security that may occur are to be brought to the attention of all concerned.

PART II - TELEGRAPH SECURITY

6. Classified matter may be transmitted in the clear only over certain land line, Type 10, and VHF telegraph circuits on the Continent and cross-Channel, the security of which is considered adequate to carry the particular category of traffic, and provided the security precautions enumerated in paragraph 16 below are strictly complied with.

7. Since the degree of security of the various systems of land line, Type 10, and VHF telegraph vary according to the system employed, their location in relation to enemy occupied territory, and the local conditions along the routes concerned, it is at the discretion of commanders to impose such security restrictions as they deem necessary on telegraph circuits in their areas, but the general conditions given below are to be taken into consideration before clearing channels for classified messages.

8. Landline Systems. All telegraph circuits, cross-Channel and on the Continent, which meet the following conditions, may be approved for the transmission in CLEAR of messages classified up to and including SECRET.

(a) That terminal points, main frames, repeater stations and

/all....

all other such terminal or control points are operated and maintained by Allied military personnel or by approved Allied civilians who have been investigated by the appropriate authority.

(b) That landline routes (underground and overhead) are patrolled and inspected at frequent and irregular intervals.

9. In general, the conditions relating to terminal points above will always apply, but the interpretation of the remaining conditions above is to be made by commanders concerned after consultation with the authorities responsible for the provision and maintenance of the communication links in question. In the case of 8(b) above, normal wire maintenance patrols will be deemed to be sufficient for overhead routes. There is no objection to air forces inspecting internal installations or cable routes carrying their circuits although these routes or installations may, in fact, be another commanders' responsibility. Army commanders have been informed of this.

10. Type 10 systems. Type 10 telegraph circuits may be authorised for the transmission in CLEAR of messages up to and including CONFIDENTIAL provided that:

(a) The messages are not unparaphrased literal texts of cypher signals.
(b) No terminal is situated less than 50 miles from enemy occupied territory or of the Reich. In considering the distance of 50 miles, account must be taken of the possibility of an increased range where equipment is set up at any exceptional point of vantage.

11. VHF circuits neither of whose terminals are within 100 miles of enemyheld territory or of the Reich, whether occupied by Allied Forces or not, or of a neutral country, will be governed by the same security regulations as line circuits.

12. VHF circuits one or both of whose terminals are within 100 miles of enemyheld territory or of the Reich, whether occupied by Allied Forces or not, or of a neutral country, will be considered as insecure radio circuits and normal radio security will apply.

13. VHF teleprinter circuits are to be connected to the land line system by means of specially marked cords and jacks on the switchboards concerned and operators are to be given adequate instructions to ensure that the possibility of making unintentional connections to radio circuits is eliminated.

14. Cryptographic Procedure. The definitions, restrictions and security precautions enumerated above are designed to ensure the maximum security of communications consistent with the requirement for speed and efficiency. Despite all precautions, however, no telegraph system within the Continent can be guaranteed against unauthorised interception.

15. In accepting the risks of interception in the interests of speed, it is necessary to ensure that it is only the contents of messages that are liable to be prejudiced and not the cypher systems in which those messages and very many others are transmitted.

16. Consequently, the following procedures are to be followed.

/(a)....

(a) A multiple-address message that requires to be encyphered for transmission by insecure link (including W/T) to one or more addressees is to be:

(1) Transmitted to all addressees in cypher.
or (2) Paraphrased for transmission to other addressees in clear over secure links.

(b) When it is necessary to send or re-transmit the same message in two different cyphers or cryptographic systems, one message must be a paraphrased version of the other except when either version is in One Time Pad, or except as specifically provided for with certain American high grade cryptographic systems.

(c) When a message, the transmission of which has been initiated over a secure link in CLEAR, requires (by reason of the downgrading of a link, or for other reasons) to be onward-routed over an insecure link in cypher, that message is to be paraphrased (USA code rooms) or "scrambled" (British Cypher Offices).

17. The definition of "paraphrase" is given in:

USA AR 380-5, 15 March 1945, paragraph 48
BR S.D. 0461, Paras 81(ii) and 94(ii)
A.P. 3086, Para. 23(ii).

18. A message is "scrambled" when the text is re-arranged as follows:

(a) Commence encyphering somewhere in the middle of the text of the message.
(b) Continue to the end and include the dat-time-group.
(c) Encypher an appropriate phrase to the effect that "this is a scrambled message encyphered by.....Message begins".
(d) Encypher the address.
(e) Proceed to the beginning of the text, including Originator's reference number, date and classification and continue to the point where encyphering began.
(f) Give the scrambled message a new date-time-group.

PART III - SECURITY CLASSFICATION RETURNS

19. Instructions are to be issued by each headquarters as to the extent to which any telegraph circuits in their area of Command may be considered secure.

20. Restrictions which are not co-ordinated throughout the whole A.E.F. area will cause confusion to the various signals centres when routing traffic in CLEAR or cypher over a common telegraph network which may consist of telegraph circuits of varying degrees of security. It is therefore necessary to prescribe a system whereby formations/ units concerned are informed of circuits not authorized by commanders for the transmission in CLEAR of material classified up to and including SECRET.

21. A list shown in Appendix A showing cable and overhead line sections and local ends and a list as shown in Appendix B showing line and VHF telegraph circuits over which classified material up to

/ and....

and including SECRET cannot be transmitted in CLEAR within Com Z, and within air formation/units and between air formation/units and army formations/units are to be submitted to this headquarters by 2nd Tactical Air Force, Ninth Air Force, and First Tactical Air Force (Prov.), duplicate copies being sent by the last two to CSO, Com Z, and further copies are to be exchanged between the three commands cited and given such internal distribution as deemed necessary within the zones of the various commands.

22. Lists are to be originated on the last Monday of each month. Throughout the month, amendments to lists are to be made by means of messages as they occur. Nil reports will be rendered, where appropriate.

23. Instructions are to be issued that the originating Signal Centres ensure that adequate cypher precautions are taken with matter which must be transmitted or re-transmitted over insecure circuits.

(For the Deputy Supreme Commander:
Sgd. PHILLIP D. O'CONNELL
Lt.Colonel, Air Corps, Acting
Adjutant General).

Distribution

2 - SHAEF Main Sig.Div.
2 - SHAEF Rear Sig.Div.
1 - Air Staff, SHAEF Rear.
6 - HQ 2nd TAF (Main)
2 - HQ 2nd TAF (Rear)
4 - HQ Ninth Air Force
6-HQ 1st TACAF (Prov)
2 - HQ Fighter Command
2 - HQ Transport Command
2 - HQ 46 Group
2 - HQ 72 Wing

1 - Air Ministry, Whitehall
Sigs.5
1 - Com.Z
1 - USSTAF
1 - First Allied Airborne Army
1 - ANCXF
2 - HQ Bomber Command
2 - Eighth Air Force
2 - HQ 60 Group

Internal

D/COS (Air)
D/COS (A-2)
Operations Records
A/COS (A-3)
A/COS (A-4)
CASO
D/CASO.1
D/CASO.2
CAFSO
Radar
Signals 1
Sigs.Plans
Sigs. - Security
Sigs. - ADLS
Sigs.1A
Sigs.1B

/Appendix "A"
and Appendix "B"

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

O N

O P E R A T I O N 'O V E R L O R D'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

S E C T I O N IX

USE OF V.H.F. R/T DUPLEX (RACEHORSE) CIRCUITS

CROSS CHANNEL RADIO CIRCUITS

1. After the initial stages of the assault and when the major Air Force Headquarters and Signals Centres had moved over to the Continent the V.H.F. R/T Duplex circuits ('Racehorse') provided by the 'South Coast Radio Scheme' were used to provide standby speech and teleprinter circuits to the submarine cable circuits which had been provided by this stage. The Radio Communications Unit in the U.K. and the Mobile Signals Units Type 'W' on the Continent were utilised as radio terminals. These circuits were longer than those originally planned and for which the equipment had been designed, but nevertheless, were found to work satisfactorily.

RELAY UNITS

2. It was decided to increase the range of these circuits much further and one circuit was worked with two 'W' units working back to back as a relay unit. This circuit gave fair results but was considerably improved when the two 'W' Units were substituted by a 'C.A.' Unit which had been designed specially to work as a relay. The main difference between two 'W' Units being worked back to back and one 'C.A.' Unit, was that the S plus D and Two Tone equipment was not provided in the 'C.A.' Unit, thus removing a considerable amount of superfluous equipment and making the circuit quieter and more stable.

LINING UP PROCEDURE

3. It was found that a considerable amount of the unserviceability on Racehorse circuits was caused by incorrect settings of modulators and volume controls, due to no standards being available for these to be set to, especially in a circuit containing a relay point. On these circuits a terminal R.T.O. was apt to increase his volume to overcome increased attenuation, when in fact the attenuation had occurred in the link over which he had no control.

4. Experiments were carried out in co-operation with Headquarters No. 26 Group, and a lining up procedure drawn up detailing the standards to which modulation and volume had to be adjusted to give the least overall attenuation consistent with the most stable conditions and best signal to noise ratio.

5. A procedure was then introduced so that the radio link was lined up to these standards daily and the overall circuit, i.e., terminal to terminal, was lined up weekly in co-operation with the G.P.O. and Air Formation Signals.

FAULT CONTROL AND LOCALISATION

6. Each cross channel circuit consisted of three sections, each maintained by a different service. The U.K. terminations and landlines were provided and maintained by the G.P.O., the radio equipment by the R.A.F. and the continental termination and landlines by Air Formation Signals.

7. To prevent faults being reported to any of these services unnecessarily, terminal operators 'localised' faults as far as possible before reporting and then reported to the appropriate service, e.g. if the U.K. operator could not speak to the continental operator, but could speak to the radio operator at the U.K. radio terminal, it was obvious that the portion of the circuit maintained by the G.P.O. was not faulty; such faults would, therefore, be handed over to the radio terminal for them to deal with.

PROCEDURE

8. Speech - Initially normal R/T procedure was used, all users having R/T callsigns. After the necessity for strict security of names of formations had ceased, R/T procedure was dropped and normal telephone procedure was substituted with the addition that users were still warned before connection that they were being connected to a radio channel.

9. Teleprinter - Initially W/T procedure was used in the absence of any alternative, but with the issue of AP 3032, addendum No.1. the radio teleprinter procedure laid down in that publication was used. The subject matter of all messages was still encyphered.

EXTENDED USE OF RACEHORSE CIRCUITS

10. It was decided by Headquarters 2nd T.A.F. that Racehorse circuits could be used to provide communications to the tactical groups during periods of advance, and a number of 'A' and 'C.A.' Units were called forward to the Continent for this purpose, and quite extensive use was made of the facilities provided by these Units during the final stages of the campaign in Europe.

CONCLUSION

11. Racehorse circuits provided an essential link in the communications chain during the initial stages of the assault; during the period of comparative stability of the major Headquarters when submarine cable circuits became more plentiful and more reliable, the services of the Racehorse units were not called upon to any great extent, nevertheless, they provided an excellent insurance against complete isolation due to submarine cable failures. During the latter stages of the war in Europe when formations were moving quickly, Racehorse Units once more came into their own and enabled communications to be maintained. Without a doubt the use of Racehorses proved to be one of the most reliable methods of communication by both speech and teleprinter. Their serviceability and performance were excellent and often they were the only means of communication between the various formations using them.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE.

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES.

SECTION X

THE USE OF AMERICAN FREQUENCY MODULATED VHF COMMUNICATION EQUIPMENT.

GENERAL.

1. During the operations on the continent from D day until VE day the Air Forces made considerable use of American frequency modulated very high frequency equipments. These included the AN/TRC-1,3 and 4, and the Link 1498, 50 watt equipments operating in the frequency range 70 to 100 megacycles; the Link 1505, similar to the Link 1498 except with a power of 250 watts; the AN/CRC 3 and 4, transportable equipment operating in the frequency range 30 to 40 megacycles; and the SCR 609 and SCR 610, very low power extremely portable sets operating between 20 and 40 megacycles.

2. One of the major problems that was met in connection with the use of this equipment was that of interference - mutual interference between sets, interference from other types of Allied equipments, such as Radio Countermeasure and Radar, and interference from enemy sources. This problem was especially important during the period immediately after the initial landings in Normandy when a great mass of equipment was operating in a small, confined area. No great extent of interference was encountered, but without doubt this was the result of careful planning and instructions based on the recommendations of the Mutual Interference Sub Committee of the Combined Signal Board, who had made an exhaustive study of interference problems, especially with reference to VHF and Radar equipments prior to D Day. Careful attention had been given to the assignment of frequencies, and the promulgation of various restrictions designed to minimize interference, especially the geographical zoning of frequencies and power that could be used on them by various types of equipment. Practically no interference was experienced from enemy sources, since apparently they were not prepared with jamming devices or did not choose to use them, and apparently did not make nearly as extensive a use of the VHF spectrum as did the Allies.

3. After the rapid advance through France and the great expansion of the territory occupied by the Allies in the West, AN/TRC equipment operating in the 70-100 megacycle region was used to a greater extent, by the Ground Forces as well as the Air Forces. This gave rise to another interference problem. Due to the frequency multiplication in both the transmitter and receiver of this equipment many combinations of frequencies cannot be used by a transmitter and a receiver, or even two receivers, in the same area without mutual interference. Because of siting, as well as personnel problems it was almost always desirable to have several sets on one site, and therefore, it was extremely difficult to find

sufficient transmitting and receiving frequencies that would work satisfactorily in such combinations. In the latter part of December a meeting was called to discuss this problem and to make changes in the frequency allocation such that each Army Group, Air Force, Communications Zone, etc. would have an allocation including more frequencies usable in combination. At this meeting Ninth Air Force presented the results of a comprehensive study they had made of the problem with the cooperation of Twelfth Army Group, together with specific recommendations. A second meeting was held in January 1945 at which time the Ninth Air Force recommendations as amended were in the major portion adopted and specific new frequency assignments were agreed upon. At the same time it was agreed that a uniform report be made by each Headquarters concerned for each VHF circuit established showing locations and frequencies of each relay and terminal, a copy to be sent to each of the other headquarters represented. It was further decided that one Headquarters desiring to operate a relay or terminal in the area of another Headquarters would clear the sites and frequencies concerned directly with the second Headquarters. This system proved very successful and continued in use until VE Day.

4. AN/TRC equipment operating in the frequency spectrum from 70 to 100 megacycles was used by the Ninth Air Force for command communications and for Fighter Control Centres, starting with one AN/TRC one hundred mile system obtained from the First U.S.Army by IX Tactical Air Command shortly after D Day, the use of VHF FM for command communications was greatly expanded and developed. Links were set up between the Advance and Main Headquarters of Ninth Air Force, between the Advance Air Force Headquarters and the Tactical Air Commands and Bombardment Division, between these commands and their Wings, and in some cases on down to Groups. It became a practice, when moving Command Posts from one location to another, to establish a radio relay circuit first, and later establish wire communications. After wire communications had been established, radio relay circuits were used to supplement these facilities, and not merely as a standby means of communications.

5. At first equipment was not available for the command links mentioned above, but about the fifteenth of September, 1944, it was learned from a War Department message that Fighter Squadrons and Fighter Control Squadrons were authorized to draw AN/TRC-1 equipment over and above current Tables of Organization and Equipment. Because of the extreme shortage of this type equipment a number of sets were charged against the above project but diverted to use on the command links. Twenty six such sets were shipped from the United States by Air Priority and put into immediate use.

6. Link 1498 and AN/CRC-3 sets were used in combination at Fighter Control Centres for communications to other points. This was done because of the fact that more frequencies were usable in combination without mutual interference by mixing the two types of sets, than would be possible by using one type or the other exclusively. The link 1498 was used for communications for Light Warning Posts, Direction Finding Posts, and Ground Observer Posts, and for links between Fighter Control Centres. The AN/CRC-3 was primarily used for circuits to the Fighter Direction Posts and for Radar reporting.

7. One problem which was never solved was the interference to AN/CRC-3 equipments from SCR 609 sets used in light liaison and artillery observer planes. This interference was of course very sporadic and unpredictable.

8. The SCR 609 and SCR 610 sets were used primarily by Ground

/Observer

Observer Posts for communications with their forward Ground Observer Teams. Because of extreme portability these sets were well suited for this use. It was found that ranges up to twenty miles could be obtained without difficulty, although the distances used were generally less than this.

9. The Link 1505 set was never used as such by Ninth Air Force except on one occasion - the original cross channel circuit from Normandy to Uxbridge, although about a dozen of these sets were available. It was not used on other occasions because the power output was not necessary and only contributed to greater possible interference to other circuits. The power amplifier was disconnected in these sets and the 1498 portion only was used.

10. The uses made of American frequency modulated very high frequency equipment by the First Tactical Air Force (Prov) after its inception in the latter part of 1944 were very similar to the uses, already described, made of this equipment by Ninth Air Force, but on a smaller scale. XII Tactical Air Command, however, made a more extensive use of AN/TRC-1, 3, and 4 equipments in preference to the AN/CRC-3 and 1498, since the former, as normally used with CF-1 and CF-2 carrier equipments provides several speech and teleprinter circuits, whereas the later provide only one speech or teleprinter circuit.

11. Because of a shortage of line construction personnel which existed at that time, coupled with the difficult mountainous territory in which the First Tactical Air Force was located, their use of AN/TRC VHF FM communications equipment was of extreme importance and advantage. Without this type of equipment it would have been impossible for them to maintain adequately some of their most important command circuits.

12. The British Second Tactical Air Force used several link 1505 sets from their Group Control Centres and Ground Control Interception stations, and for cross channel communication links.

13. No VHF FM equipment was used by the Allied Expeditionary Air Force Headquarters (later Air Staff SHAEF) because of the shortage of this type of equipment in the Theatre and since other adequate means of communications could be provided. However, AN/TRC circuits belonging to the Air Forces were many times used by this Headquarters and their use was very important and necessary, since often these circuits were the only means of communication between this headquarters and other Air Force headquarters.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION XI

DEVELOPMENT AND USE OF NO.1 M.R.C.U. USING ARMY TYPE 10 COMMUNICATION EQUIPMENT.

DEPLOYMENT.

1. September to December 1944: No. 1 Mobile Radio Communications Unit was formed by No. 26 Group at R.A.F. Station, Chigwell, for H.Q. A.E.A.F., and was equipped with sixteen Army Wireless stations Type 10 - Eight channel centimeter signals radio equipment - each station forming one Section with a Corporal Radar Mechanic in charge and three Radar operators. The Headquarters Unit, comprising 3 officers and 13 other ranks, together with eight Sections, were deployed on the Continent to satisfy an urgent requirement, after only approximately ten days intensive training in the United Kingdom. The first commitment was to set up six speech channels between H.Q. A.E.A.F. Versailles and the Air Force Cross-channel PBX at Stanmore, using three relay points covering a total radio distance of 120 miles, with one terminal at Folkestone, operated by an extra Section deployed from H.Q. No. 26 Group.

2. Teething troubles and inexperience prevented this Paris U.K. link ever being set up satisfactorily and on the move of Air Staff S.H.A.E.F. (Forward) No. 1 M.R.C.U. was re-deployed to provide six speech circuits between S.H.A.E.F. (Forward) at Reims and S.H.A.E.F. (Main) at Versailles. The radio distance covered was approximately 100 miles and three channels were used by Air Staff S.H.A.E.F. while three were given to S.H.A.E.F. These links were satisfactory and gave reasonable serviceability.

3. Experience showed that the establishment of sixteen units was too large and in January 1945 the establishment was changed to reduce the number of the Unit's Sections from sixteen to nine. The ninth Section was mainly to act as standby equipment in case of major breakdowns and for testing and checking purposes.

4. April to May 1945: The improvement of land line facilities between Versailles and Reims reduced the necessity for Type 10 Circuits and in view of difficulties which were experienced in providing circuits for H.Q. First Tactical Air Force (Prov) (U.S) due to frequent changes of location and shortage of Signal units No. 1 M.R.C.U. was assigned to that H.Q. The installation of circuits was made difficult by the terrain and changing tactical conditions. The first task was to link H.Q. First T.A.C.A.F. at Heidelburg with H.Q. First T.A.C.A.F. (Adv) at Ulm, this was requested on 27th April 1945. The second task was to link Heidelberg with Kaufbeuren which was requested on 1st May 1945. In both cases the radio links were installed but had not been used operationally for traffic.

SECTION (XI)

On 6th May 1945 circuits were requested from Heidelberg to H.Q. XII T.A.C. at Augsberg - a distance of 171 miles. This link was completed by the 9th May 1945, but was not operational until 13th May 1945, due to delays in the laying of land lines. Satisfactory circuits were provided until 30th May 1945, at which time the requirement ceased and the circuits were closed down.

5. No. 1 M.R.C.U. also installed a short link between H.Q. First T.A.C.A.F.(Prov) at Heidelberg and H.Q. XII T.A.C.(Rear) at Darmstadt, and also gave additional field experience to personnel of the U.S.Air Force Signal Company of XII T.A.C. eventually handing over operation of the link to them.

USE OF EQUIPMENT.

6. The Army Wireless station type 10 works on a wavelength of 6 to 7 centimeters approximately, has a beamed transmission 5 degrees in width, requires purely optical paths between pairs of stations, uses pulse-width Modulation for each of the eight speech channels and has a synchronising pulse.

7. Interception of transmissions, other than by similar equipment situated along the line of shoot, and within optical range is extremely improbable, due to narrow beam-width and the scrambling effect produced by eight speech channels on the same frequency. These factors allowed traffic up to the classification of 'Confidential' to be passed in the clear, unless literal unparaphrased versions of Cypher messages, or where on of the stations was within fifty miles of enemy occupied territory.

8. Experiments were conducted using a four channel V.F. Telegraph system on one of the six speech channels between Reims and Versailles, with highly satisfactory results up to normal landline standard, so that, had the land lines been out of service for any considerable period, a Type 10 channel could and would have been used. This was confirmed during the commitment for First T.A.C.A.F. during which Telatype was successfully worked for eighteen days. Speech + Duplex equipment, either British or American can be used on any or all channels without sacrificing a speech circuit. The siting of type 10 [redacted] Wireless stations is of paramount importance since the paths of transmission must be rigorously optical between each pair of stations to ensure that signal levels and signal-to-noise ratios are as great as possible. The normal formula for the calculation of optical distances between two points viz: $R = 1.23 (\sqrt{H1} + \sqrt{H2})$ is employed despite the fact that communication is possible under conditions where intervening obstacles cut the path given by this formula, provided that they are not worse than the calculation for optical 'radio' distance for propagation of ~~the frequencies employed~~ given by the formula: $R = 1.41 (\sqrt{H1} + \sqrt{H2})$. In the latter case it is generally found that fading and noisy circuits are obtained during abnormal propagation conditions. The average distance covered by each individual link is approximately 40 to 50 miles for average terrain, the longest link worked was over a range of 71.75 miles which gave excellent results.

9. The propagation conditions of the 6 to 7 centimetre band have been reliable except during the period of excessive temperature change, often occurring at dusk and dawn, after a period of great [illegible] heat during the day when followed by a large drop in temperature at night. The likelihood of this phenomenon being the result of an instrumental fault has been checked and appears unlikely since it occurs over all links at the same time, being more noticeable over long range links or those having poor optical clearance.

/ para. 10

10. The lining up of channel circuits is relatively easy when only one or two pairs of stations are used, but difficulties are multiplied by the addition of more links. The greatest number operated in tandem was eight, needing considerable care, experience and constant monitoring to ensure that the speech circuits were not noisy and that breakdowns due to operational and instrumental faults were not frequent. Line amplifiers have been used at the terminals of type 10 circuits, but there would appear to be no advantage unless the lengths of land line cause excessive losses.

11. The unit was unfortunate in the early days of its formation due to hurried and insufficient technical training, the lack of technical spares when an equipment task (MMER) did not materialise, the poor quality of a series of Magnetrons and no means of thoroughly checking spares and individual units. These difficulties were gradually overcome by practical experience in the field, the use of 'liberated' German components (such as Resistors and Condensers) the receipt of a new series of Magnetrons, the calling forward to the Continent of an extra Section for testing and checking purposes and the laying on of another equipment task (BASS).

12. The average serviceability of this equipment is high when properly maintained, e.g. The Versailles to Reims circuits used eight Stations in tandem and averaged better than 90% efficiency, including the time taken out for regular maintenance, the average time these circuits were available was approximately 22 hours per day, but it is of interest to note that the time off for actual breakdowns averaged only 11 minutes daily. A very good performance was maintained during the operation of the Heidelberg to Augsberg link which used six stations in tandem; in a period of eighteen days operation, only 1 hour 30 minutes serviceable time was lost, due to two instrumental breakdowns, although no routine maintenance was taken.

OBSERVATIONS.

13. The results given by this unit have shown that Army Wireless stations Type 10 can be utilised to provide Speech and telegraph circuits to assist other forms of Signals communications, especially in cases where land line circuits are not available, provided that the personnel manning these equipments are fully trained and that reserves of technical spares are available.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION VII

PROVISION OF COMMUNICATIONS FOR AIR TRANSPORT SERVICES AND FLYING CONTROL ORGANISATION

1. The Air Staff S.H.A.E.F. Signal Division, by virtue of its responsibility for co-ordinating all air communications within the European theatre and between the European theatre and the U.K., had a considerable interest in the communications required for Air Transport services and for Flying Control organisations.

2. The Headquarters responsibilities in establishing communications for R.A.F. Transport Command, involved the allocation of frequencies for W/T point-to-point, Air to Ground, and R/T Air to Ground, Navigational Aid Beacons and Radio Ranges, and the approval of long distance speech and telegraph circuits. The allocation of frequencies for R.A.F. Transport Command is dealt with in more detail in the Frequency Section. The communications authorised were in the main in accordance with the various Air Ministry Signals War Orders published from time to time, detailing the communication links required.

3. The Headquarters responsibilities for establishing communications for U.S. Air Transport Command, likewise involved the allocation of frequencies and the approval of long distance speech and telegraph circuits.

4. In order to set up on the Continent an organisation similar to the Central Flying Control at R.A.F. Bomber Command in the U.K., it was decided to establish at Le Bourget Airfield, Paris, a Continental Flying Control Centre. This Centre was provided with speech and teleprinter circuits to No. 11 Group Filter Room, Hill House, in the U.K., the U.K. Cross Channel telephone switchboard, and such Air Force organisations on the Continent as were deemed necessary by virtue of their size and the number of aircraft they operated.

5. Towards the end of 1944, joint Air Ministry and U.S.S.T.A.F. Flying Control organisation, named the Joint Continental Air Traffic Board, was set up to establish airways along the major transport aircraft routes on the Continent, and between the Continent and the U.K. and Control Zones of 25 miles radius covering London and the cities on the Continent having a large amount of Air Transport traffic. Centres known as Joint Air Traffic Centres were initially set up in London, Brussels, Paris and Marseilles, and airways were provided linking London with Paris and Brussels, and Paris with Brussels and Marseilles. The Joint Continental Air Traffic Board was given authority for laying down

/at

what height aircraft should fly or cross the airways, and no aircraft were allowed to use the airways unless they were in two way communication with a ground station. Regulations were laid down by the Joint Air Traffic Centres for the control of flying under non-contact conditions in the area of their Centre. Under non-contact conditions, aircraft approaching the Centre would fly in accordance with instructions given from the Joint Air Traffic Centre and aircraft leaving airfields within the Centre's area and using the airways, were compelled to fly in accordance with a flight plan previously submitted by the Pilot and approved by the Joint Air Traffic Centre.

6. It was apparent that this organisation would require extensive landline communications and navigational aids in order to effect the necessary control of the transport aircraft, and arrangements were made for the Signal Division, Air Staff S.H.A.E.F. to be represented at most of the meetings of the Joint Continental Air Traffic Board. This enabled an advance picture to be obtained of the communications required for this organisation. In the main, the communications consisted of speech and teleprinter circuits linking the Joint Air Traffic Centres, and speech communications from each Centre to the Flying Control Tower of the airfields within the Centre's area. In certain cases, speech communication was also required from the Centres to various check points along the route of the airway, check points taking the form of an H.F. or V.H.F. R/T channel.

7. An example of the need for and advantages to be gained from co-ordination of long distance landline communication requirements by the highest level Headquarters in any theatre was obtained in January, 1945, when separate requests were received from Joint Continental Air Traffic Board, R.A.F. Transport Command and U.S. Air Transport Command, for Speech communications from the Paris area to other locations on the Continent and in the U.K. The total speech communication links requested by these organisations were impossible to provide between the Continent and the U.K. and very difficult and uneconomical in the cases where the circuits were entirely on the Continent. A meeting was, therefore, held on the 30th January, 1945, under the Chairmanship of the Chief Air Signals Officer at which all the interested agencies were present and proposals were made for the joint use of available cross channel and continental speech circuits. The proposals comprised the establishment at the Joint Air Traffic Centre, Paris, of a telephone switchboard, on which it was proposed to connect two circuits to the Joint Air Traffic Centre, London, and one circuit to the airfields at Marseilles, Lyons and Dijon. At London and Paris the various agencies requiring communication for Air Transport purposes were supplied with direct speech circuits to the switchboard serving the respective Joint Air Traffic Centres. The agreement of the organisations present at the meeting to such a joint use of communications was obtained and considerable saving in landline circuits resulted.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION OVERLORD

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION XIII

PROVISION OF COMMUNICATIONS FOR MOVEMENT LIAISON SERVICES

1. It was decided that movement information of friendly aircraft flying between the Continent and the U.K. must be available to all concerned with identifying friendly and enemy aircraft for the following reasons :-

(i) To avoid useless intercept sorties.

(ii) To ensure that enemy raids were engaged.

(iii) To avoid engaging friendly aircraft.

2. In so far as aircraft flying from the UK to the Continent were concerned, it was decided to use the UK M.L.S. organisation at Hill House, Stanmore, and transmit movement information in advance to the Continent by W/T, where all interested could receive the information.

3. M.L.S. Hill House was connected to the main operational Commands in the U.K. by teleprinter and the movement information of aircraft was passed to the M.L.S. When received at Hill House the information was encoded and transmitted on the M.L.S. Medium Frequency Broadcast. Adequate arrangements were made to see that traffic levels were maintained so that the enemy could get no information of impending raids from traffic peaks.

4. It was decided to split the M.L.S. broadcast into two halves, one transmitting movements which were mainly of interest to the U.S. Zone, and one to the British Zone. In practice the rules governing the overlap of the two Zones were so broad that all movements had to be transmitted on both frequencies. Later this caused considerable trouble, as the numbers of sorties were so large that messages got seriously delayed. Efforts were then made to reduce the overlap messages to ensure that only those movements were transmitted to the respective Zones which would definitely interest them.

5. Movement messages were given serial numbers. The object of this was to enable units to check that they had received all messages. If they missed one they could ask for a repeat on an H.F. channel upon which M.L.S. Hill House kept permanent watch. Hill House kept a listening watch on one H.F. channel for the British Zone and one for the U.S. Zone.

6. The system as originally established worked satisfactorily throughout the operation in so far as the British Zone (North Western and Northern France, Belgium, the Netherlands and North Western Germany) was concerned. The only change made was to instal a higher

power M/F transmitter to counter attenuation as the distances increased, and to overcome the interference from German sources as our forces approached these sources and moved away from Hill House.

7. In the U.S. Zone the system worked satisfactorily at first, but as distances increased, particularly when U.S. Forces approached the Swiss and Southern German frontiers, it became unsatisfactory. A certain amount of the difficulties experienced were outside the scope of pure signals, but the fact also remains that the distances involved, the cratic areas of reception, and the interference from German sources made reception of the broadcast difficult.

8. To try to overcome the difficulty both changes in frequency and increases in transmitted power in the Hill House broadcast to the U.S. Zone were tried but neither were satisfactory over the 24 hours. It was thus clear that retransmission from the Continent would be necessary.

9. The Ninth Air Force had set up at Le Bourget an internal Continental Movements and Flying Control Organisation. It was decided to adapt this organisation to include the movements of aircraft from the U.K. to or through the U.S. Zone. The M.L.S. Broadcast from Hill House was received at Le Bourget and passed over an H/F network to the interested Ninth Air Force units. Ninth Air Force were also made responsible for passing the information to First TACAF Units.

10. Later a teleprinter circuit was provided between Hill House and Ninth Air Force M.L.S. Le Bourget and wire circuits from Le Bourget downwards.

11. In the U.S. Zone the Ninth Air Force not only passed the information to Tactical Control Centres, but also to the Air Force A.A. Brigades which would be affected by particular flights. A.A. G.O.R's were notified from T.C.C's through the Army A.A. Liaison officers on duty in the T.C.C. Operations Rooms, who transmitted a "Hold Fire" order to their G.O.R's covering the specific times and areas of the flight concerned.

12. Although the U.S.Continental system as described in the preceding paragraphs worked very well in its final form, some difficulties were encountered at first which caused, or at least contributed to, the unnecessary loss of several friendly aircraft.

13. Due to an apparent misunderstanding of S.H.A.E.F. and of Ninth Air Force instructions, the H/F transmissions from Le Bourget were used only as a "standby" to direct reception of the Hill House broadcasts by the T.C.C's, and were made only on request of the T.C.C. concerned. Since this was a negative use in that it was manifestly impossible for the T.C.C. to know if it had failed to receive a complete Hill House message, many complete messages failed entirely to reach the T.C.C's and G.O.R's. Also, in the case of at least one T.C.C., the responsible officers had not been informed of the presence of an M.L.S. station at their location, and were depending upon Operations channels from their Tactical Air Command Headquarters to supply them with M.L.S. information, which often arrived too late to be of value.

14. Upon discovery and correction of the faults quoted above, the Movements Liaison Service on the Continent operated satisfactorily to the end of the war in Europe.

15. It was considered that the complications of a wireless organisation for reporting movements to the U.K. would be so great as

to make such a system unworkable. It was, therefore, decided to rely on the use of corridors for flights to the U.K. The condition of the enemy Air Force helped to make this system satisfactory.

16. A copy of the ~~Army~~ AIR Staff directive on the M.L.S. organisation is attached at Appendix "A".

APPENDIX "A" to SECTION XIII

AIR STAFF
SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE

Policy Memorandum
No.....4

APO 757, US Army
8 April, 1945

AIRCRAFT MOVEMENT LIAISON IN THE UNITED KINGDOM AND ON THE CONTINENT, ROUTING OF AIRCRAFT AND RULES FOR FLIGHTS BETWEEN THE UNITED KINGDOM AND CONTINENT

APPENDICES

Appendix 'A'	-	Organization MLS Hill House
Appendix 'B'	-	Organization MLS Le Bourget
Appendix 'C'	-	Organization MLS at GCC/TCC and Base Defense Wings
Appendix 'D'	-	Security Regulations
Appendix 'E'	-	Communications
Appendix 'F'	-	Definition of Terms
Appendix 'G'	-	Flying Restrictions

INTRODUCTION.

1. It is essential for Units which are primarily concerned with Air Defense to receive early notification of the movements of friendly aircraft, in order that :-

a. All Operations and Filter Rooms (whether Air Force or A4) where tracks of aircraft are plotted, may have a means of identifying the tracks.

b. Unnecessary air raid warnings shall not be given.

c. Friendly aircraft approaching a defended area shall not be engaged.

2. The procedure for the notification of friendly aircraft movements throughout the BRITISH ISLES is defined in Air Ministry Publications SD 158 & 533 but these documents do not define the procedure for the notification of aircraft movements to any Air Defence system established on the Continent.

OBJECT.

3. The object of this instruction is :

a. To define the organization and procedure for the notification of friendly aircraft movements to Air Defence systems on the Continent.

b. To ensure co-ordination amongst the existing Movement Sections and any further Sections which may be established on the Continent.

c. To amplify the terms of Air Ministry Publications SD 158 and 533 to the special requirements of Continental Operations.

d. To allocate the various responsibilities to those concerned with the Aircraft movement organization.

/RESPONSIBILITY

RESPONSIBILITY OF THE SUPREME HEADQUARTERS.

4. The Supreme Headquarters, AEF is responsible for :

a. Laying down the policy for the Movement organization in so far as the Continent of Europe is concerned.

b. Defining all corridors to be used for flights by aircraft engaged on non-operational missions between the UK and the Continent and for passing this information to the Air Ministry with a request for it to be promulgated in SD 533.

OUTLINE OF ORGANIZATION FOR THE NOTIFICATION OF FRIENDLY AIRCRAFT MOVEMENTS AND DEFINITION OF RESPONSIBILITIES.

Existing Air Ministry Instructions pertaining to the UK.

5. In order to deal with the movements of aircraft which are directly concerned with Continental operations and which are flying between the UK and the Continent the normal movement notification system set up to deal with movements in the UK as laid down in Air Ministry Publications SD 158 and 533 has had to be reinforced. The provisions of SD 158 and 533 will however remain in force in this new organization and will be augmented as shown below.

6. It will be the responsibility of the appropriate Air Force Commands in the United Kingdom to notify the appropriate Movement Liaison Section in accordance with SD 533, aircraft movements for flights through the Supreme Commander's theatre of operations.

Central Aircraft Movement Liaison Section at Hill House

7. The Air Officer Commanding-in-Chief, Fighter Command, has established and operates in accordance with the requirements of Air Staff SLEF, a central Aircraft Movement Section in No.11 Group Filter Room at Hill House. The AOC-in-C, Fighter Command, has arranged the MLS at Hill House to be responsible for :-

a. Broadcasting by wireless to the Continent, the movements of aircraft affecting the BRITISH areas.

b. Passing to the Ninth Air Force MLS Section at LE BOURGET the movements of aircraft affecting the US areas.

c. The dissemination within the UK to those units concerned of movements of aircraft flying from the Continent to the UK.

The detailed organization which the AOC-in-C, Fighter Command has put into effect at MLS Hill House is given at Appendix 'A'.

Central Movement Liaison Section at Le Bourget.

8. The Commanding General, Ninth Air Force, is responsible for setting up a MLS Section at LE BOURGET. He is to arrange for the MLS Section, LE BOURGET, to be organized to carry out the following responsibilities :

a. The reception of MLS messages affecting the Ninth Air Force or First TACAF areas from Hill House, and the re-transmission of these messages to those units under command of the Commanding General, Ninth Air Force, which require the information.

The MLS Section, LE BOURGET, is also to re-transmit the information to those units of the First TACAF which require it.

The detailed organization on which the LE BOURGET MLS is to work is at Appendix 'B'.

b. Passing to the MLS at Hill House such movements of aircraft flying from the US areas to the UK as are required by SD 533.

c. Passing to the apropriate US formations internal movements between US Sectors on the Continent.

9. Commanding General, Ninth Air Force, is to make arrangements direct with the Commanding General, First TACAF for the re-transmission of the MLS information from LE BOURGET to First TACAF units.

MLS at Control Centers and Air Defense Formations on the Continent.

10. The Commanding Generals, Ninth Air Force and First TACAF, and the Air Officer Commanding-in-Chief, Second Tactical Air Force, are to arrange for Special Movements Sections to be set up at their respective sub-units as follows:

a. Group Control Centers/Tactical Control Centers.

b. Base Defense Sectors/Air Defense Wings.

11. The Commanding Generals, Ninth Air Force and First TACAF and the Air Officer Commanding-in-Chief, Second Tactical Air Force are to arrange that the Special Movement Sections set up at their respective sub-units :

a. Receive in the case of American areas, the movements messages of aircraft broadcast from LE BOURGET.

b. Receive, in the case of the British Areas, the movement messages broadcast from Hill House.

c. Arrange for the passing of internal movements of aircraft flying within the Continent or to the UK as detailed in Appendix 'C'.

ROUTING OF AIRCRAFT AND RESTRICTIONS ON FLYING.

Aircraft Engaged on Operational Missions.

12. Aircraft engaged on operational missions do not require clearance from any Movement Section, but must notify the movement to the appropriate Movement Section.

13. All aircraft engaged on operational missions, other than day fighters and night fighters under ground control and Bomber Command aircraft, must be routed clear of Restricted Areas to Flying. Details of the routes to avoid these areas will be obtained through the Movement Section to which the Unit concerned normally notifies aircraft movements.

14. Further restrictions to flying are contained in Appendix 'G' which is in accordance with the provisions of SHAEF Operation Memoranda No.7, Appendix 'E'.

Rules for Flights between Airfields on the Continent by Aircraft engaged on Non Operational Missions.

15. The rules for clearance and notification for pilots of aircraft proceeding from the United Kingdom to forward airfields and from Base areas to forward airfields are contained in para.5 of SD 533 (NEUGRIP).

16. Pilots of aircraft flying between the areas of Composite Groups/Tactical Air Commands will obtain permission for their proposed flight from the Group Control Centre/Tactical Control Center before taking off.

Establishment of Corridors Between the United Kingdom and Continent.

17. The corridors to be used between the United Kingdom and the Continent have been published by Supreme Headquarters, Allied Expeditionary Force. All alterations and additions to the list of corridors will be promulgated as amendments to SD 533 (NEUGRIP); this document also contains instructions for flights in corridors and it must be made available to all pilots.

ACTION AT AAORS ON THE CONTINENT

18. a. AAORs will be issued with the code referred to in Appendix 'D' and they will be able to obtain friendly aircraft movement notifications by listening in to the broadcasts from Hill House or to LE BOURGET in case of the US AAORs. They will in any case be connected to the appropriate Group and Tactical Control Centers or Base Defense Sector/Air Defense Wings concerned, and it is the responsibility of the liaison officer in each GCC/TCC, BDS/ADW to insure that all necessary information on the movements of friendly aircraft is passed to the AAOR.

b. Information concerning aircraft movements may be passed to gun sites in Slidex Code when the aircraft are within 15 minutes of their estimated time of arrival over the area in question.

c. AAOR's will normally be located at the Tactical Control/Group Control Center or will have two-way communications with these centers. All movements notifications will be received by the duty officer at the AAOR (or the AALO if the AAOR is not at the TCC/GCC) from the movement liaison officer at the TCC/GCC.

d. Upon receipt of a "positive" or negative message from the TCC/GCC regarding Bomber Command's proposed operations for the coming night the AAOR will pass the appropriate message to the Restricted Areas for Flying under its operational control.

e. Similarly when the TCC/GCC requests a "hold fire", the AAOR will pass on these requests to the AADC at the Restricted Areas concerned. Any subsequent change, in the time limit of the "hold fire" will be immediately passed from the AAOR to the AADC at the appropriate Restricted Areas.

COMMUNICATIONS.

19. The communications set up for the MLS organization are shown at Appendix 'E'.

20. The WT security regulations for reporting movements of aircraft by WT are detailed at Appendix 'D'. These regulations are to be strictly enforced.

PASSING OF FRIENDLY PLOTS IN THE CLEAR TO A.A.DEFENCES.

21. a. In general, current plots of friendly aircraft making an unscheduled entry from the direction of enemy held territory into an area defended by AA will be passed immediately to all AA gun Sections "in the clear", and also transmitted laterally to adjacent sections that may be affected, except that if the number of aircraft in the flight involved is more than five, the controller will rule whether or not the plots will be passed "in the clear", basing his

decision in each case on :

(1) The likelihood that such current information could be used to advantage by the enemy under the conditions existing at the time and

(2) The likelihood of the planes being fired on by friendly AA if their identity was not broadcast.

b. If an AA position recognizes or identifies as friendly, aircraft returning from the direction of enemy held territory that are being plotted as unidentified, or on which there is no previous information, the identity will be reported upwards in clear, in order that the action authorized sub-paragraph (a) above may be taken by the Controller.

By direction of the Deputy Supreme Commander:

(signed)
D.M. SCHLATTER,
Major General, U S Army,
Deputy Chief of Air Staff.

APPENDIX 'A'

AIRCRAFT MOVEMENT LIAISON, HILL HOUSE

1. Aircraft movements notifications will be received at Hill House either by telephone or teleprinters. One copy of the message is for the Filter Controller for normal identification purposes. A second copy of the message is to be delivered to the Movement Officer who will :

a. Co-ordinate the information with that of other movement messages.

b. Allot a Hill House prefix letter and reference number.

c. Pass the message to Hill House Cypher Section.

2. For the purpose of notification from Hill House to formations on the Continent aircraft movements will be divided into three categories, namely;

a. Those which affect the BRITISH areas.

b. Those which affect the US areas.

c. Those which affect both the BRITISH and US areas.

3. Movements in category a. will be transmitted in code by W/T for reception by units in the BRITISH area.

4. Movements in category b. will be sent in code by teleprinter to the Central Movement Liaison Section at LE BOURGET. An R/T two-way link exists as a standby in case of teleprinter breakdown and as a further standby, movements may be passed over the telephone network to LE BOURGET via SHAEF Air Ops PBX.

5. Movements in category c. will be sent by W/T to the BRITISH areas as shown in paragraph 3 above and by teleprinter to LE BOURGET as shown in paragraph 4 above.

6. Notification of the movements of RAF Bomber Command operating by night will be repeated in the broadcast every half-hour and this repetition will continue until the aircraft have crossed the Continental Coast on their way home.

7. In addition to the procedure detailed in paragraph 6 above, a general warning will be sent out as early as possible each day to indicate whether Bomber Command Aircraft will be operating that night. See Appendix 'D' Security Regulations.

8. It is the responsibility of the Officer in charge of the Movement Section to ensure that a sufficiency of dummy W/T messages are transmitted during periods of little activity to maintain an even flow of movements messages each day. Details of the Security Regulations are contained at Appendix 'D'.

9. Whenever possible the Movements Officer at Hill House will clear by 0500 hours daily, all movement notifications in respect of pre-arranged missions scheduled for that day, thus leaving communications clear for other sorties ordered at short notice.

10. With the exception of movements of strategic bombers operating by night and on night fighters, no movement notifications may be transmitted by W/T from Hill House before 0001 hours in respect of

sorties scheduled to take-off after 0300 hours. This restriction does not in any way affect the notification of aircraft movements being sent to Hill House at any time.

11. Movement messages must be broadcast either to the BRITISH sector or sent by teleprinter to LE BOURGET strictly according to the serial numbers allocated.

APPENDIX 'B'

AIRCRAFT MOVEMENT LIAISON ARRANGEMENTS AT LE BOURGET

1. On receipt of movement messages from Hill House, the Movement Liaison Section, LE BOURGET is to re-transmit the messages to those units of the Ninth Air Force and First TACAF which might be affected by the flights in question.

2. The M.L.S. messages passed by W/T to the units of Ninth Air Force and First TACAF are to be broadcast as received from Hill House and in accordance with the security regulations contained in Appendix 'D' to this instruction.

3. The MLS Section, LE BOURGET, is to arrange that any movements of Bomber Command aircraft received from Hill House, are transmitted to the units for which it is responsible, every 30 minutes from the time they are received until the aircraft have crossed the Continental Coast on their way home.

4. In addition to the procedure detailed in paragraph 3 above, the general warning indicating also whether Bomber Command aircraft will be operating that night will be transmitted to units when received from MLS Hill House.

5. MLS, LE BOURGET, is to keep MLS, Hill House, informed of the various US Tactical Areas. Any alteration in these areas is to be passed to Hill House immediately. Grid co-ordinates will be used for passing this information. The boundary between Second TAF and 9th Air Force will be passed to Hill House from the SHAEF Main War Room every week or whenever there is an alteration.

6. Aircraft movements affecting the U.S. areas will be sent to the M.L.S. Section LE BOURGET. The MLS Section at LE BOURGET will pass any notifications of internal movements of aircraft within the continent received by them to the US Tactical Air Forces and Air Defence Wings concerned.

ORGANIZATION WITHIN MOVEMENT SECTIONS AT GROUP CONTROL CENTRES/ TACTICAL CONTROL CENTRES AND BASE DEFENCE SECTORS/AIR DEFENCE WINGS

1. Each Group Control Centre/Tactical Control Centre and Base Defence Sector/Air Defence Wing will obtain the notification of movements of aircraft flying from the UK to the Continent as appropriate, and will have this information available to assist in the identification of tracks.

2. The Movement Officer at each Group Control Centre/Tactical Control Centre and Base Defence Sector/Air Defence Wing is to identify the tracks plotted.

3. The Movement Officer at a Group Control Centre/Tactical Control Centre will transmit notification of movements by aircraft operating from the airfields of his Group Control Centre/Tactical Control Centre as follows :

a. Aircraft flying to a Base Area. To the Movement Section at the appropriate Base Defence Sector/Air Defence Wing.

b. Aircraft flying between Composite Groups/Tactical Air Commands. Whenever aircraft fly out of the area of their own Group Control Centre/Tactical Control Centre or Base Defence Wing/Air Defence Wing, it is the responsibility of the Movement Officer to notify the flight to the Movement Officer at the Group Control Centre/Tactical Control Centre or Base Defence Wing/Air Defence Wing into whose area the aircraft will fly. There will be no necessity to inform Hill House of friendly aircraft movements over the Continent when such aircraft do not intend to land in or approach within 20 miles of the coast of the United Kingdom.

4. a. Movement Notification for Transport Aircraft Operating from Forward Airfields. Forward Staging Posts will be set up for the use of Transport aircraft, and it is the responsibility of the Movement Officer at the Base Defence Sector/Air Defence Wing to notify movement of aircraft from the Forward airfields. It is the responsibility of the Group Control Centre/Tactical Control Centre or Base Defence Sector/Air Defence Wing in whose area the Forward airfield lies, to provide communications for movement notifications.

b. Movement notification for flights by aircraft which are not under the operating control of any GCC/TCC. Movement notifications in respect of flights by aircraft which are not under the operational control of any GCC/TCC are to be made either to the nearest Group Control Centre/Tactical Control Centre which is to be detailed for this duty by Headquarters, Second Tactical Air Force, Headquarters Ninth Air Force or Headquarters, First TACAF (Prov), who are also responsible for ensuring that adequate communications are provided for this purpose, or to the Central Movement Liaison Section at LE BOURGET, and it is the responsibility of the Movement Liaison Officer at the GCC/TCC or at LE BOURGET respectively, to ensure that this information is passed out to all concerned.

5. Aircraft movements affecting the US areas will be sent to the Central Movement Liaison Section at LE BOURGET and from there they will be transmitted to the Tactical Control Centres of the U.S. Tactical Air Forces concerned and to the Air Defence Wings.

APPENDIX 'D'

SECURITY REGULATIONS

AIRCRAFT MOVEMENTS CODE

1. The Aircraft Movements Code (CD 0299) will be used for encoding Aircraft Movement messages - sent either by W/T, teleprinter or telephone.

2. The Aircraft Movements Code (abbreviated by A.M.C.) is to be used in accordance with the instructions printed inside the cover of the code and the Supplementary Instructions for Movement Liaison issued separately.

MOVEMENT REFERENCE NUMBERS.

3. Every movement message passed by one Movement Section to one or more other Movement Sections is to be given a Movement Reference Number by the Movement Section first receiving the message from the Flying Unit, or originating the message by instructions from an Operations Order, with the exception that messages transmitted from MLS, Hill House by W/T or teleprinter, will invariably bear a Hill House prefix, irrespective of whether or not the message originated in another Movement Section.

4. Movement Reference Number consists of a prefix letter or number (as listed below), indicating - except in the case of MLS Hill House - the originating Movement Section, followed by a serial number allotted by the originating Movement Section.

5. The following prefixes will be used :

MLS 9 Group	- 9
MLS 10 "	- 10
MLS 11 "	- 11
MLS 12 "	- 12
MLS 13 "	- 13
MLS R.A.F.N.I.	- R
MLS Fareham	- F
MLS Sub-Section Abbotsinch	- A
MLS Hill House	- H
83 Group	- L
84 Group	- C
85 Group	- D
IX US Tactical Air Command	- X
XIX US Tactical Air Command	- Y
IX US Air Defence Command	- Z
MLS Netheravon	- N

6. Each movement section will start its daily series of reference numbers with the figure 1 at 0001 hours daily, and continue with numbers in sequence until midnight, when a new sequence will be started.

7. Messages from Hill House for the British Sector will start with the reference HB1 at 0001 hours daily and those for the American will start with the reference HA1 at 0001 hours daily. It is essential that all messages be transmitted in their correct sequence throughout the 24 hours.

8. Movement Reference Numbers are NOT to be encoded, but all references thereto in the texts of other messages must invariably be in Code (see para.11).

/PRIORITIES

PRIORITIES

9. Normal signals priorities will be allotted by MLS, Hill House to all movement messages transmitted by W/T or teleprinter as follows :

MOST IMMEDIATE - For messages requiring urgent attention.

IMMEDIATE - For Flights crossing Continental Coast within 30 minutes of TOO of messages.

IMPORTANT - For flights crossing Continental Coast between 30 and 60 minutes after TOO of messages.

NO PRIORITY - For Flights crossing Continental Coast more than 60 minutes after TOO of messages.

PRELIMINARY WARNINGS.

10. In addition to the general notification of the movements of RAF Bomber Command aircraft, a general warning will be broadcast (twice) with an interval of one hour between as early as possible each day to indicate whether or not RAF Bomber Command aircraft will be operating that night. These messages are to use the groups for "positive" and negative in the AMC and are to be padded up to at lease nine groups in accordance with the "Instructions for Movement Liaison" (Tables V and VI of the AMC).

SECURITY PRECAUTIONS.

11. Messages encoded in AMC are to consist entirely of code groups except for :

a. The initial group, comprising of Movement Reference Number,

b. Aircraft call signs (see Instructions to AMC), and

c. The time of origin, all of which will invariably be in plain language.

12. Messages that have been transmitted in AMC are NOT to be retransmitted in plain language, whether by W/T, teleprinter or telephone. Nor are the literal texts of messages in AMC to be retransmitted in another code.

13. A.A.Operations Rooms wishing to pass movement information to gun sites (not holding AMC) may do so in Slidex Code provided that :

a. The message passed is not a literal text of the AMC message in question.

b. The message is passed not more than 15 minutes before the aircraft ETA over the area.

14. The Aircraft Movements Code, used in accordance with instructions, provides adequate security to the contents of messages. Certain precautions, however, must be taken in order that the type and volume of traffic transmitted do not provide the enemy with valuable advance information of impending operations.

15. Movements Sections are to conceal the volume of "live"

traffic originated or retransmitted by them by the transmission of dummy messages. The preparation and transmission of "Dummies" is to be in strict accordance with the instructions to the AMC and to the following additional instructions :

a. Under no circumstances must signal operators be permitted to know which messages are "live" and which are "dummy".

b. The time of origin given to a "dummy" message must be from 5 to 15 minutes earlier than the time it will be transmitted. This time lag represents the time normally taken to encode a true message, but depends upon the length of the "dummy" message concerned.

c. Service signals on "dummy" messages must be passed in the same proportion as are passed on "live" messages and must be replied to in the same manner as in "live" messages.

d. "Dummy" traffic is not to be transmitted when weather conditions make flying impossible.

e. The volume and timing of "dummy" traffic transmitted is to be so controlled as to conceal all but major variations in the flow of "live" messages. Since it is normally impracticable to maintain the total ("live" plus "dummy") traffic at a level sufficiently high to cover major peaks, it is essential to conceal operational intentions that are revealed by the creation of false peaks.

f. At certain Movements Sections (e.g. Continental MLS Le Bourget) the volume and timing of outgoing "live" traffic bears a relation to the volume of incoming "live" traffic. This correlation between incoming and outgoing messages must also be established in the passing of "dummy" traffic.

g. Dummying is to take place on traffic passed by MLS Hill House to Continental MLS, Le Bourget, regardless of whether this traffic is transmitted by W/T or teleprinter. This is necessary in order that the proportion of that traffic which it is necessary for Continental MLS Le Bourget, to retransmit shall carry the correct ratio of "dummy" traffic, as explained in f. above.

16. The responsibility for controlling the flow of traffic in the manner above indicated is to be assigned to an officer. He is to make a close analysis of traffic, keep graphs showing total traffic and genuine traffic hour by hour and regulate the flow of outgoing "dummy" messages in such manner as will achieve the desired purpose.

APPENDIX 'E'

COMMUNICATIONS

UNITED KINGDOM TO BRITISH SECTOR.

1. All notification of movements from MLS Hill House to the BRITISH Sector will be broadcast on MF W/T.

2. Movement messages are broadcast strictly according to the serial numbers of the movement messages. In order that any GCC or Base Defence Sector can request a repetition of a message missed or not received correctly, the MLS Section will maintain an HF W/T watch for the BRITISH Sector. Any movement messages which any GCC or Base Defence Section wishes to pass to MLS Hill House, will be passed over this HF W/T channel.

UNITED KINGDOM TO LE BOURGET MLS.

3. All notification of movements from MLS Hill House to the American Sector will be passed by teleprinter to MLS LE BOURGET. In addition, an HF W/T watch is to be maintained between MLS Hill House and MLS LE BOURGET.

4. If MLS Hill House and MLS LE BOURGET are out of communication both by teleprinter of W/T, the Air Staff SHAEF Ops. telephone circuits may be used. The SHAEF Ops telephone circuits are connected directly to SHAEF Air Ops PBX at Air Staff, SHAEF (MAIN) and Cross Channel PBX, Stanmore.

MLS, LE BOURGET TO NINTH AIR FORCE AND FIRST TACAF, FCC's AND BASE DEFENCE WINGS.

5. The Commanding General, Ninth Air Force, in conjunction with the CommandingGeneral, First TACAF, will arrange for a satisfactory network to be established between MLS LE BOURGET and the FCC's and Base Defence Wings of the Ninth Air Force and First TACAF.

6. In the event of MLS LE BOURGET losing communication to any of the FCC's or Base Defence Wings, of the Ninth Air Force or First TACAF the Air Staff SHAEF telephone channels to the commands concerned may be used for passing on the movement information. This communications system, however, is not to be considered as the primary means of communication for passing notification of movements, but as an emergency system to be used should the normal system fail.

NOTIFICATION OF INTERNAL CONTINENTAL MOVEMENTS OF AIRCRAFT.

7. Movements of aircraft on the Continent will be warned through the normal operational communications network which provides communications between the Base Defence Sector/Air Defence Wings, and the Group Control Centres/Tactical Control Centres of the Composite Groups/Tactical Air Commands. Lateral communications will also be provided between Groups/Commands and between Group Control Centres/Tactical Control Centres.

FREQUENCIES.

8. Air Staff SHAEF will be responsible for allocating frequencies for thoseW/T channels set up between the UK and the Continent.

9. The Commanding General, Ninth Air Force will be responsible for allocating frequencies for those channels set up between MLS LE BOURGET and FCC's and Base Defence Wings.

(SECTION XIII)

APPENDIX 'F'

DEFINITION OF TERMS.

1. Terms used in this Memorandum are defined as follows:

a. NON-OPERATIONAL MISSION. An aircraft is engaged on a non-operational mission if the primary purpose of its flight is not to engage the enemy but to carry out training, reinforcement, supply, transportation of stores or personnel, (other than airborne forces intended to be dropped in a combat role in the course of the flight in question), or any other activity not directly dependent upon the presence of the enemy.

b. RECOGNIZED, means that an aircraft has been determined to be friendly or hostile by its physical appearance, observed actions or display of visual signals.

c. IDENTIFIED, means that an aircraft has been determined to be friendly or hostile by such means, other than visual, as IFF signals and Air Force flight report indicating presence or absence of friendly aircraft.

d. FRIENDLY AIRCRAFT, are aircraft which have been recognized or identified as friendly by one of the following means:

(1) Recognized as friendly by appearance.

(2) Displaying correct recognition signals.

(3) Showing IFF signals. However, failure to show IFF signals is NOT proof that an aircraft is hostile.

(4) Flying with undercarriage or landing gear down, unless clearly recognized as hostile.

(5) A bi-plane, unless clearly recognized as hostile.

(6) A flying boat, unless clearly recognized as hostile.

(7) Any aircraft with gliders in tow, unless clearly recognized as hostile.

(8) Following a prescribed route and method of approach to a given point, and its type behavior corresponding with information received concerning movements of friendly aircraft.

(9) Four engined aircraft unless clearly recognized as hostile.

e. HOSTILE AIRCRAFT, are aircraft which have been recognized or identified as hostile or which have committed a hostile act.

f. HOSTILE ACT. The following are defined as hostile acts:

(1) Attacking friendly personnel, ground targets, ships or aircraft with bombs or other weapons.

(2) Dropping flares at night without prior notification to the defences over territory occupied by friendly forces or over shipping lying in ports or off beaches in the bridgehead.

/ (3) Diving

(3) Diving on friendly personnel or ships, unless the aircraft is in pursuit of the enemy.

(4) Diving from out of the sun, from any height, on an airfield or other specified vulnerable area, unless clearly recognized as friendly by appearance or by showing correct recognition signals.

(5) Dropping groups of parachutists greater in number than crews of similar types of friendly aircraft, unless prior notification has been received.

g. RESTRICTED AREAS, are vulnerable areas defended by anti-aircraft artillery which by their classification as Inner artillery Zones, Gun Defended Areas or Airfields have different degrees of restrictions to flying and special rules for anti-aircraft engagement.

h. UNRESTRICTED WATERS. This means that AA fire is unrestricted - NOT that flying is unrestricted.

i. HILL HOUSE is the name of the 11 Group Filter Room at Stanmore.

j. DOUBTFUL TRACKS, are tracks in respect of which the evidence of friendly identity and the evidence of hostile identity are considered by the Identifying authority to be approximately equal. Within the Raid Reporting System such tracks are designated with the letter 'X'.

(SECTION XIII)

APPENDIX 'G'

RESTRICTIONS TO FLYING.

GENERAL.

1. This Appendix contains a summary of those restrictions to flying which are designed to reduce the risk of damage to friendly aircraft by anti-aircraft gunfire and which Air Force pilots flying over the Continental Theatre of Operations and adjacent waters must know. Special arrangements have been made to safe guard aircraft of RAF Bomber Command flying by night over areas defended by AA guns. Details of these arrangements are contained in SHAEF Air Defence Instruction No. 5.

PURPOSES OF RESTRICTIONS.

2. The purposes of these restrictions to flying are to reduce the possibility of surprise attack by enemy aircraft and also reduce the risk of damage to friendly aircraft by anti-aircraft gunfire.

AVOIDANCE OF "HOSTILE ACTS"

3. Friendly aircraft will avoid flying in such a manner as to give the appearance of committing a "hostile act". Among the "hostile acts" to be avoided are:

a. Diving on friendly personnel or ships.

b. Diving from out of the sun, from any height, on an airfield.

ESTABLISHING OF IDENTITY.

4. a. Use of IFF. IFF sets must be used in accordance with the instructions laid down in SHAEF Operation Memorandum No.19.

b. Use of recognition signals. Whenever friendly aircraft find themselves over ships or restricted areas, have inadvertently committed a "hostile act", have come under fire from anti-aircraft artillery over friendly territory, are approaching airfields at night to land, or generally wish to establish their friendly indentity, they will either flash the letter of the period on their downward recognition lamp or fire the colours of the period by Verey pistol. Care must be exercised that the proper recognition signals for the period are used.

FLYING OVER RESTRICTED AREAS.

5. a. Inner artillery zones (IAZ's). Except for aircraft of RAF Bomber Command which are permitted to operate over certain IAZ's provided movement notifications are made, aircraft are prohibited from flying over an IAZ. The only time the prohibition may be lifted will be during the hours of daylight when the Sector/Area Controller may order anti-aircraft gunfire withheld or suspended by passing the order "HOLD FIRE" so that fighters may make interceptions over the IAZ. Air Force Commanders will inform pilots of the limits of each IAZ.

b. Gun defended areas (GDA's). Aircraft are prohibited from flying below 500 feet over a GDA. This prohibition may be lifted by the Sector/Area Controller passing the order "HOLD FIRE" to anti-aircraft artillery, so that fighters may operate at any altitude over the GDA. Except for aircraft of bomber command for

whom the necessary movement notifications have been passed, friendly aircraft should normally avoid flying over GDA's unless they are in close pursuit of enemy aircraft. Air Force Commanders will inform pilots of the limits of each GDA.

c. Airfields. The following rules for approaching airfields are designed to lessen the risk of friendly aircraft being mistaken for enemy:

(1) Reduce speed on approaching the airfield.

(2) If possible, lower undercarriage before descending below 1,000 feet.

(3) On no account make the first approach out of the sun.

(4) Never approach in a straight line at a low altitude except on prearranged ground missions.

(5) Circle at a height of not less than 1,000 feet, or below cloud before approaching to land. If the airfield is adjacent to a restricted area, circling must be done within three miles of the centre of the airfield.

(6) At night, unless weather conditions make it impracticable, approach the airfield at a height of not less than 2,000 feet.

(7) When landing on a strange airfield, or one which has no organized night landing procedure, flash the letter of the period on the recognition light, followed by the letter "F" if floodlight is required.

FLYING OVER SHIPPING.

6. a. Ships in unrestricted waters. Aircraft will, as far as possible avoid flying over ships in unrestricted waters, which are all sea areas not specifically classed as "Limited" or "restricted". Ships in unrestricted waters are at liberty to engage any aircraft within effective range (12,000 yds for Heavy A.A.guns, 2,000 yards for Light A.A. guns), not recognized or identified as friendly.

b. Definition of Aircraft Areas. An "Aircraft Area" is a sea area in which the conduct of aircraft and surface craft is governed by special rules based on the absence of enemy air activity. Ships will be instructed that all aircraft are to be assumed friendly, and that they are not to engage any aircraft unless definitely visually recognized as hostile or seen to commit a "hostile act". The burning of a leigh light (searchlight) by aircraft will not be regarded as a hostile act. Aircrews are to be instructed that, before they attack surface objects located by radar, the contact must be visually recognized as hostile. If operational conditions permit Allied warships will fire the aircraft pyrotechnic recognition signal of the period if it is considered that this will assist an aircraft in establishing the ships friendly identity. The non-firing of the aircraft recognition signal is not, however, to be taken by aircrews as an indication that the ship is hostile.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION XIV

FORMATION OF THE FIRST TACTICAL AIR FORCE (PROVISIONAL)

1. The landings on the Mediterranean coast of France, and the drive northward towards a juncture with the Twelfth Army Group, was made by Mediterranean Theatre troops which later became the Sixth Army Group, and by elements of the Mediterranean Allied Air Force. When the juncture was made, and the Sixth Army Group came under the full command of SCAEF and became ETO troops, the problem of command of air units for further operations with the new Army Group Headquarters arose. It was decided by SCAEF and the Commanding General, USSTAF, to provide such support by the formation of a new air force headquarters, in preference to placing the responsibility of co-ordinating with two Army Groups upon an enlarged Ninth Air Force. This new air force, as the First Tactical Air Force (Provisional), was composed of three major components; the XII Tactical Air Command, the First French Air Corps, and the 42nd Bomb Wing (M), plus ancilliary troops.

2. The initial staff for the new Air Force Headquarters was drawn largely from Headquarters, Allied Expeditionary Air Force, and from units forming First TACAF (Prov). Signal troops were initially provided to First TACAF (Prov) by AEAF, by the transfer of the 385th Signal Service Company (Avn), less a small WAC cryptographic detachment which remained with Signal Division, AEAF. This left AEAF entirely dependent upon the Royal Air Force for radio communication and upon Air Formation Signals for wire communication, the only U.S. signal function handled by U.S. troops being that of cryptographic service. Further signal troops made available to First TACAF (Prov) from other sources were the 322nd Signal Company, Wing, and the 459th Signal Construction Battalion, (H) (Avn).

3. Although First TACAF (Prov) had available the signal troops set forth in paragraph 2 above, they were insufficient for its actual needs, especially in the matter of signal construction units. Due to the poor existing civil and military wire systems in their area of operation, the very difficult mountainous and sparsely populated terrain, and the fact that the First French Air Corps had no wire construction facilities or troops, there was a real requirement for at least two, and probably three, Signal Construction Battalions (H), in addition to the 459th.

4. The original construction unit, the 459th Signal Construction Battalion (H) (Avn) was transferred from Ninth Air Force to First TACAF (Prov) in the latter part of November, 1944.

/Three ....

Three more such battalions were requested of USSTAF, to be requisitioned from the United States and assigned to First TACAF (Prov), but they failed to materialize. An attempt was also made to obtain a French battalion from North Africa, but upon discovering that it would have to be completely equipped and trained before use, it was not considered practicable. Thus, First TACAF (Prov) was required to operate with less than an operable minimum of signal construction units, with all the attendant hardships and difficulties. In view of this situation the results obtained in the provision and maintenance of wire circuits were surprisingly good.

5. Signal operations of the First TACAF (Prov) began in fact on 25th October, 1944, when advance parties from the 385th Signal Service Company (Avn) and from the 322nd Signal Company, Wing, moved from Versailles, France, to Vittel, France (the site of Headquarters, First TACAF), to commence the installation of a signal centre. Communication was first opened to the major units comprising the Air Force, to the Sixth Army Group and to Ninth Air Force (Adv). Further expansion of the system followed in record time, and by shortly after 15th November 1944, basic tactical communications for the Air Force were established in some form to all superior, parallel, and subordinate headquarters.

6. Due to the personal acquaintance with the staff officers, and the somewhat "paternal" feeling toward the Communications Division First TACAF (Prov), unusually close cooperation and understanding existed between the staffs of the Chief Air Signal Officers, Air Staff, SHAEF, and the Director of Communications, First TACAF (Prov).

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION XV

WORK OF THE S.H.A.E.F. MISSION - FRANCE

Prior to the liberation of France in 1944, the French Air Ministry and the French Air Force in France had practically ceased to exist and the manpower resources of the Air Force had been widely dispersed. Furthermore, throughout the period of the war no technical advances in aeronautical matters had been made and consequently, when France was liberated, the technique of signals and radar as known in the French Air Ministry was very much out of date. Steps were taken, therefore, to set up a signals branch in the Air Component of the SHAEF Mission to France which would be competent to render the necessary advice to the French Air Ministry on British and American equipment and technique, subject to security release by Washington and Air Ministry.

2. In January 1945 Colonels Vercouter and Vuillot of the French Air Force visited London to study the organisation of the Directorate General of Signals in the Air Ministry. After two weeks study they produced a report for the French Chief of Air Staff in which they described the Air Ministry Signals organisation and the staff functions of the Directorate General of Signals. Concurrently, the Mission provided information to the French Air Ministry on the signals activities and organisation in operational commands in the Royal Air Force.

3. In February 1945 Air Vice Marshal Sir Victor H. Tait attended a discussion in Paris with the French Air Staff at which it was decided that an International Advisory Committee should be formed to advise the French Air Ministry concerning Air Signals matters.

4. It was agreed that this Committee should be under the chairmanship of Colonel Vercouter who had been appointed Director General of Signals in the French Air Ministry, and that it should comprise representatives of Air Staff SHAEF (Signals), SHAEF Mission to France and the French Air Ministry. This Committee was required to make recommendations for placing American and British Signals facilities in organisation, training, equipment and operational methods at the disposal of the French for the purpose of rehabilitating the Signals organisation of the French Air Force, and to ensure that such recommendations would allow of a close co-operation by all Air Forces mentioned. This Committee has met periodically since its formation and has functioned as a convenient debating organisation covering all signals matters of mutual interest to the Americans, British and French.

5. Advice was tendered on the organisation of the Signals Branch of the French Air Ministry and the British organisation of D.C. of S has been adopted in the main, with the exception that the Defense Aerienne du Territoire, equivalent to the British Fighter Command, has been in sole control of radar. It is now intended to build up a Radar Directorate in the French D.C. of S. to control radar policy, and the Defense Aerienne du Territoire will cover the operational application of radar to Fighter defence.

6. An important task of the Signals Branch of the Air Component of the SHAEF Mission to France has been to advise the French Air Ministry on personnel requirements for the French Air Force. Calculations were made on the basis of an Air Force of 100 squadrons with an overall total of 200,000 men. The Signals personnel total was estimated at 24,200. The trades were presumed to be comparable to those in the Royal Air Force with the exception that operations and filter room personnel, landline tradesmen and certain A.A. gunnery personnel in the French Air Force are within the Signals organisation.

7. The problem of initiating signals training was complicated by the lack of proper instructors and training equipment. In April the A.O.C. of No. 27 (Signals Training) Group accompanied by two staff officers, visited Paris and Auxerre and evolved a scheme in conjunction with the SHAEF Mission to France and the French Air Ministry, for the training of radio mechanic instructors. The curriculum to be applied to this training has been designed to bring trainees into line with the Royal Air Force standards. It is anticipated that this scheme will commence in August 1945.

8. Arrangements have been made with Air Ministry for a further 48 potential French instructors to be trained at Cranwell commencing in July.

9. The syllabuses for the training of radio tradesmen are being carefully drawn up by the French Air Ministry, assisted by the Signals Branch of the Air Component of the SHAEF Mission to France, on the basis that trainees should have a thorough grounding in broad principles so that they can adapt themselves to handling any particular equipment, be it French, British or American, with a brief period of specialised instruction on that particular equipment.

10. The Defense Aerienne du Territoire is the only operational Command which has been formed to date. A study is being made within the Signals Branch of the Air Component of the SHAEF Mission to France of the defence organisation that should be set up in France. In order to ensure that this study receives the best possible advice on the British side, Air Ministry have been asked to allow staff officers from Fighter Command to advise on operational layouts. It is proposed that initially arrangements will be made to make use of surplus equipment in this theatre for the French Fighter defence and Air Sea Rescue organisations.

11. The fighter defence organisation in the South of France has been taken over by French personnel, subject to supervision and instruction by a few British Officers and NCOs. A plan for radar cover in Southern France, Corsica and North Africa has been prepared and a demand for the surplus equipment being thrown up by M.A.A.F. has been presented to Air Ministry, who have stated that no decision is possible at present. Air Ministry have therefore been asked to suspend the destruction and salvage of GCI/COL equipment at present proceeding in the Mediterranean area until it is known whether or not more modern equipment will be available for French use.

12. It has been found necessary to release Classified

Documents to the French; hitherto each document has been cleared separately and considerable difficulty has been encountered in obtaining permission to give comprehensive information on radio navigational aids in France. Much progress has been made, however, towards setting up a translating organisation for Classified and other documents under proper security control within the French Air Ministry, and also a Distributing Authority competent to handle British secret documents. This has been agreed by the Air Ministry subject to an RAF officer being employed as Head of the Distributing Authority until such time as he is able to recommend that the method of distribution and precautions taken at lower Formations and Units are efficient and secure. The officer has been established and nominated. Advise has also been given to the French Air Force on the security precautions desirable in connection with the printing of classified documents.

13. Liaison with the Service Industrielle et Technique in the French Air Ministry has been maintained so as to facilitate the exchange of information between M.A.P. and French manufacturers. A contract for the repair of one hundred sets TR 1143 has been placed with "Le Materiel Telephonique" and visits to M.A.P. by representatives of that firm and of S.A.D.I.R. - Carpentier and Radio-Technique have been arranged. Liaison has been established with the French radio representatives of the Ziegler Mission, who are at present visiting the United States.

14. An exhibition of working specimens of British radio and radar equipment for the French Government and selected manufacturers has been arranged. This will take place in Paris towards the end of July. Arrangements are also in hand to show a selection of radio and radar vehicles from 2nd TAF to the French Air Ministry in Paris.

15. Minor signals matters dealt with by the Mission include the improvement of meteorological communications between London and Paris, provision of VHF R/T sets for Devoitine 520 aircraft in the Forces Aerienne de L'Atlantique and arrangements for communications for the fly-past of French squadrons over Paris on 18 June.

16. Further progress in Signals planning for the French Air Forces will inevitably be slow until Operational Commands, with appropriate Headquarters, have been set up and are able to formulate their operational requirements.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE CESSATION OF HOSTILITIES

SECTION XVI

AIR FORMATION SIGNALS ORGANISATION

1. The seven Air Formation Signals units allotted to the Allied Expeditionary Air Force prior to "D" Day had been organised and trained to work with the Royal Air Force formations and headquarters on a functional basis, and the distribution in the first instance was as follows :-

11 Air Fmn Sigs	... 83 Composite Group.
12 Air Fmn Sigs	... Headquarters, 2nd T.A.F.
13 Air Fmn Sigs	... 84 Composite Group.
15 Air Fmn Sigs	... 2 (L.B) Group.
16 Air Fmn Sigs	... 85 (Base) Group.
18 Air Fmn Sigs	... Headquarters, A.E.A.F.
17 Air Fmn Sigs	... Theatre Reserve.

2. It was soon evident that 85 (Base) Group would require more than one unit, and therefore C.A.F.S.O. transferred No. 17 Air Formation Signals from Theatre Reserve to 85 Group.

3. During the planning stages it had been apparent that the territorial restrictions on the beachhead would bring about confusion if all Air Formation Signals personnel were not under one command, and yet it was important that elements of No. 16 Air Formation Signals with 85 Group units should go into the beachhead on "D" day so as to construct the communications which they would ultimately have to maintain when the beachhead had been expanded. In consequence those elements of No. 16 Air Formation Signals which went ashore in the early phases were placed under command of O.C., No. 11 Air Formation Signals with 83 Group. Furthermore, as the campaign progressed it was necessary to place C.S.O., Air Fmn Sigs, Base Area under the operational control of C.S.O., Air Fmn Sigs, 2nd T.A.F., which arrangement remained throughout the campaign, due to the change whereby 85 Group was placed under command of A.M.C., 2nd T.A.F.

4. Thenceforth the build-up of Air Formation Signals units on the continent continued until by the end of September 1944 all of the units had moved over to the continent except No. 15 Air Formation Signals with 2 (L.B.) Group.

5. Having allotted No. 17 Air Formation Signals to 85 Group in the early stages, A.E.A.F. was left without any reserve of Air Formation Signals, and therefore the Air Ministry was requested to hasten the mobilisation of No. 14 Air Formation Signals, and to allot it to A.E.A.F.

as/

as a Theatre Reserve to cover unforseen developments. Some difficulty was experienced due to the original Godwin-Austin conception that there should be one Air Formation Signals unit for every fifteen squadrons. Whilst this is considered to be a good guide, the large number of Headquarters which had to be served in the A.E.A.F. made such a definition most impracticable. However, C.A.F.S.O. obtained Air Ministry authority to treat the unit as a Theatre Reserve for training purposes, without it being specifically allotted to A.E.A.F.

6. The decision to send 72 Wing to the Continent precipitated negotiations, for Air Ministry laid down that although 72 Wing could function with only very limited landline communications, it was imperative to provide a general link up of R.N.A. Stations, despite the distances involved, otherwise only very poor results would be obtained. Air Ministry authority was obtained on the 11 September 1944, and No. 14 Air Formation Signals was immediately allotted to 72 Wing to come under the operational control of C.S.O., Air Fmn Sigs, Base Area.

7. The setting up of communications for No. 33 Wing was expected to require a Composite Company of Air Formation Signals, and in view of the fact that there were to be only two echelons of H.Q., A.E.A.F., or later Air Staff, S.H.A.E.F., on the Continent, No. 3 Company of 18 Air Formation Signals was loaned to 2nd T.A.F. to cover the initial provision of communications. In January 1945 it was possible to withdraw the Company and to allot it to 107 Wing of Transport Command, (which had set up in PARIS), and its associated Staging Posts throughout France.

8. Later, various other minor commitments arose in the Paris area, such as Continental Flying Control at LE BOURGET, and the Joint Airways Traffic Centre. All of these were conveniently covered by the Company with 107 Wing. When 87 Group was formed by 2nd T.A.F. to administer all R.A.F. units in France, No. 3 Company, 18 Air Formation Signals was transferred to it from 107 Wing. By this time the commitments in the Paris area had grown to such an extent that the Company was not strong enough to deal with the additional responsibilities of 87 Group. This was only a temporary situation, because in due course Air Ministry would be replacing all Air Formation Signals operating personnel by R.A.F. or W.A.A.F., in accordance with the normal agreed policy. The Company was, therefore, reinforced by a section on loan from 2nd T.A.F.

9. By the time the decision had been made to move 80 Wing to the Continent, the Air Formation Signals and Army Signals manpower situation had become very acute. Communications had become very stretched, rapid advances had necessitated hasty improvisation, the Ardennes battle had undone considerable rehabilitation, and technical personnel had to be left behind in the rear areas to help the French Postes and Telegraphes to establish and maintain long distance and cross-channel landline communications. It was, therefore, quite out of the question to provide Air Formation Signals personnel for 80 Wing from Continental resources. C.A.F.S.O., therefore, in December took up the case with Air Ministry for the allotment of an additional Air Formation Signals unit to this Theatre. No. 1 Air Formation Signals had just returned to the United Kingdom from Italy, and Air Ministry and War Office agreed to allot it to 80 Wing, but on reduced establishment, there being insufficient time and trained personnel available to make the unit up to strength. The most serious deficiency was a Terminal Equipment section containing almost half of the technical men in a unit, and as stated previously the expansion of the theatre had made immense calls on such personnel.

10. During the initial planning for operation "APOSTLE", it had been visualised that there would be no requirements for Air Formation Signals personnel for that operation, as Scottish Command had accepted responsibility for providing all landlines for the R.A.F. elements. Early in 1945, however, Fighter Command commenced detailed planning, and it was appreciated that it would be very unwise to accept this policy, as had been proved from experience in other theatres with amphibious operations. C.A.F.S.C. was therefore consulted in the matter, and recommended to Fighter Command that there should be an Air Formation Signals Composite Company added to the Order of Battle, and a small Air Formation Signals staff on the Headquarters of the A.C.C. Air Ministry then requested Air Staff, S.H.A.E.F. to provide this Composite Company, as well as another Composite Company for Headquarters, Air Division, C.C.G.(B.E.). These commitments could only be accepted on the basis that :-

(a) "APOSTLE" would not be mounted until some forty days after "V.E" Day.

(b) 80 Wing would be withdrawn after "V.E" Day.

(c) C.C.G.(B.E.) would not require any Air Formation Signals before "V.E" Day.

11. Air Ministry gave a policy ruling regarding the withdrawal of 80 Wing, and C.A.F.S.C. was able to go ahead with the planning and instruct C.S.O., Air Fmn Sigs. 2nd T.A.F. to earmark the company. As it happened, operation "APOSTLE" was mounted earlier than was planned, and considerable difficulty was experienced in getting the Composite Air Formation Signals Company to the Concentration Area in the time available, with no small amount of disorganisation of communications, particularly at 87 Group, due to the sudden withdrawal of sections.

12. By the end of the Campaign there were on the Continent nine Air Formation Signals units under C.A.F.S.C. totalling some 330 officers and 7,130 other ranks. The redeployment of these units is a matter of considerable difficulty, for apart from the need to reorganise them to enable complete units, made up of suitable men, to go to the Far East as a matter of some urgency, the operational signals commitments show no signs of reducing for some time. To facilitate this work, and to avoid confusion, No. 18 Air Formation Signals has been transferred to the Order of Battle of 2nd T.A.F., and C.S.O., Air Fmn Sigs, 2nd T.A.F. made responsible for arranging the redeployment of Air Formation Signals units with the Air Ministry.

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

O N

O P E R A T I O N 'O V E R L O R D'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES.

S E C T I O N XVII

LONG DISTANCE CONTINENTAL LANDLINE COMMUNICATIONS

1. Army Groups, Tactical Air Forces and Com. Z were each responsible for developing a main line network, either by building new routes or by rehabilitation of existing plant in their respective areas, according to a pre-arranged scheme calculated to meet the requirements of all formations and Headquarters as they were phased over to the Continent and moved forward along their axes of advance.

2. In the first instance the main line network was built by Army Groups/Tactical Air Force Signals as a series of overhead routes following the main axes of advance; but as the advance became more rapid these over-head routes were linked up to existing underground cables which had been hastily rehabilitated. The work of rehabilitation was mainly carried out by Army/Air Force Signals personnel later assisted to an increasing extent by the French P.T.T. In this connection the achievements of Ninth Air Force in extending two cross-channel circuits from CARENTON to LUXEMBOURG is worthy of note, for that Headquarters never lost touch by telephone with the cross-channel switchboard in STANMORE except for limited periods of unserviceability.

3. In the early stages the only line communications outside the Army Group/Tactical Air Force sphere of responsibility were those serving echelons of H.Q., A.E.A.F., S.H.A.E.F. and H.Q., U.S.S.T.A.F., and the allocation of resources to meet these requirements was made by C.S.O., S.H.A.E.F.

4. Up to the fall of PARIS the numbers of extra Army Group/Com. Z circuits was very small, but afterwards, consequent upon the moves of various Headquarters and Formations to the Continent which were not under the command of the Supreme Commander, in addition to the normal base organisation, the allocation of long distance circuits passing through more than one of the Army Group/Com. Z areas became extremely difficult. With effect from the 1st September 1944, the Supreme Commander assumed responsibility for the direct control and co-ordination of the main trunk telecommunication network on the Continent. A.E.F. Long Lines Control was, therefore, set up by C.S.O., S.H.A.E.F. in the Head Office of the P.T.T. in PARIS to control through the Com. Z machinery, the rehabilitation of the French P.T.T. system, and the allocation of cable pairs on certain specified main routes, up to and including designated forward repeater stations. Rehabilitation of cables and allocation of pairs beyond these stations on the main routes, and

/similar

similar work on other cables in the Army Group areas, were handled by the appropriate Army Group/Tactical Air Force. A Senior Officer representing C.S.O., S.H.A.E.F. was responsible for the Long lines Control and officers were attached from each of the army Groups. Responsibility for the operation and maintenance of land line facilities was shared by Army Group/Tactical Air Force and Com. Z, boundaries of responsibility being agreed upon and varied to correspond with the forward moves of Army Group Headquarters. As it was evident that a large number of long distance Air Force circuits would have to be set up in the base area, C.A.F.S.O. made arrangements with C.S.O., S.H.A.E.F. for a part of C.A.F.S.O's Staff to be detached for duty with A.E.F. Long Lines Control to look after the interests of the Air Forces. At the same time careful consideration was given to the possibility of establishing Air Formation Signals or U.S. Air Force Signals personnel at each of the main Repeater Stations, to assist the Com.Z/Army Group/P.T.T. staffs and to look after the Air Forces long distance circuits. The scheme, however, was found impracticable owing to manpower considerations, but the principle was agreed that wherever possible subordinate Air Forces should detach technical personnel to Repeater Stations handling their own circuits; and in consequence a small detachment of No. 18 Air Formation Signals was associated with the MAIS Repeater Station. Subsequent experience proved that this action had achieved excellent results, particularly in the maintenance of Air Force circuits and the clearance of faults on them.

5. Up to the amalgamation of H.Q., A.E.A.F. and S.H.A.E.F., C.A.S.O. had only been responsible for communications of H.Q., A.E.A.F. and the Tactical Air Forces. Afterwards, however, he was made responsible for the co-ordination of all Air Force landline requirements in the theatre, which included H.Q., U.S.S.T.A.F., A.A.C.S., Air Transport Command, R.A.F. Transport Command and Eighth Air Force Fighter Command. This co-ordination could not be carried out at A.E.F. Long Lines Control and in consequence an Air Force Landline Priority Sub-committee was set up under the chairmanship of C.A.F.S.O. consisting of D/C. A.S.O.I., D/C.A.S.O.II and C.A.F.S.O., for the purpose of examining all requests for long distance land-line circuits required by Air Forces Headquarters and Formations other than the Tactical Air Forces. The Committee also dealt with conflicting requirements over routes controlled by A.E.F. Long Lines Control, by the assessment of circuit requirements on a priority basis. A copy of the directive to this Committee is attached at Appendix A.

6. This increase in the responsibilities of C.A.S.O. meant that the Air Forces representative at A.E.F. Long Lines Control had to be reinforced and two additional officers were attached there.

7. The decision in January to move part of First Allied Airborne Army from the U.K. to the Continent created a special problem because the responsibility for providing long distance communications was partly Army and partly Air Force. It was, therefore, agreed with C.S.O., S.H.A.E.F. that the Air Forces would be responsible for the communications required within Ninth Troop Carrier Command on the Continent as well as any long distance circuits required by the ground forces which terminated on airfields. First Allied Airborne Army had no construction personnel for main line construction, but considerable building effort was saved by locating two of the Troop Carrier Wings and their associated Groups at Stations and Airfields previously occupied by Ninth Bomber Division formations. Necessary construction in the American area was performed by Com. Z Signal personnel. The third Wing was accommodated in the AMIENS area, and C.A.F.S.O. was able to make arrangements with C.S.O., Air Fmn Sigs, 2nd T.A.F. for the loan of some Air Formation Signals construction personnel to provide communications for the 52nd Troop Carrier Wing. Although the

/ time

time element was short, First Allied Airborne Army expressed their satisfaction with the landlines set up for Operation "VARSITY".

8. The shortage of signal construction battalions within the American Air Forces referred to above and also referred to in the chapter on Formation of the First Tactical Air Force (Prov) was of a serious nature. Originally, the Ninth Air Force had six signal construction battalions which were distributed one to each of the two Tactical Air Commands, one to the Ninth Air Force Service Command, one to the Ninth Air Defence Command and two to the Ninth Air Force Headquarters. In order to simplify construction and maintenance, trunk lines which were common to Air Force and Ground Forces were constructed under the supervision of the Ground Forces Headquarters, pooling the Air Force and Ground Force construction units that could be made available. This was notable in the case of circuits between Air Force and Tactical Air Command Headquarters which largely coincided in routing with the circuits from Army Group to Army Headquarters. Below Tactical Air Command Headquarters' level, many of the Air Force circuits were along routes differing from those used by Ground Forces by virtue of the fact that Wing and Group headquarters were located so as to be near to airfields, whereas the Corps and Division headquarters were located to be in favourable positions with respect to front line Ground troops. This pooling of construction personnel was felt to be of material advantage in meeting construction requirements. The Signal Officer of the Ninth Air Force estimated that he obtained use of over 50% of the circuits constructed in order to meet the large Air Force requirements but contributed only about one-third of the construction troops involved in building these lines.

9. The construction effort available to the Ninth Air Force was reduced upon the formation of the Headquarters, XXIX Tactical Air Command (Prov) to operate with the Ninth Army, and again when the Headquarters First Tactical Air Force (Prov) was formed. A signal construction battalion assigned to each of these two headquarters resulted in a corresponding loss of two construction battalions from those previously serving Headquarters, Ninth Air Force, Ninth Air Force Service Command and Ninth Air Defence Command. In order to compensate for this loss a request was made through USSTAF in November, 1944 for three additional Signal construction battalions to be assigned to the American Air Forces in this Theatre.

10. The shortage of signal construction battalions was felt more strongly when Ninth Troop Carrier Command was moved to the Continent without any signal construction units available for assignment to that Command. The situation was still further complicated by Eighth Air Force units being brought to the Continent without signal construction units. In the U.K. the Eighth Air Force had relied on the G.P.O. to meet all wire line requirements.

11. In March, 1945 it was learned that no signal construction battalions could be made available from the United States for a period of six months. It was found at that time, however, that two construction battalions could be obtained from the Mediterranean Theatre, and these were brought in. The first was assigned to the Ninth Air Force and the second to the First Tactical Air Force (Prov). By this time it was evident that the war would not last for a further six months in Europe and the request made on the United States for additional battalions was cancelled.

12. It is believed that the original six battalions assigned to the Ninth Air Force may have been suitable for its purposes if its original organization had continued. The introduction of

additional Air Force headquarters into the Theatre without the accompaniment of additional signal units caused a severe weakening of the Signal organization. The formation of additional headquarters must always be accompanied by the provision of additional signal units to serve the headquarters.

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SECTION XVII

APPENDIX 'A'

AIR FORCES LAND LINES PRIORITY COMMITTEE

TERMS OF REFERENCE

1. The Committee is charged with the consideration where necessary, as explained hereafter, of the priority of all long distance land line circuits which cross an Army Group boundary, or which lie within the Com. Z/L. of C. area, of all Air Forces in the theatre, whether under the command of the Supreme Commander or not.

2. The Committee will not, however, consider the circuit requirements of the Tactical Air Forces, or of miscellaneous Air Force formations and units located in Tactical Air Force areas, which come under this heading. These circuits will continue to be arranged direct by the Tactical Air Forces concerned with the responsible Army Group or Com. Z/L. of C., in accordance with the Allied Expeditionary Force "OVERLORD" Signal Instruction, Part I, Section I.

3. The Committee will consider allocation of all Air Force Cross-channel submarine cable circuits.

4. In the execution of the foregoing responsibilities

(a) All circuit demands, other than cross-channel received by Air Staff, S.H.A.E.F. will be dealt with initially by D/C.A.S.O.I in respect of U.S.A.A.F. demands, and by D/C.A.S.O.II in respect of R.A.F. demands.

(b) When D/C.A.S.O.I and D/C.A.S.O. II have satisfied themselves of the validity of the demands they will submit them to C.A.F.S.O. for immediate provision.

(c) In the event of C.A.F.S.O. not being able to provide, or in the event of any conflicting requirements, the matter will be considered by the Air Forces Land Line Priority Committee at their next meeting.

(d) Cross-channel cable demands will be submitted initially direct to C.A.F.S.O. to be placed on the Agenda for the next committee meeting, where such demands will be considered by the whole Committee.

/Signed: R.G. HART

Air Commodore,
Chief Air Signals Officer.

FLS/

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE CESSATION OF HOSTILITIES

SECTION XVIII

CROSS CHANNEL COMMUNICATIONS

1. Submarine cables were planned to be laid across the channel under arrangements made by the War Office and the British Post Office, under the general direction of the Supreme Commander. Allocations were made by the S.H.A.E.F. Combined Signal Board to all major arms, i.e., Army, Navy, Air Forces, Press, Foreign Office, etc., and in the case of the Air Forces the Air S.O.-in-C. had to reallocate the circuits to the various Tactical Air Forces. The initial planned allocation for the first phase after D-Day is shown in schedule form at the end of this Section. Appendix 'A'.

2. Difficulties were experienced initially because of the number of wrecks on the sea bottom and the mines encountered, but the ultimate programme was completed as follows:-

SOUTHBOURNE	- LONGUES	No.1.	completed 13 Jun 44 - 4 chnls.
SOUTHBOURNE	- LONGUES	No.2.	completed 18 Jun 44 - 3 speech and 6 teleprinter.
SWANAGE	- CHERBOURG	No.4.	completed 5 Aug 44 - 12 chnls.
SWANAGE	- CHERBOURG	No.5.	completed 3 Aug 44 - 12 chnls.
CUCKMERE	- DIEPPE	No.6.	completed 12 Sep 44 - 12 chnls.
DOVER	- ANDRESELLES	No.7.	completed 23 Oct 44 - 12 chnls.
DOVER	- SANDGATTE	No.8.	completed 24 Oct 44 - 12 chnls.
DOVER	- SANDGATTE	No.9.	completed 11 Jan 45 - 12 chnls.
DOVER	- SANDGATTE	No.11.	completed 17 Jan 45 - 12 chnls.
CUCKMERE	- DIEPPE	No.12.	completed 6 Mar 45 - 12 chnls.
ST. MARGARETS BAY	- LA PANNE	1926	cable rehabilitated by 23 Dec 44 16 circuits.
ST. MARGARETS BAY	- LA PANNE	1930	cable rehabilitated by 31 Nov 44 14 circuits.

/3.

3. It had been proposed to lay a No. 10 cable to LA PANNE, but the retention of the DUNKIRK area by the Germans prevented this from being accomplished, and in consequence a second cable was laid to DIEPPE. The rehabilitation of the 1926 and 1930 LA PANNE cables was not entirely successful owing to the proximity to shipping lanes into ANTWERP, and in consequence one was retained out of service as a standby to the other.

4. In addition two Type 10 links were installed by War Office Signals across the channel to serve as standby against cable failures.

5. During the latter phases of the campaign, equipment had been installed on the Cable No.11. to CALAIS to provide 60 speech channels on one cable, and a second was being converted at the time of cessation of hostilities.

6. It was decided to maintain one or two centres in the United Kingdom to act as Switching Centres for cross channel circuits, so that the service could be made available to the greatest possible extent. It was decided as impracticable to do this on the Continent owing to the difficulty in providing and maintaining high grade circuits from any Switching Centre on the Continent. In this way it was also considered that greater control could be exercised over the users of cross channel facilities.

7. Initially the cross channel Switching Centre was located at UXBRIDGE, but after the departure of H.Q. 2nd T.A.F. and Ninth Air Force to the Continent, it was moved to STANMORE. At this stage, however, it was necessary to split the concentration point in the United Kingdom into two. STANMORE to serve the needs of the Royal Air Force and H.Q. U.S.S.T.A.F. at BUSHEY to serve the U.S. Air Forces. Later when H.Q. U.S.S.T.A.F. moved to the Continent the U.S. Cross channel Switching Centre, both telegraph and telephone, was moved to H.Q. Eighth Air Force at HIGH WYCOMBE. Later operational demands made it imperative for certain point to point cross channel circuits to be provided, but the principle of maintaining two principal cross channel telegraph and telephone Switching Centres in the United Kingdom was followed throughout the entire campaign.

8. The difficulties which were experienced with cross channel submarine cable circuits were mainly confined to the Continental extensions from the cable head. As was emphasised in dealing with long distance landline communications generally, considerable use had to be made of French civil cables, which in the vicinity of the initial beachhead, were very badly damaged. Early extension could be made from LONGUES on overhead construction either open wire or carrier quad, but as the advance progressed beyond PARIS this became impracticable. The cables at LONGUES and CHERBOURG had to be relied upon until after the capture of DIEPPE, as it was not practicable to lay a concentric cable to any intermediate point owing to the distances involved. As it was, only four channels were available on each LONGUES cable, compared with twelve in the CHERBOURG ones, on account of the additional distance.

9. The route which could be used for extension eastward was either CARENTON - BAYEUX - FALAISE - ROUEN - PARIS or CARENTON - ST. LO - AVRANCHES - RENNES - LE MANS - CHARTRES - PARIS, and whereas the former was seriously damaged during the fighting, the latter was long and badly damaged over the CARENTON - ST. LO - AVRANCHES portion. The former route was used for the extension of circuits to the British Forces, when suitably restored by the laying of fourteen pair 40 lbs.

cable east of BAYEUX, and the latter was used for extension to the American forces by building an overhead Rapid Airline route from CARLTON to LAVAL. Cross channel circuits for Ninth Air Force took the LAVAL route, and were successfully extended through PARIS to VERDUN on underground cable, and thence to LUXEMBOURG on overhead routes, and though the serviceability at times was indifferent, operational contact was maintained throughout the summer and autumn. The extension of circuits to 2nd T.A.F. was more difficult, and after the headquarters had moved north of the Seine communication was unsatisfactory until the completion of the Dieppe cable. Once 2nd T.A.F. was installed in BRUSSELS communications gradually improved both in quality and quantity as additional cables became available. The fact, however, that the centre of gravity for Continental communications moved north and east always was accompanied by difficulties owing to the inadequacy of the main cables to Belgium from the Pas de Calais, and so the rehabilitation of the LA FAUNE 1926 and 1930 cables in January proved most valuable to 21st Army Group and 2nd T.A.F.

10. The provision and maintenance of teleprinter circuits to the United Kingdom provided a special problem. In the initial stages use was made of S plus D equipment in order that the small number of speech circuits could be used to the greatest effect, and although in certain cases satisfactory telegraph channels were obtained, it was found that unless the speech and telegraph channels were to work between the same points, the telegraph channel could not be guaranteed to be reliable. On the other hand Voice Frequency channels are not capable of indefinite extension, and, therefore, it was decided to open up a 12-channel system from the Base Signal Centre at GHENT to STANMORE, but owing to equipment shortages at STANMORE, it was finally installed to UXBRIDGE. This system provided the bulk of the telegraph circuits to 2nd T.A.F. Headquarters, Eighth Air Force Fighter Command and 72 Wing, as extensions were engineered on direct Air Force systems from the Base Signal Centre to the formations involved.

11. At the end of this section, schedules are shown giving the allocations of Air Force circuits in the LONDON and CHERBOURG cables, and also the final list of working circuits on VE-Day. Appendices 'B' & 'C'

12. With the amalgamation of S.H.A.E.F. and A.E.A.F. in October, 1944, C.-in-C.S.O. was made responsible for the co-ordination of all cross channel requirements of the Allied Air Forces. This work was carried out by the Air Forces Landline Priority Committee under the chairmanship of C.A.F.S.O., and made all sub-allocations to Air Forces and Formations on an individual circuit basis. The requests had to be examined in detail to ensure that operational requirements obtained highest priority. During the latter part of 1944 and early 1945, however, there were increasing demands for communications by formations operating non-operational aircraft, as well as the requirements of the Joint Continental Airways Traffic Board which had been set up in LONDON to handle the control of aircraft flying between the United Kingdom and the Continent. Joint Airways Traffic Centres were being set up in LONDON, PARIS and BRUSSELS which required cross channel communications and which to a certain extent duplicated and conflicted with those already requested by the various organisations associated with the operation of transport aircraft such as U.S.S.T.A.F., A.T.C., R.A.F. Transport Command and Continental Flying Control. In consequence a meeting was called by C.-in-C.S.O. in January 1945, as a result of which it was decided to utilise the Joint Airways Traffic Centres at PARIS and UXBRIDGE as Switching Centres for the various operating formations. It was, however, found possible to provide telegraph channels to meet

individual needs, partly because they were more numerous and because switching of telegraph circuits had not proved altogether successful or economical.

13. As the campaign came to a close the submarine cable facilities were so improved that consideration could again be given to the provision of the individual requirements in the PARIS area because they could be provided on cross channel cables in the Western Group, which for geographical and engineering reasons could not be extended into Germany.

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APPENDIX 'A'

SECTION XVIII

ALLIED EXPEDITIONARY AIR FORCE

Schedule of Cross channel Submarine Cable Requirements

STAGE 1.

D + 6 - D + 12 (incl).

Total circuits available .....3 + 6
Allotment.....1 + 2

Note: Teleprinter circuits are shown as T/P
Teletype circuits are shown as T/T

Distribution:-

1. 1 Phone shared (483 GCC) (IX TAC.FCC) to CCC (11 Gp Ops)

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2. 1 T/P 483 GCC to CCC

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3. 1 T/T IX TAC.FCC to CCC

STAGE 2.

D + 13 - D + 14 (incl).

Total circuits available.....6 + 12
Allotment.....2 + 5

Note: Teleprinter circuits are shown T/P
Teletype circuits are shown as T/T

Distribution:-

1. 1 Phone shared (483 GCC) (IX TAC.FCC) to CCC (11 Gp Ops)

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2. 1 Phone shared (IX TAC.FCC) (21 Wing) to CCC

Note:- The above to be shared by day and 21 Wing to have exclusive use of this circuit from ½ hour before dusk until ½ hour before dawn. Tails at both ends to be switched on COP.

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3. 1 T/P 483 GCC to Hillingdon House

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4. 1 T/P 483 GCC to CCC

5. 1 T/T IX TAC.FCC to CCC

6. 1 T/T IX TAC.FCC to Hillingdon House Ops

7. 1 T/P 21 Wing to CCG

STAGE 3

D + 15 - D + 17 (incl)

Total circuits available.....16 + 24
Allotment..... 7 + 6

Note:- Teleprinter circuits are shown as T/P
Teletype circuits are shown as T/T

Distribution:-

1. 1 Phone 483 GCC to CCC

1a. S + D 1 T/P 483 GCC to CCC

2. 1 Phone 483 GCC to Hillingdon House Ops

2a. S + D 1 T/P 483 GCC to Hillingdon House

3. 1 T/P 483 GCC to Hillingdon House

4. 1 T/P 483 GCC to CCC

5. 1 T/P 483 GCC to Hillingdon House
(later to be transferred to BSC)

6. 1 Phone shared (IX TAC.FCC) / (21 Wing) to CCC

Note:- The above to be shared by day and 21 Wing to have exclusive use of this circuit from ½ hour before dusk until ½ hour before dawn. Tails at both ends to be switched on COP.

7. 1 Phone IX TAC to Hillingdon House

7a. S + D 1 T/T IX TAC to Hillingdon House

8.		1 Phone	IX TAC to Hillingdon House
8a.	S + D	1 T/T	IX TAC to Hillingdon House
9.		1 T/T	IX TAC.FCC to CCC
10.		1 T/T	IX TAC.FCC to CCC
11.		1 T/P	21 Wing to CCC
12.		1 Phone	TAF Main to Hillingdon House (for 2 Gp. Rear T.A.F. and CCC)
12a.	S + D	1 T/P	TAF Main to Hillingdon House
13.		1 Phone	IX TAC to Hillingdon House
13a.	S + D	1 T/T	IX TAC to Hillingdon House

STAGE 4.

D + 18 - D + X

Total circuits available .... 24 speech + 24 T/P + 24 (S + D)
Required A.E.A.F. allotment.. 8 speech + 6 T/P + 8 (S + D)

Note:- Teleprinter circuits are shown as T/P
Teletype circuits are shown as T/T

Distribution:-

1.		1 Phone	TAF (M) to AEAF Ops STANMORE
1a.	S + D	1 T/P	Y Services TAF (M) to BLETCHLEY

Note:- S + D equipment to be located at Stanmore and the T/P circuit to be extended from Stanmore to Bletchley on a V.F. channel.

2.		1 Phone	TAF (M) to Hillingdon House (for 2 Gp, Rear T.A.F. and CCC)
2a.	S + D	1 T/P	TAF (M) to Hillingdon House
3.		1 Phone	Adv. AEAF to AEAF ops STANMORE
3a.	S + D	1 T/P	Adv. AEAF to AEAF STANMORE

APPENDIX 'A'

SECTION XVIII

4. 1 Phone 85 Group to CCC UXBRIDGE

4a. S + D 1 T/P Base Signal Centre to AEAF STANMORE (AUTO)

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5. 1 Phone Ninth A.F. to Gangway (as a switching centre for Rear Ninth A.F. and IX Bomber Command, etc.)

5a. S + D 1 T/T Ninth A.F. to Gangway.

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6. 1 Phone Ninth A.F. to AEAF (Admin) STANMORE

6a. S + D 1 T/T MET Ninth A.F. to DUNSTABLE

Note:- S + D equipment to be located at STANMORE and the duplex T/T circuit to be extended from STANMORE to DUNSTABLE on a V.F. channel.

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7. 1 Phone shared (IX TAC.FCC) (21 Sector) to CCC UXBRIDGE

Note:- The above to be shared by day and 21 Sector to have exclusive use of this circuit from ½ hour before dusk until ½ hour before dawn. Tails at both ends to be switched on COP

7a. S + D 1 T/T IX TAC.FCC to CCC UXBRIDGE

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8. 1 Phone Ninth A.F. to Hillingdon House

Note:- Facilities to be arranged for 25 Sector as necessary by C.S.O. Ninth Air Force

8a. S + D 1 T/T Ninth A.F. to Hillingdon House

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9. 1 T/P GEE Station 7821 near CHERBOURG to 84 Wing R.A.F. CAMBRIDGE

Note:- Actual location of station on continent is: France 1/25000 Sheet No. 31/22 S.E. St. Pierre Eglise. Map reference 371203. The Station will be named "ANNEVILLE-EN-SAIRE".

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10. 1 T/P Base Signal Centre to AEAF STANMORE (AUTO)

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11. 1 T/T Ninth A.F. to GANGWAY

---

12. 1 T/P Ninth A.F. to Hillingdon House

---

13. 1 T/P 21 Sector to CCC UXBRIDGE

---

14. 1 T/P MET Main TAF to DUNSTABLE

/STAGE 5

APPENDIX 'A'

SECTION XVIII

STAGE 5.

D + X - D + Z

Total circuits available ..... 24 speech + 48 T/P + 24 (S + D)
Required A.E.A.F. allotment .. 8 speech + 16 T/P + 8 (S + D)

Note:- Teleprinter circuits are shown as T/P
Teletype circuits are shown as T/T.

Distribution:-

1. 1 Phone TAF (M) to AEAF Ops STANMORE

1a. S + D 1 T/P Y Services TAF (M) to BLETCHLEY

Note:- S + D equipment to be located at STANMORE and the T/P circuit to be extended from STANMORE to BLETCHLEY on a V.F. channel.

---

2. 1 Phone TAF (M) to Hillingdon House (for 2 Gp. Rear T.A.F. and CCC)

2a. S + D 1 T/P TAF (M) to Hillingdon House

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3. 1 Phone Adv. AEAF to AEAF Ops STANMORE

3a. S + D 1 T/P Adv. AEAF to AEAF STANMORE

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4. 1 Phone 85 Group to CCC UXBRIDGE

4a. S + D 1 T/P Base Signal Centre to AEAF STANMORE (AUTO)

---

5. 1 Phone Ninth A.F. to GANGWAY (as a switching centre for Rear Ninth A.F. and IX Bomber Command, etc.)

5a. S + D 1 T/T Ninth A.F. to GANGWAY

---

6. 1 Phone Ninth A.F. to AEAF (Admin) STANMORE

6a. S + D 1 T/T MET Ninth A.F. to DUNSTABLE

Note:- S + D equipment to be located at STANMORE and the duplex T/T circuit to be extended from STANMORE to DUNSTABLE on a V.F. channel.

---

7. 1 Phone shared (IX TAC.FCC) (21 Sector) to CCC UXBRIDGE

Note:- The above to be shared by day and 21 Sector to have exclusive use of this circuit from ½ hour before dusk until ½ hour before dawn. Tails at both ends to be switched on COP.

/7a.

7a. S + D 1 T/T IX TAC.FCC to CCC UXBRIDGE.

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8. 1 Phone Ninth A.F. to Hillingdon House

Note:- Facilities to be arranged for 25 Sector as necessary by C.S.O. Ninth Air Force.

8a. S + D 1 T/T Ninth A.F. to Hillingdon House

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9. 1 T/P GEE Station 7821 near CHERBOURG to 84 Wing RAF CAMBRIDGE

Note:- Actual location of station on continent is: France 1/25000 Sheet No. 31/22 S.E. St. Pierre Eglise. Map reference 371203. The station will be named "ANNEVILLE-EN-SAIRE".

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10. 1 T/P Base Signal Centre to AEAF STANMORE (AUTO)

---

11. 1 T/T Ninth Air Force to GANGWAY

---

12. 1 T/P NinthAir Force to Hillingdon House

---

13. 1 T/P 21 Sector to CCC UXBRIDGE

---

14. 1 T/P MET Main TAF to DUNSTABLE

---

3 T/T circuits to Ninth A.F.
(required for one or more of the following:-

15.) (Air Service Command
16.) (U.S.S.T.A.F.
17.) (IX Bomber Command
(A.A.C.S.
(27 Gp. A.T.C.)

---

7 T/P circuits to Base Signal Centre
(required for one or more of the following:-

18.) (2 TAF to 2 Gp.
19.) (Adv. AEAF to Air Ministry
20.) (" " to Bomber Command
21.) (" " to Rear AEAF
22.) (" " to U.S.S.T.A.F.
23.) (BSC to Maintenance Command
24.) (Radar Rqmts 60 Group
(RCM Rqmts 100 Group)

APPENDIX 'B'

SECTION XVIII

AIR FORCES CROSS CHANNEL SPEECH CIRCUITS

X CON NUMBER	FROM	TO	VIA	REMARKS
XC.4231	SHAEF AIR OPS	STANMORE	CHERBOURG No.4.	XG 405/5 LLC 4491 A
XC.4274	FWD SHAEF AIR OPS (REIMS)	STANMORE	CALAIS No.11	XG 442/7 LLC 3657 A
XC.4271	FWD SHAEF AIR OPS (REIMS)	STANMORE	DIEPPE No.6	XG.406/9 LLC 3780
XC.4171	USSTAF (MAIN)	PINETREE	BOULOGNE No.7	XG 412/8 LLC 788
XC.4173	USSTAF (MAIN)	PINETREE	CALAIS NO. 9	XG 454/11 LLC 762 B
XC.4172	USSTAF (MAIN)	U.K. BASE	CHERBOURG No.3	XG 404/11 LLC 862 B
XC.4316	USSTAF (MAIN)	PINETREE	CALAIS NO. 11	XG 444/3 LLC 4759
XC.4315	USSTAF (MAIN)	B.A.D.A. BURTONWOOD	CALAIS No.11	XG 445/4 LLC 4758
XC.2176	HQ 2 TAF (MAIN)	STANMORE	RADIO	XG 260/5
XC.4306	HQ 2 TAF (MAIN) (VENLO)	STANMORE	CALAIS No.9	XG 454/4 LLC 4898 A
XC.4307	HQ 2 TAF (MAIN)	STANMORE	DIEPPE No.6	XG 406/7 LLC 5118
XC.4234	HQ 2 TAF (REAR) (BRUSSELS)	STANMORE	CASSEL TYPE 10 RADIO	XG 260/7 LLC 5004
XC.4317	HQ 2 TAF (REAR) (BRUSSELS)	STANMORE	CALAIS No.11	XG 444/4
XC.4354	HQ 2 TAF (REAR) (BRUSSELS)	38 GP. MARKS HALL COGGERSHALL	CALAIS No.11	XG 442/3 LLC 5544
XC.4229	B.S.C.(GHENT)	STANMORE	CALAIS No.9	XG 443/3
XC.4232	B.S.C.(GHENT)	STANMORE	CALAIS No.8	XG 411/9 LLC 6130
XC.4246	B.S.C.(GHENT)	HQ No.11 GP	LA PANNE 26	XG 435/A THIS IS CCT FOR XG 732
XC.2177	B.S.C.(GHENT)	STANMORE	RADIO	XG 246/1
XC.2175	B.S.C.(GHENT)	STANMORE	RADIO	XG 260/4

/XC.4321

X CON NUMBER	FROM	TO	VIA	REMARKS
XC.4321	B.S.C.(GHENT)	STANMORE	CALAIS No.11	XG 446/9 LLC 5065
XC.4293	85 GROUP OPS ROOM	No.11 GP (UXBRIDGE)	CALAIS No.11	XG 442/5 LLC 4465 B
XC.4226	HQ IX AIR FORCE (MAIN)	STANMORE	CHERBOURG No.4	XG 405/7 LLC 3457
XC.4348	HQ IX AIR FORCE ADV. (WIESBADEN)	PINETREE	DIEPPE No.6	XG 406/12 LLC 5474
XC.4380	HQ IX A.F.(ADV) BAD KISSINGEN	PINETREE	CALAIS No.11	XG 444/5 LLC 6162
XC.4286	HQ VIII AFFC (CHARLEROI)	PINETREE	DIEPPE No.12	XG 440/5 LLC 4265
XC.4256	HQ VIII AFFC (CHARLEROI)	PINETREE	CALAIS No.11	XG 442/2 LLC 3091 C
XC.4290	F.A.A.A. (MAISON LAFFITTE)	HQ No.38 GP (MARKS HALL)	CALAIS No.11	XG 443/4 LLC 4361 B
XC.4347	IX T.C.C. LOUVECIENNES	IX T.C.C. ASCOT	CALAIS No.11	XG 443/10 LLC 5476
XC.4163	M.E.W. UNIT (GULPEN)	PINETREE	CALAIS No.9	XG 443/11 LLC 2894 A
XC.4165	72 WING RAF (MONS)	60 GROUP	DOMBURG No.4	XG.441/2 LLC 2890
XC.4330	IX BOMBER DIV (NAMUR)	8 GROUP (HUNTINGDON)	BAYEUX No.2	XG 402/3 LLC 5006
XC.4353	FIRST TAC AIR FORCE(HEIDELBERG)	PINETREE	DIEPPE No.12	XG 440/9 LLC 5554
XC.4243	C.C.F.U. (MALINES)	HILL HOUSE STANMORE	DOMBURG No.4	XG 441/3
XC.4255	No.101 STATION (ST. NIC)	7000 STATION (SENNEN)	CHERBOURG No.3	XG 404/10 LLC 3038 C
XC.4249	JATC (PARIS)	CAC/JATC (UXBRIDGE)	CHERBOURG No.4	XG.405/8 LLC 2926 A
XC.4322	JATC (BRUSSELS)	CAC/JATC (UXBRIDGE)	CALAIS No.11	XG 446/10 LLC 5283
XC.4248	No.302 TPT WING (PARIS)	No.519 AAF STN(GROVE)	CHERBOURG No.3	XG 404/6 LLC 2925 C
XC.4247	PARIS MILTY EXCH	S.A.D.A. (BURTONWOOD)	CALAIS No.11	XG 444/8 LLC 2922 B

/XC.4320

APPENDIX 'B'

SECTION XVIII

X CON NUMBER	FROM	TO	VIA	REMARKS
XC.4320	No.137 STAGING POST	O.A.C. (GLOUCESTER)	CALAIS No.11	XG 445/6 LLC 4786
XC.4319	PARIS MILTY EXCH (PARIS)	NO.519 AAF STN(GROVE)	CALAIS No.11	XG 445/5 LLC 4785
XC.4279	364 W.U. ↵ GENEVAL (NEAR BRUSSELS)	RAF STATION (CANTERBURY)	CALAIS No.11	XG 444/6

APPENDIX 'C'

SECTION XVIII

AIR FORCES CROSS CHANNEL TELEGRAPH CIRCUITS

X. CON NUMBER	FROM	TO	VIA	REMARKS
XC.7483	FWD SHAEF (AIR)	STANMORE	DIEPPE No.6	LLC 200083T-XG 736/4 V.F.
XC.7484	FWD SHAEF (AIR)	STANMORE	CALAIS No.9	LLC 9543T XG 733/18 V.F.
XC.7485	FWD SHAEF (AIR)	STANMORE	CALAIS No.11	LLC 200830T-XG 734/1 V.F.
XC.7238	MAIN SHAEF (AIR)	STANMORE	BOULOGNENo.7	LLC 9287T-XG 729/1VFC
XC.7302	MAIN SHAEF (AIR)	STANMORE	DIEPPE No.6	LLC 9637 T-XG 740/11 VFC
XC.7538	HQ 2 TAF (MAIN)	STANMORE	DUNBURG	XG 738/5 V.F.C.
XC.7542	HQ 2 TAF (MAIN) (VENLO)	STANMORE	CALAIS No.8	XG.732/10 V.F.C.
XC.7324	HQ 2 TAF (REAR)	STANMORE	CALAIS No.11	XG 734/12 V.F.C.
XC.7551	HQ 2 TAF (REAR) (BRUSSELS)	STANMORE	CASSEL TYPE 10 RADIO	S+D ON XG 4234
XC.7565	HQ 2 TAF (REAR) (BRUSSELS)	38 GROUP MARKS HALL (COGGESHALL)	CALAIS No.11	XG 727/12
XC.7322	2 GROUP (ADV)	STANMORE	CALAIS No.8	XG 726/3 V.F.C.
XC.7217	B.S.C.(GHENT)	STANMORE	RADIO	S+D ON XC 21 (RACEHORSE)
XC.7296	B.S.C.(GHENT)	STANMORE	CALAIS No.8	XG 726/2 V.F.C.
XC.7446	B.S.C.(GHENT)	STANMORE	CALAIS No.8	XG 732/4 V.F.C.
XC.7449	B.S.C.(GHENT)	STANMORE	CALAIS No.8	XG 726/1 V.F.C.
XC.7451	B.S.C.(GHENT)	STANMORE	CALAIS No.8	XG 732/15 V.F.C.
XC.7443	B.S.C.(GHENT)	HQ No.11 GR(UXBRIDGE)	CALAIS No.8	XG 732/1 V.F.C.
XC.7430	B.S.C.(GHENT)	DUNSTABLE (MET)	CALAIS NO.11	XG 727/3 V.F.C.

/XC.7448

APPENDIX "C"

SECTION XVIII

X CON NUMBER	FROM	TO	VIA	REMARKS
XC.7448	B.S.C.(GHENT)	DUNSTABLE (ALT)	CALAIS No.8	XG 732/8 V.F.C.
XC.7554	B.S.C.(GHENT)	STANMORE	CALAIS No.11	S+D ON XC.4229
XC.7319	HQ 72 WING (MONS)	HQ No.60 GP(LEIGHTON BUZZARD	DOMBURG	LLC 20235T S+D ON XG 4165
XC.7436	HQ 72 WING (MONS)	HQ No.8 GP (HUNTINGDON)	CALAIS No.8	XG 732/5 V.F.C.
XC.7452	HQ No.85 GP	No.11 GP (KEMBRIDGE)	CALAIS No.8	XG 732/16 V.F.C.
XC.7520	85 GP (M.I.S.) (GHENT)	HILL HOUSE (MIS) (STANMORE)	CALAIS No.8	XG 732/12 V.F.C.
XC.7445	HQ 80 WING (GUTPEN)	HQ No.100 GP (NORWICH)	CALAIS No.8	XG 732/3 V.F.C.
XC.7338	HQ IX A.F. (MAIN)	PINETREE	CHERBOURG No.4.	XG 730/4 VFC LLC 9299-T
XC.7468	HQ IX AF (MAIN)	PINETREE	CALAIS No.9	LLC 9360T- XG 733/4 VRC
XC.7562	IX A.F.(ADV) (WIESBADEN)	PINETREE	DIEPPE No.6	S+D ON XC.434 LLC 20440-T
XC.7552	IX BOMB.DIV (NAMUR)	HQ No.8 GP RAF HUNTINGDON	CALAIS No.9	LLC 9599T VFC XG 733/15
XC.7447	No.364 W.U. (GENVAL)	RAF STATION (CANTERBURY)	CALAIS No.8	XG 732/7
XC.7444	MET UNIT (AACHEN)	PINETREE	CALAIS No.8	XG 732/2 VFC
XC.7318	MET UNIT(AACHEN)	PINETREE	CALAIS No.11	S+D ON XC 4163
XC.7340	USSTAF(MAIN)	PINETREE	CHERBOURG No.4	LLC 9303 T XG 730/3 VFC
XC.7337	USSTAF (MAIN) (WEATHER)	PINETREE (WEATHER)	CALAIS No.9	LLC 752-B S+D ON XC 4 (FACSIMILE)
XC.7464	USSTAF (MAIN)	PINETREE	BOULOGNE No.7	LLC 9356-T XG 729/9 VFC
XC.7465	USSTAF(MAIN)	PINETREE	CALAIS No.9	LLC 9357-T XG 733/1 VFC

APPENDIX 'C'

SECTION XVIII

X.CON NUMBER	FROM	TO	VIA	REMARKS
XC.7290	USSTAF (MAIN)	U.K. BASE	BOULOGNE No.7	LLC 9271T-A XG 729/11 VFC
XC.7467	USSTAF(MAIN)	S.A.E.A. (BURTONWOOD)	CALAIS No.9	LLC 9261-T XC 733/3 VFC
XC.7336	USSTAF (MAIN)	D. OF I. (JAUTAF)	CHERBOURG No.4	LLC 9533-T XG 730/7 VFC
XC.7466	USSTAF NEWS OFFICE & JSSTAF (MAIN)	MOI NEWS OFFICE LONDON	CALAIS No.9	LLC 9375 T- XG 733/2 VFC
XC.7334	USSTAF (MAIN) (WEATHER)	DUNSTABLE (MET)	DIEPPE No.6	LLC 9647-T XG 740/2 VFC
XC.7487	USSTAF (MAIN) (WEATHER)	DUNSTABLE (MET)	CHERBOURG No.4	LLC 9558T XG 730/13 VFC
XC.7450	VIII A.F.S.C. (BRUSSELS)	PINETREE	CALAIS No.8	732/13 VFC
XC.7518	VIII A.F.S.C. (BRUSSELS)	PINETREE	CALAIS No.8	XG 732/19 VFC
XC.7477	VIII A.F.S.C. (CHARLERIO)	PINETREE	CALAIS No.11	S&D ON XC.42 LLC 20277-T
XC.7507	VIII A.F.F.C. (CHARLEROI)	PINETREE	CALAIS No.8	XG 732/11 V.F.C.
XC.7555	S.L.O. 2 TAF (VELO)	STATION 'A'	CALAIS No.8	XG 726/12 V.F.C.
XC.7291	No.5 A.A.C.S. (ORLY)	A.A.C.S. (LONDON)	CALAIS No.8	LLC 9656T XG 722/13 VFC
XC.7511	No.5 A.A.C.S. (ORLY)	A.A.C.S. (LONDON)	BOULOGNE No.7	LLC 9461 T XG 729/18 VFC
XC.7431	No.302 TPT.WING (PARIS)	No.519 AAF STN (GROVE)	CHERBOURG No.4	LLC 9265 T XG 730/10 VFC
XC.7418	FLYING CONTROL (LE BOURGET)	HILL HOUSE STANMORE	CALAIS No.8	LLC 9203 T XG 722/4 VFC
XC.7512	FLYING CONTROL (LE BOURGET)	CAC/JATC UXBRIDGE	CHERBOURG No.4	LLC 9469 T XG 730/14 VFC
XC.7498	121 STAGING POST (LE BOURGET)	CAC/JATC UXBRIDGE	CALAIS No.11	LLC 20115 T XG 740/8 VFC
XC.7521	107 WING (PARIS)	No. 46 GP. RAF (HARROW WEALD)	CALAIS No.8	LLC 9502 T XG 722/7 VFC
XC.7549	No. 93 STAGING POST (RENNES)	O.A.C. (GLOUCESTER)	CALAIS No.9	LLC 9564 T XG 733/13 VFC

/XC.7550

APPENDIX 'C'

SECTION XVIII

X. CON NUMBER	FROM	TO	VIA	REMARKS
XC.7550	No.126 STAGING POST (LYONS.)	CAC/JATC (UXBRIDGE)	CALAIS No.9	LLC 9563 T XG 733/17 VFC
XC.7548	No.137 STAGING POST(BORDEAUX)	O.A.C. (GLOUCESTER)	BOULOGNE No.7	LLC 9565 T XG 729/3 VFC
XC.7516	F.A.A.A. (MAISON LAFFITTE)	NO.38 GP RAF (MARKS HALL)	DIEPPE No.6	LLC 9645 T XG 740/1 VFC
XC.7524	F.A.A.A. (MAISON LAFFITTE)	No. 38 GP RAF (MARKS HALL)	BOULOGNE No.7	LLC 9531 T XG 729/12 VFC
XC.7547	C.A.D.A. (COMPIEGNE)	No. 519 AAF STN (GROVE)	CALAIS No.8	XG 722/18 LLC 20382T VFC
XC.7567	C.A.D.A. (COMPIEGNE)	B.A.D.U. (BURTONWOOD)	CHERBOURG No.4	XG 730/15 LLC 9680 T
XC.7503	J.A.T.C.(PARIS)	CAC/JATC (UXBRIDGE)	CHERBOURG No.4	LLC 9418 T XG 730/16 VFC
XC.7539	AIRWAYS TRAFFIC CENTRE(BRUSSELS)	CAC/JATC (UXBRIDGE)	CALAIS No.8	XG 732.14 V.F.C.
XC.7486	'Y' STATION (RELS)	BLETCHLEY 'Y'	CALAIS No.11	LLC 9643 T XG 740/5 VFC
XC.7473	AIR INFORMATION (S.H.A.E.F.) VERSAILLES	AIR MINISTRY PR.2. (WHITEHALL)	CALAIS No.11	LLC 9635 T XG 740/13 VFC
XC.7333	O.N.M. (PARIS)	DUNSTABLE(MET)	BOULOGNE No.7	LLC 9269 T-A XG 729/15 VFC

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION XIX

LANDLINES FOR GROUND BASED R.C.M. (80 WING)

1. It was visualised during preliminary planning of communications for 80 Wing that the locating of Jamming Centres so near the Front Line would preclude the connection of these centres to 80 Wing Headquarters, but that it would be possible to provide the local requirements of the Jamming Centres to their associated stations.

2. When eventually the Wing was set up in the British Zone on a restricted scale, it was found possible for the Jamming Centres to be located near existing Switching Centres and for them to be given landline facilities to 80 Wing Headquarters. The Headquarters itself was given administrative outlets to the Base Signal Centre, and a teleprinter link back to 100 Group in the United Kingdom.

3. The local requirements in 80 Wing were provided by allotting part of No. 1 Air Formation Signals to the Wing on a functional basis.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION XX

AIRBORNE RADAR

INTRODUCTION

1. The Radar Section, Air Staff, S.H.A.E.F. had few responsibilities in connection with airborne radar. Whilst A.E.A.F. was in being they were responsible for a great deal of the fitting of airborne radar in the British forces, but fitting responsibility in the case of U.S. equipment in U.S. aircraft, being an administrative matter, was carried on without reference to A.E.A.F. On the dissolution of A.E.A.F., the British fitting responsibilities were transferred to Second Tactical Air Force and 38 Group. Although during the later stages, airborne radar responsibilities were almost completely de-centralised, it would seem to be an advantage to collate in this report the airborne radar equipments which were being used in the various Air Forces, and to summarise the results obtained. This has, therefore, been done in the following paragraphs.

SECOND TACTICAL AIR FORCE - NO. 2 GROUP

2. This medium bomber group operated Mitchell, Mosquito and Boston squadrons. The force was equipped with Gee throughout, and in addition one-third of each Mitchell and Mosquito squadron was initially fitted with G-H for blind bombing. In the summer of 1944, the role of Mosquito aircraft changed from that originally envisaged, and they were used for low level night attacks, for which they had to fly singly. Whilst a heavy bomber carries a sufficient load to make the chances of success from an individual attack reasonably good, medium bombers flying singly and using G-H had little chance of hitting their target, and it was consequently decided to withdraw G-H from the Mosquitoes. Towards the end of hostilities the SCR.584 was used to control medium bombers by day and by night in a blind bombing role, further details of which will be found in the Ground Radar Section of this report.

SECOND TACTICAL AIR FORCE - NO. 85 GROUP

3. No. 85 Group was originally responsible for the night defence organisation in the British areas, and one of their Sectors (No. 21) was, until the end of August, under the operational control of Ninth Air Force, for use in the night defence role in the U.S. areas. In view of this, all R.A.F. night fighter squadrons were initially in 85 Group.

/During....

During periods when the rate of advance of the Allied line was slow, this division of responsibility resulted in 85 Group GCI stations being sited often alongside 83 or 84 Group GCI stations each one performing separate functions. This system was uneconomical both in personnel and equipment. Consequent upon a careful study of the operational situation, it was decided early in 1945 to transfer one night fighter squadron of 85 Group to each of 83 and 84 Groups, when these had satisfactory equipment and an organisation to control night fighters. In fact, the transfer never took place.

4. The night fighter force in 85 Group consisted of Mosquito Mk. XIX's fitted with A.I. Mk. VIIIB and Mosquito XXX's fitted with A.I. Mk. X (SCR.720). Squadrons fitted with Mk. VIII A.I. were retrospectively re-armed with A.I. Mk. X. This was not completed by the end of hostilities. A great deal of assistance was rendered in the refitting of these aircraft by D.C.D. Post Design personnel.

5. There were, at various times, nine different night fighter squadrons operating in 2nd T.A.F. The total results achieved by these squadrons by night, during the period from D-Day to V-E Day, 1945, were 298 aircraft destroyed, 15 probably destroyed, and 44 damaged. Detailed operational results during the five month period from 1st October, 1944, to 31st March, 1945, were as follows:

Attempts	A.I. Contacts	Hostile Visuals	Combats	Destroyed	P.Destroyed
589	373	156	107	92	2

Damaged - 10

A considerable percentage of these successes was against enemy night fighters.

6. The A.I. ranges obtained during March, which are typical of the results obtained during the period, were as follows:

	SCR.720	A.I. Mk. VIII	SCR.729	Lucero
Best maximum range	10 miles	8 miles	100 miles	90 miles
Average " "	4.9 "	4.16 "	75 "	56 "

SECOND T.A.F. - 34 WING

7. This photographic reconnaissance wing was made up of squadrons equipped with P.R. Spitfires, one squadron of Mosquitoes, and one Squadron of Wellingtons. The night Mosquitoes were initially equipped to use either Gee or Rebecca-H, but later both were fitted, and towards the end of hostilities, the day Mosquitoes which had been fitted only with Gee, were also given Rebecca-H.

8. There were eight ground Rebecca-H stations, all of which normally transmitted on 219 mc/s. or 224 mc/s., whilst the aircraft interrogators normally transmitted on 229 mc/s. or 214 mc/s. Early in December, 1944, the enemy started to jam the whole Rebecca-Eureka band from 214 mc/s. to 234 mc/s., using C.W. or M.C.W. It was never fully established whether the enemy's effort was specifically aimed at Rebecca-H.

9. The photographic missions were normally flown between 1,500 ft. and 5,000 ft., at which heights the R/H ranges were approximately 40 and 80 miles respectively. The overall photographic successes using

/Rebecca-H....

Rebecca-H were 70% but most of the failures were not due to radar but were due to intervening clouds.

NO. 38 GROUP

10. Upon the dissolution of A.E.A.F., the administrative control of 38 Group was vested in H.Q. Fighter Command. The operational control was made an Air Staff, SHAEF responsibility through First Allied Airborne Army.

11. After the Arnhem operation intensive development trials were undertaken by 38 Group in order to develop a dropping technique which could be used from 7,000 - 8,000 ft., so as to lessen danger from flak. G-H was fitted to one squadron of the Group and "Talking Rebecca-Eureka" was introduced. Modifications were made to standard Rebecca to improve line and azimuth accuracy. Master bomber technique was to be employed making use of a combination of these equipments. The development trials of the system were satisfactory, and it was proposed to use this scheme for the airborne operation planned for the Rhine crossing, and in particular for re-supply of the airborne forces taking part in the operation.

12. Although "Talking Eureka" equipment was taken in by the airborne troops on the first day of the operation, the link-up with the ground forces was so rapid that it was found unnecessary to employ the high level dropping technique at any time during the operation.

NINTH AIR FORCE

13. The Ninth Air Force had two night fighter squadrons equipped with P.61 aircraft. These aircraft were fitted with SCR.720, SCR. 729, AN/APS-13, AN/APN-1 and beacons. Both squadrons were originally controlled by the IXth Air Defense Command for strictly night fighter defence work, but were transferred to the IXth and XIXth Tactical Air Commands during October, 1944, so that these squadrons could be used for offensive night intruder work and at the same time continue night fighter work under the control of the ground radar stations of the T.A.C.'s.

14. Night fighting results for the period 1st September - 8th May were:

		Destroyed	P.Destroyed	Damaged
Total sorties : 2173	Total claims:	43 1 flying bomb	6	4

15. Night intruder results are not available.

FIRST TACTICAL AIR FORCE

16. This Air Force was activated on the 1st November, and had two night fighter squadrons, one using Beaufighters and the other P.61 aircraft fitted A.I. Mk. VIII and SCR.720 respectively. These squadrons also did mainly intruder work. The night fighting results of these squadrons during the period 1st January to 8th May, 1945, were as follows:

Total sorties - 417. Total claims - 1.0.0

/TAIL WARNING....

TAIL WARNING

17. Extensive plans were made to fit tail warning (AN/APS-13) to U.S. night fighters, tactical reconnaissance aircraft, and even a percentage of day fighters. U.S. night fighters generally performed their intruder missions under ground control and they found tail warning to be of little value as they were warned of the approach of another plane by the ground station. Crews of night photographic and intruder aircraft believed it was quite valuable, although there was some disadvantage when they were operating at low altitudes as ground returns actuated the alarm. The U.S. day fighters fitted used it frequently in the role of altitude warning device since the alarm would trip when the plane approached the ground too closely.

18. By the end of hostilities, a number of planeswere fitted in Ninth Air Force, and although a considerable quantity of equipment had been received by First TACAF no planes were fitted. In April, 1945, No. 85 Group of 2nd T.A.F. submitted an operational requirement, but the end of hosilities came before action was taken to provide it.

RADIO ALTIMETERS

19. Plans were made in 2nd T.A.F., before D-Day, to fit all night fighters with AYD radio altimeters (AN/APN-1). As these models were in short supply, AYN's were subsequently accepted, but because of the limited fitting effort available for the various rush programmes during the summer of 1944, the majority of aircraft were not fitted until the squadrons arrived on the continent. It was rumoured that this equipment was not accurate, but it was found that in the hands of experienced radar mechanics such as are found on night fighter squadrons, the equipment could be set up satisfactorily, and once the setting-up procedure had been accomplished it proved sufficiently accurate for their purposes; aircrew had faith in these radio altimeters. Both Ninth Air Force night fighter squadrons were fitted, but the equipment for the two squadrons in First TACAF arrived early in May, so that there was insufficient time to fit before hostilities ceased.

BEACONS

20. There was a growing tendency, particularly in U.S. areas, towards closer ground control of aircraft, and the number of microwave ground radar stations increased as the new equipments became available. It was anticipated that all primary control and reporting over the tactical areas would eventually be accomplished by centimeter sets, with lower frequency sets used only for standby or in the manner in which L.W. equipments were used. This switchover to microwave equipment was accelerated because of serious interference experienced from friendly R.C.M. used against the enemy. The principal limitation to control and reporting was the difficulty in identification of friendly aircraft. The Mark III I.F.F. had neither the flexibility nor the resolution commensurate with that of a ten centimetre radar so the use of small lightweight "S" band beacons installed in the planes, was introduced in the U.S. forces. The increase in range, positive instantaneous identification, and ability to track through permanent echoes at low altitudes placed this equipment in high priority. USSTAF was therefore requested in February, 1945 to procure an adequate quantity of beacons and ancillary equipment to enable both Ninth and First Tactical Air Force to accomplish the following:

(a) Equip and maintain the following planes with airborne beacons similar to the AN/APN-19.

/(i)....

(i) All intruder and night fighter aircraft.
(ii) All night photographic aircraft.
(iii) One half of all tactical reconnaissance aircraft.
(iv) One fourth of all fighter bomber aircraft.

(b) Equip all "S" band ground radar stations used for control purposes with the appropriate receiving equipment.

21. Second Tactical Air Force were also interested in having beacons installed for use with the SCR.584, and requested B.B.R.L. to supply experimental models and Air Ministry to arrange for supply in quantity. These were never provided.

22. The beacon production schedule in the United States was not sufficiently far advanced to allow immediate shipment of the equipment, and on 25th April, 1945, USSTAF reduced the beacon requirements to only 430, based on the tactical situation and time involved in production and installation of equipment. The beacon programme had not advanced beyond the installation of experimental sets by the end of the war in Europe.

23. The results achieved with the airborne R.N.A. equipments are referred to under R.N.A. in Section No. XXIII.

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

O N

O P E R A T I O N 'O V E R L O R D'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

S E C T I O N XXI

GROUND RADAR

CHAPTER NO.

1 - GENERAL

2 - SITING

3 - DEPLOYMENT

4 - AIR TRANSPORTABLE RADAR

5 - CROSSBOW

6 - SCR.584

7 - AN/CPS-1A

8 - A.M.E.S. TYPE 70

9 - MISCELLANEOUS

A. AN/MPN-1

B. ACR. MK. II

C. LIGHT WARNING

D. LIGHT WEIGHT RADAR EQUIPMENT FOR SURFACE VESSEL WATCHING.

10. - TECHNICAL AND OPERATIONAL DEVELOPMENT

-----oOo-----

CHAPTER 1 - GENERAL

1. By the time the assault phase of the invasion was over, it became apparent that air superiority had been attained, and that the main role of the Tactical Air Forces would henceforth be still closer co-operation with the Ground Forces. Consequently, the original aircraft warning and fighter control system changed from essentially a defensive system to one concerned with controlling our own aircraft mainly on offensive missions. In the case of Ninth Air Force, these changes began from the original system designed for the Tactical Air Commands which was based on R.A.F. plans of 1943, for an analogous organisation and used identical equipment. Subsequent to these earlier plans Air Ministry initiated the production of 10 and 50 centimeter equipment due to the possibility of the enemy jamming the older 200 megacycles sets.

2. It therefore became the function of the Radar Section, A.E.A.F. to:

(a) obtain and disseminate information about these new sets;
(b) ensure that the Air Forces altered the supply requirements accordingly through proper administrative channels;
(c) arrange with Air Ministry to train both British and U.S. operating and maintenance crews at R.A.F. schools;
(d) assist in the difficulties arising in procuring spare parts for maintenance of these equipments.

3. In spite of the established policy of equipping U.S. units in this Theatre with British ground radar, Headquarters Army Air Forces in Washington finally agreed to supply limited quantities of U.S. radar to Ninth Air Force which eventually affected the control system to a marked degree. The superior performance and additional display accommodations afforded by the AN/CPS-1A (MEW) provided the inducement to shift the major amount of control from the Fighter Control Centers of the Tactical Air Commands to the Forward Director Posts. The accuracy that was expected to be obtained from the modified SCR.584 completed the shift in close control away from the Fighter Control Center.

4. Due to the addition of new types of equipment right up to the cessation of hostilities, and continual improvement in operational tactics, the aircraft warning and fighter control systems underwent a continual change from the time the original plans were made. Each organisation developed a different set-up and standardisation became impossible. This tendency toward rapid changes led to improvements although at times the confusion resulting from so many changes offset many of the advantages. Details of the development of the ground radar programme in the Tactical Air Forces and operations during the assault up to D plus 40 are contained in A.E.A.F. Air Signal Report on Operation NEPTUNE. A diagram showing the layout of the various systems used in the Tactical Air Commands/Groups during October, 1944, is shown in Figures 1 to 7.

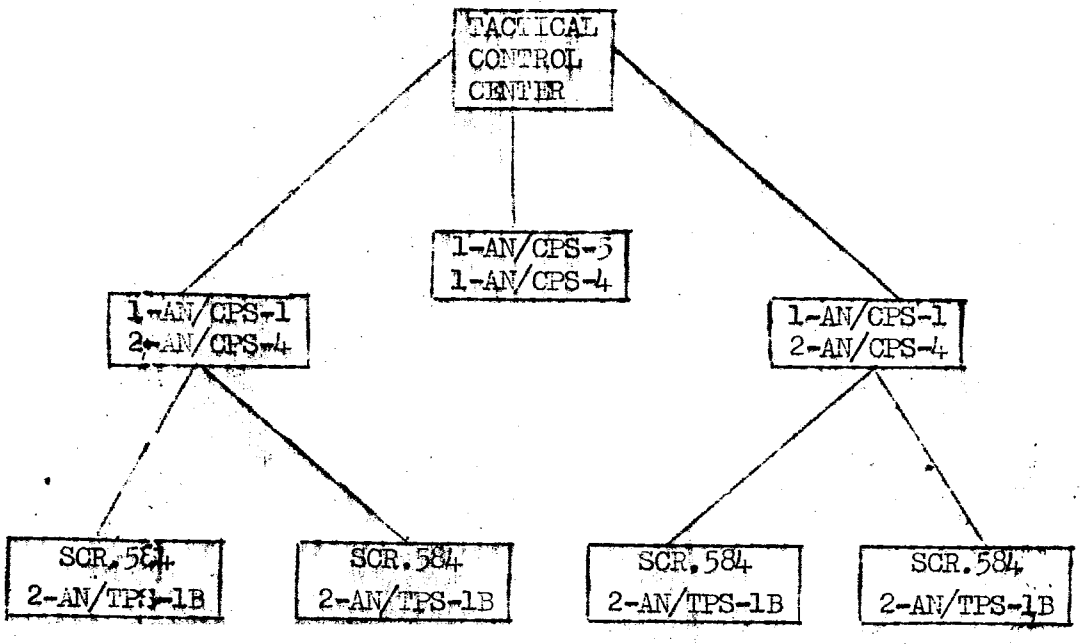
5. The inability of the enemy to attack our bases on the scale anticipated in the planning stage, made it possible for the base areas, ports and harbour installations to be adequately defended by Nos. 24 and 25 Base Defence Sectors of 85 Group. Ninth Air Force released No. 21 Base Defence Sector, and accordingly the decision was taken by 85 Group on 23rd September to return the major portion of No. 21 Base Defence Sector to the United Kingdom. This decision resulted in a reduction of three A.M.E.S. Type 25, two A.M.E.S. Type 14 and 15, and one M.R.U. on the establishment of 85 Group.

/Similarly....

Similarly, the experience of 83 Group proved that operational requirements had never been such as to necessitate the deployment of three Forward Director Posts and a G.C.I. station. Accordingly, one F.D.P. and one G.C.I. were lodged with 85 Group in the bridgehead during the advance of the ground forces into Belgium. Subsequently, in September, these units, being surplus to operational requirements, were returned to the United Kingdom and the establishment of 83 Group amended accordingly. Throughout the entire operation, the number of radar units deployed were continually being reduced to a minimum consistent with operational requirements. The advantages so gained were increased mobility, conservation of personnel required for other commitments, and reduction of requirements for communications

6. The offensive tendency referred to in paras. 1 and 4 resulted in Ninth Air Force making a request for equipment that would enable the following systems to be standardised for Tactical Air Commands and Defence Commands. The following diagrams indicate the organisation which was planned but which did not come into force as the war ended before the equipment became available.

(a) Tactical Air Commands.

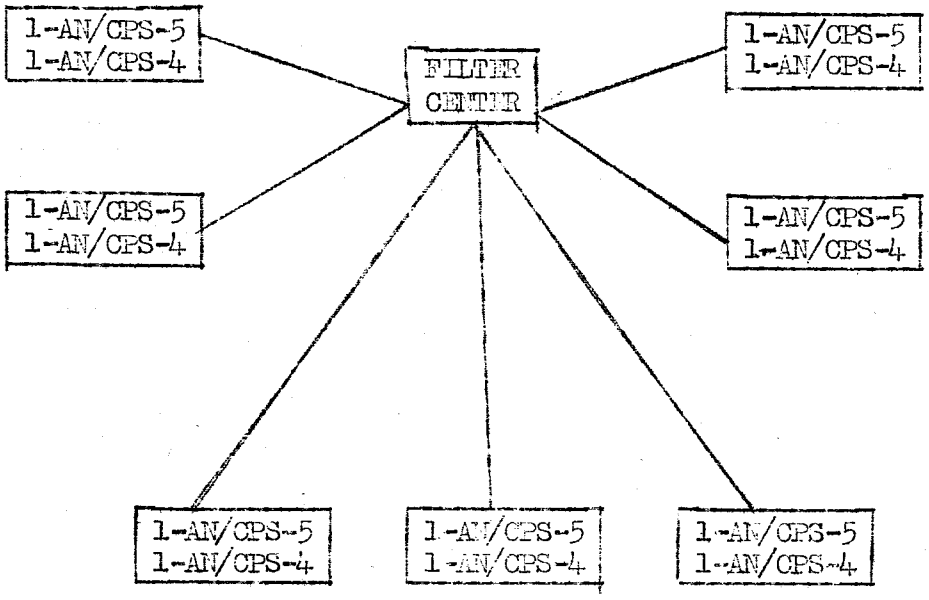


Total:

5-AN/CPS-4
1-AN/CPS-5
8-AN/TPS-1B

/b. Air Defense Command.

(b) Air Defense Command



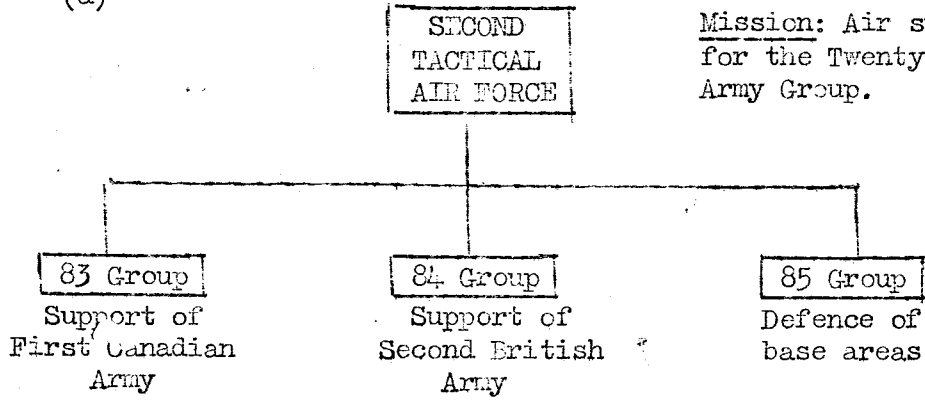
Total:
7-AN/CPS-4
7-AN/CPS-5

Legend

AN/CPS-1	is production M.E.W.
AN/CPS-4	is centimetre height finder. ("Beavertail")
AN/CPS-5	is 1300 mc/s. solid search equipment.
AN/TPS-13	is 1300 mc/s. L.W. equipments.

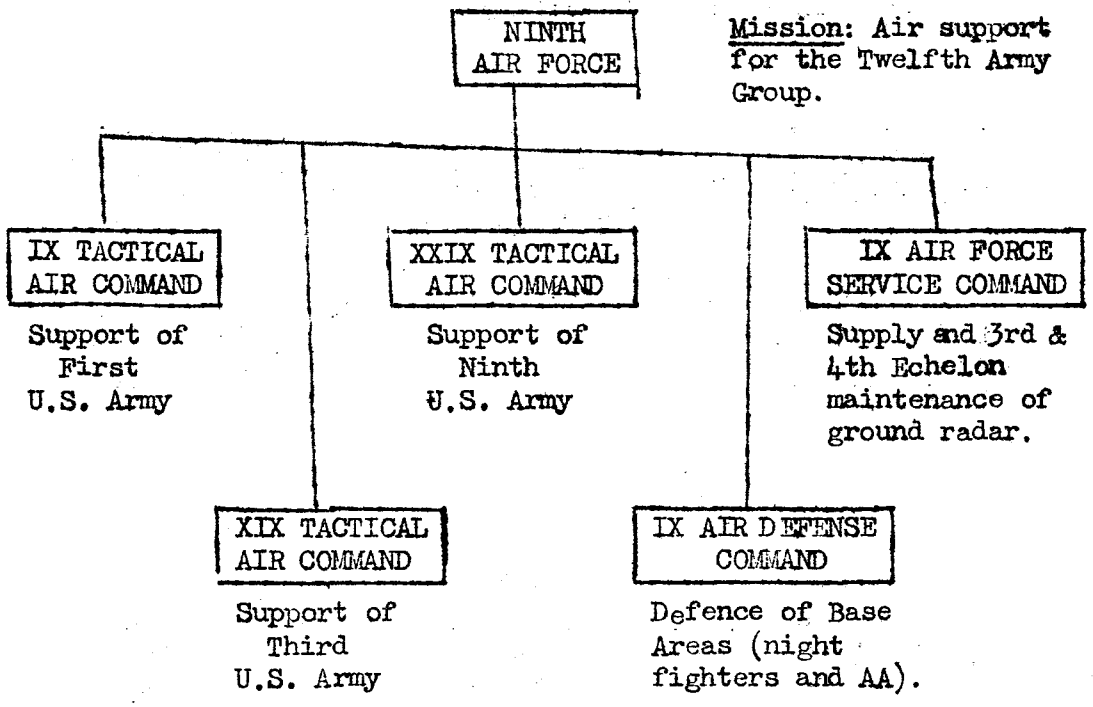
7. As an aid to understanding the functions of the various radar units in the Tactical Air Forces, the following functional charts are given, emphasising only those functions pertinent to the ground radar system:

(a)

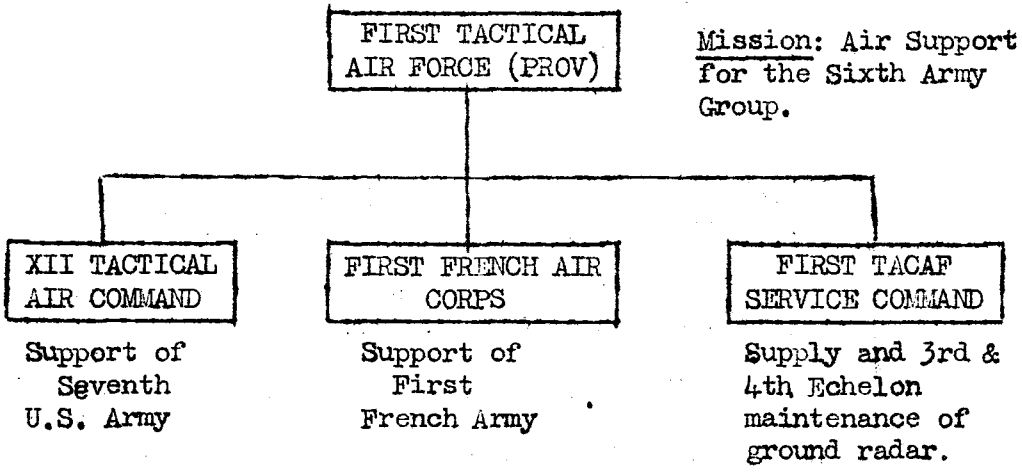


/(b).....

(b)


NINTH AIR FORCE
Mission: Air support for the Twelfth Army Group.
IX TACTICAL AIR COMMAND
Support of First U.S. Army
XXIX TACTICAL AIR COMMAND
Support of Ninth U.S. Army
IX AIR FORCE SERVICE COMMAND
Supply and 3rd & 4th Echelon maintenance of ground radar.
XIX TACTICAL AIR COMMAND
Support of Third U.S. Army
IX AIR DEFENSE COMMAND
Defence of Base Areas (night fighters and AA).

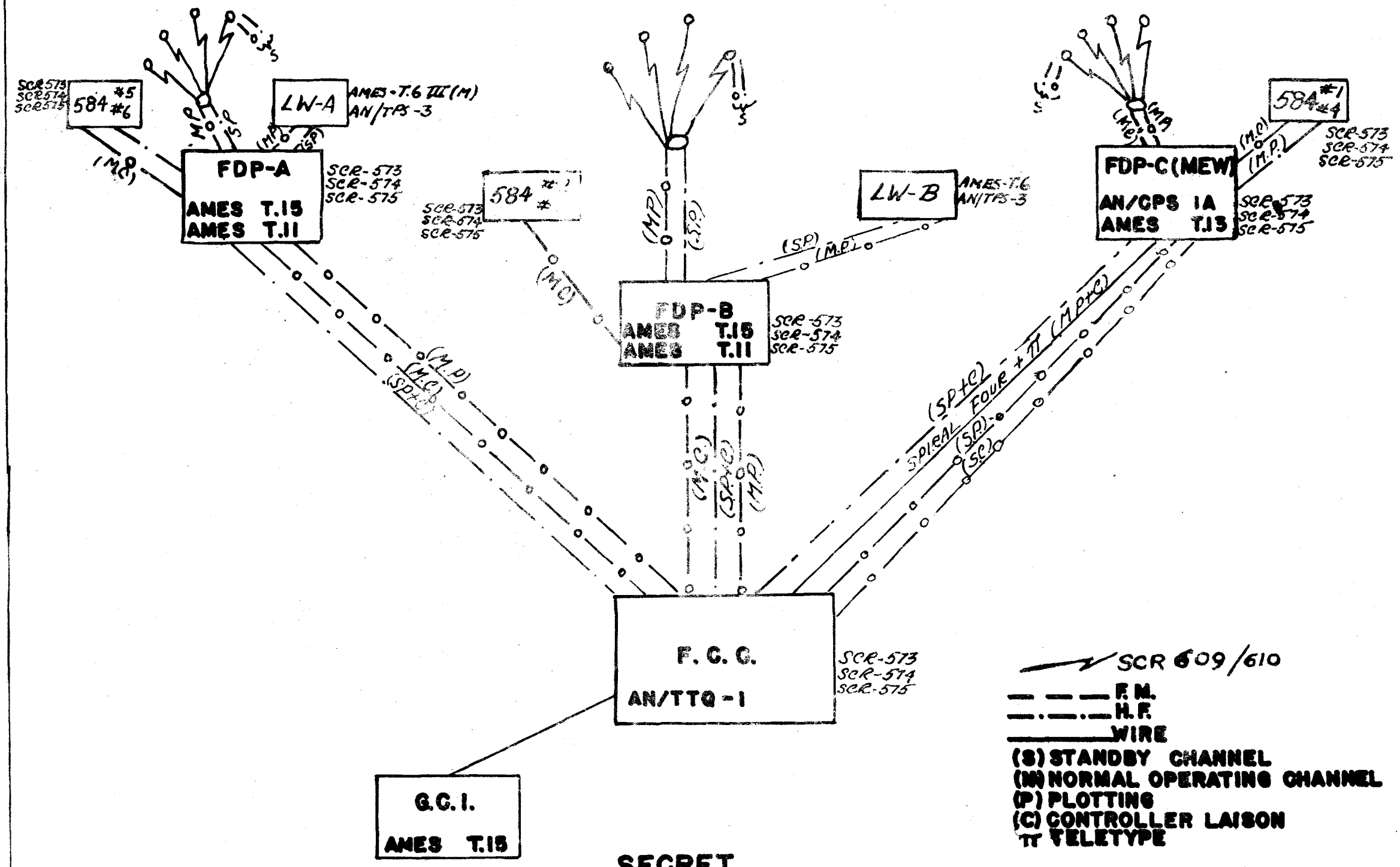
(c)


FIRST TACTICAL AIR FORCE (PROV)
Mission: Air Support for the Sixth Army Group.
XII TACTICAL AIR COMMAND
Support of Seventh U.S. Army
FIRST FRENCH AIR CORPS
Support of First French Army
FIRST TACAF SERVICE COMMAND
Supply and 3rd & 4th Echelon maintenance of ground radar.

/Chapter 2,....

SECRET

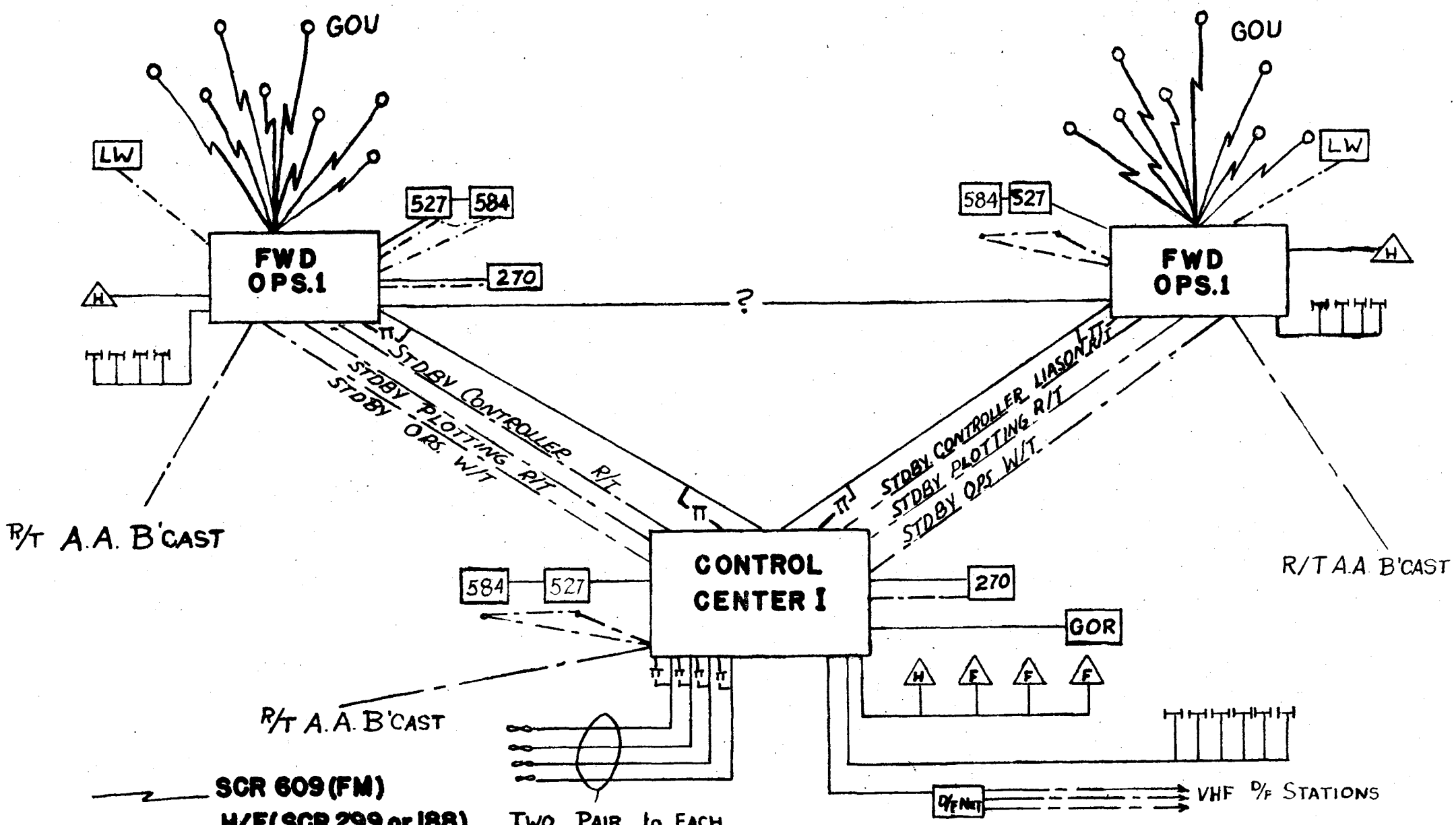
FIGHTER CONTROL/AIR WARNING SYSTEM
IX TACTICAL AIR COMMAND



SECRET

FIG. 1

XII TAC FIGHTER CONTROL SYSTEM



SCR 609 (FM)

H/F (SCR 299 or 188)

LANDLINE

—π— SIMPLEXED TELETYPE

SINGLE VHF AIR to GROUND CHANNEL

H HOMER VHF D/F

F DIRECTION-FINDER, VHF

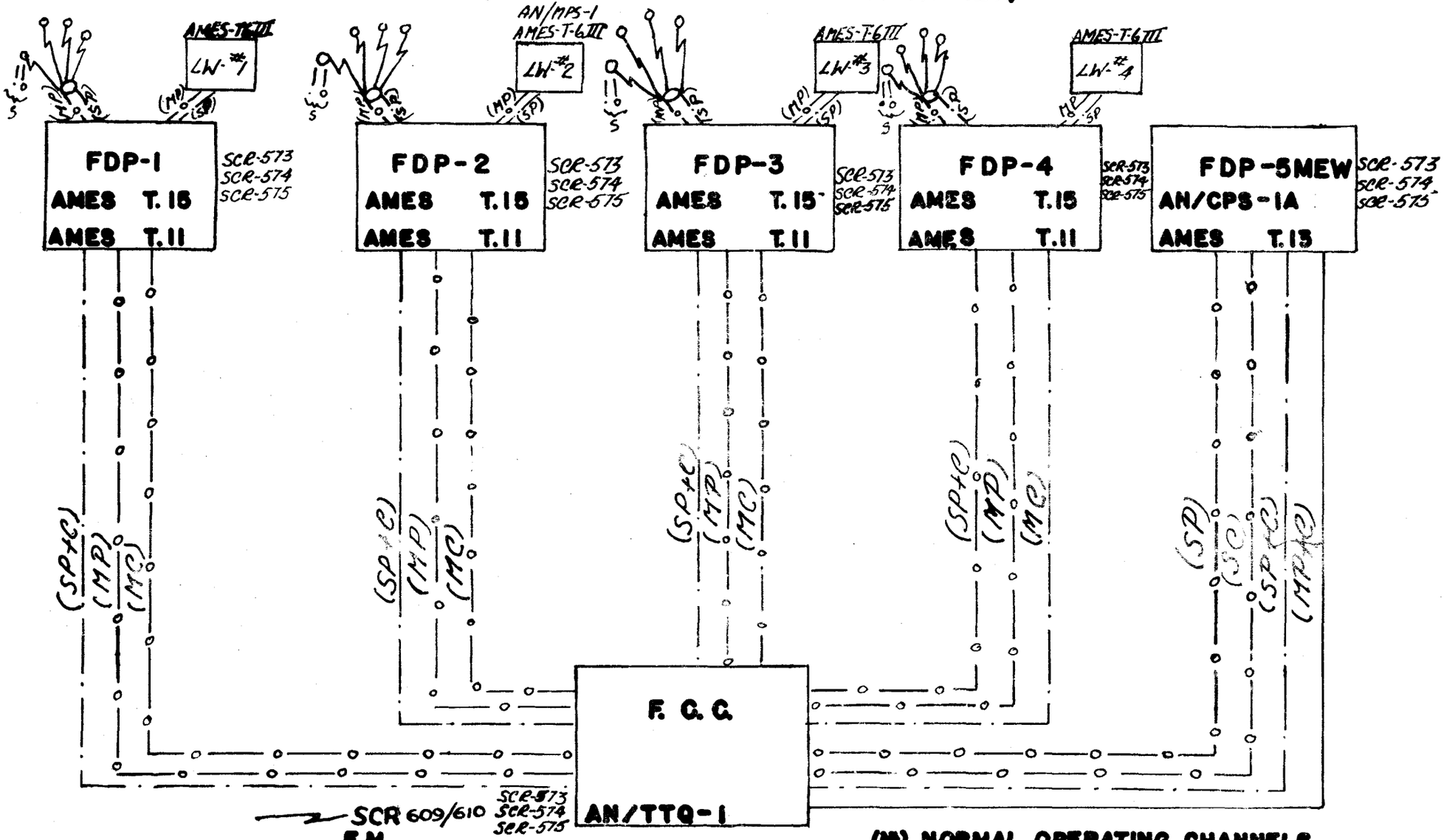
* EQUIPMENT of CC II IDENTICAL to CC I

CONTROL* CENTER II (LEAPFROG)

FIG. 2

SECRET

FIGHTER CONTROL/AIR WARNING SYSTEM
XIX TACTICAL AIR FORCE
(DOES NOT INCLUDE SEPARATE D/F NET)



SECRET

FIG. 3

SECRET

FIGHTER CONTROL / AIR WARNING SYSTEM
~~XXIX~~ TACTICAL AIR COMMAND

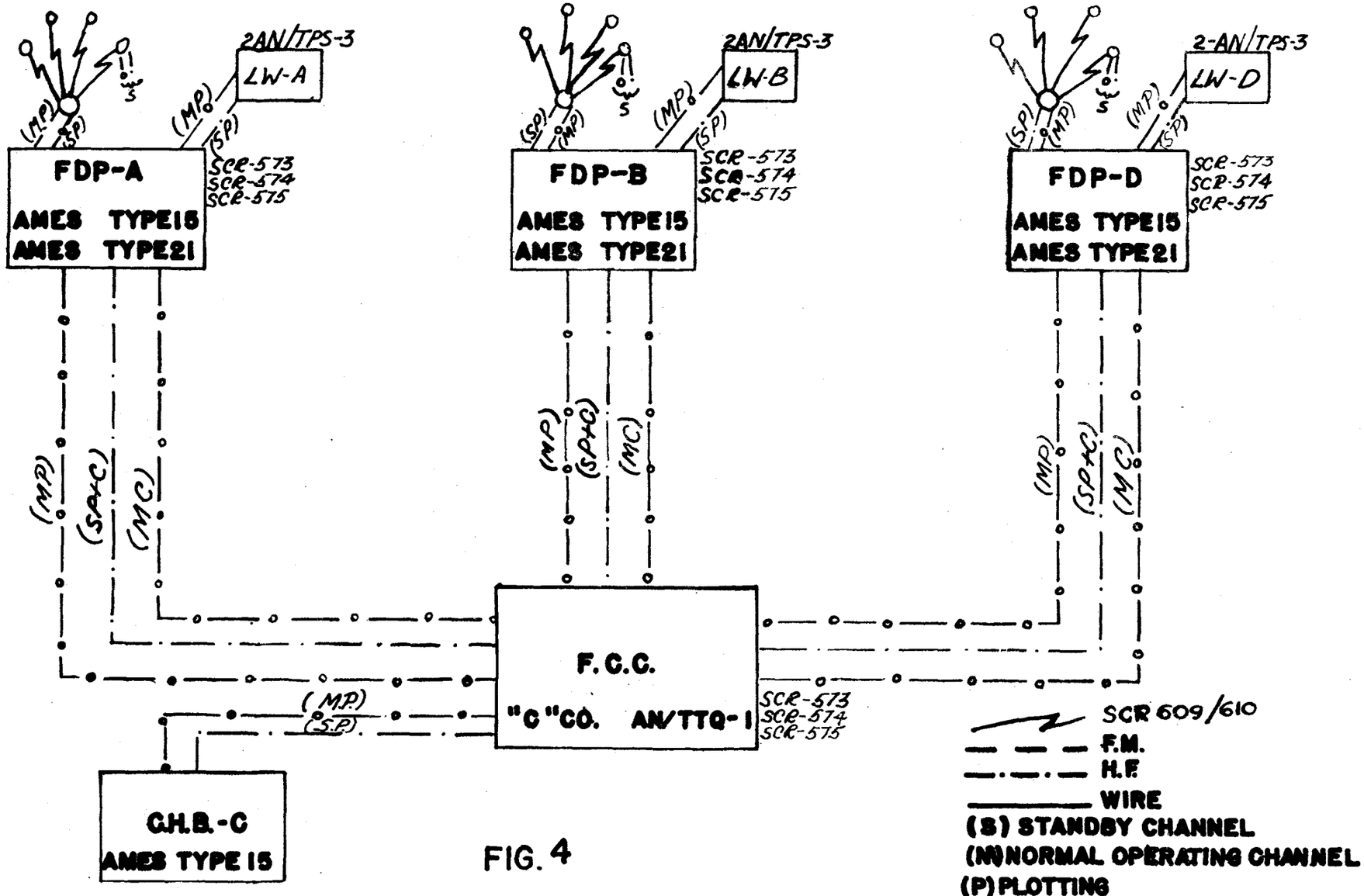


FIG. 4

SECRET

A CHARACTERISTIC LAYOUT FOR A TACTICAL GROUP OF 2ND TAF (IN APRIL 1945)

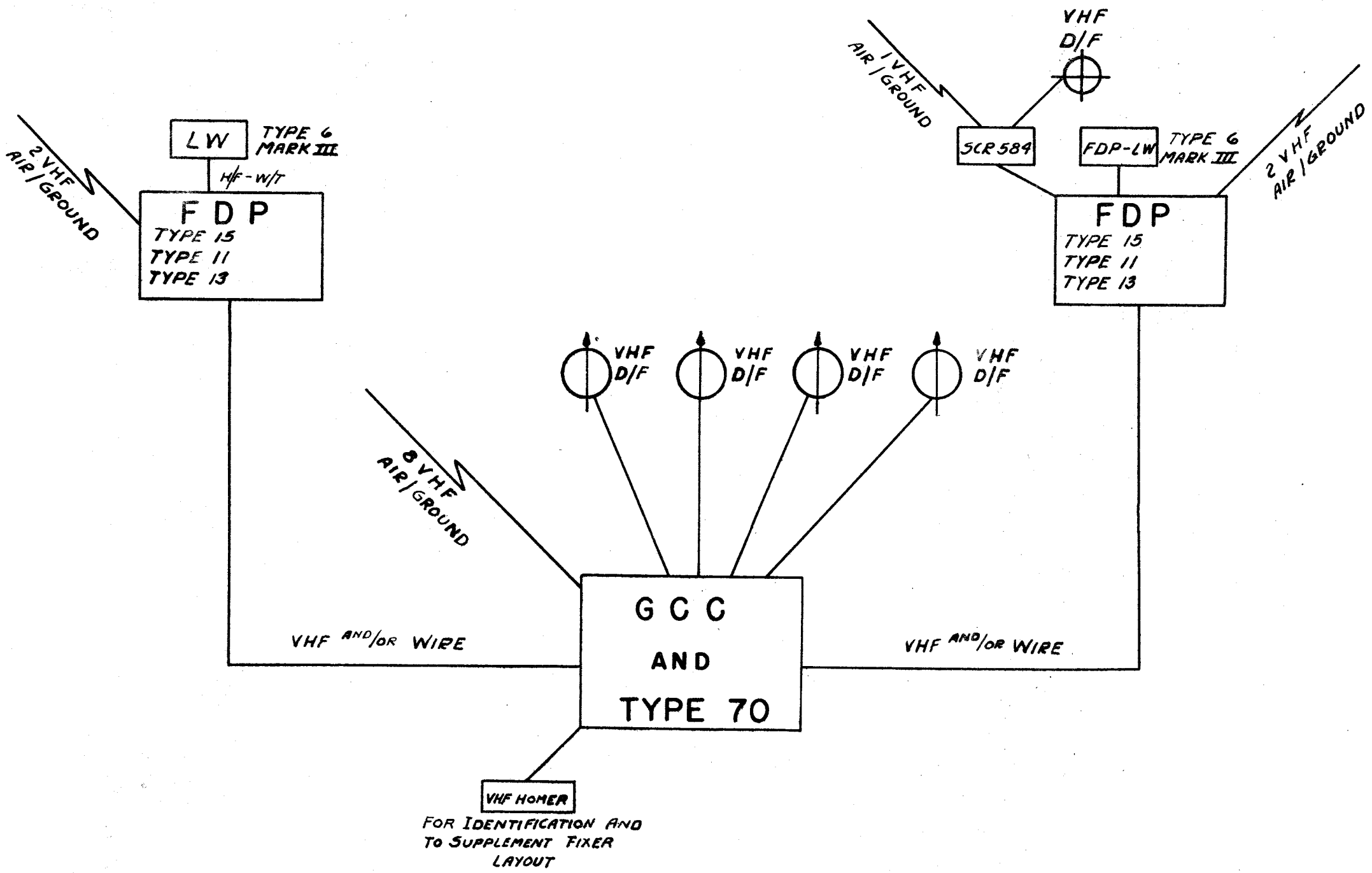


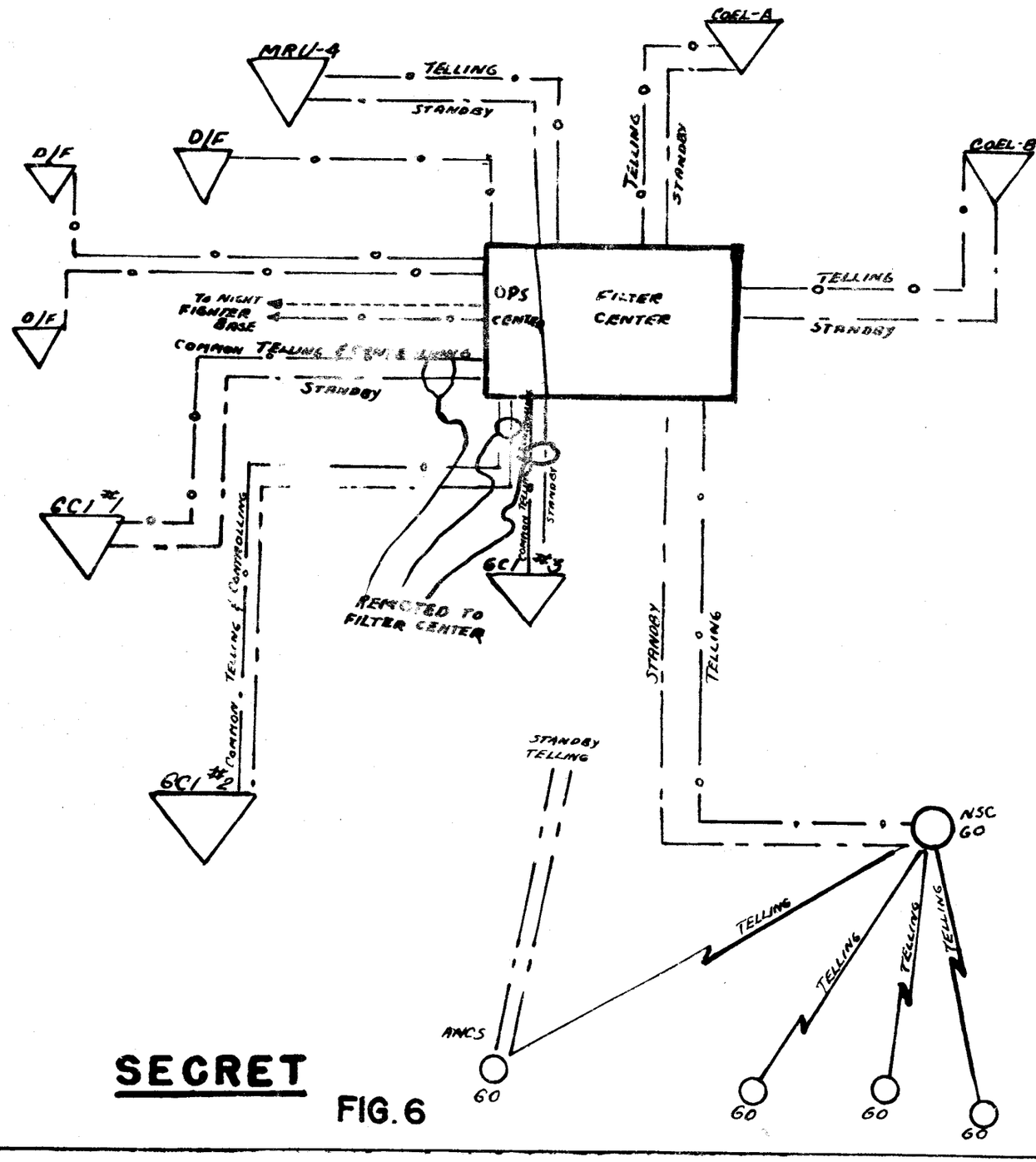
FIG. 5

SECRET

AIR WARNING SYSTEM

1 ST AIR DEFENSE WING (PROV.)

SECRET



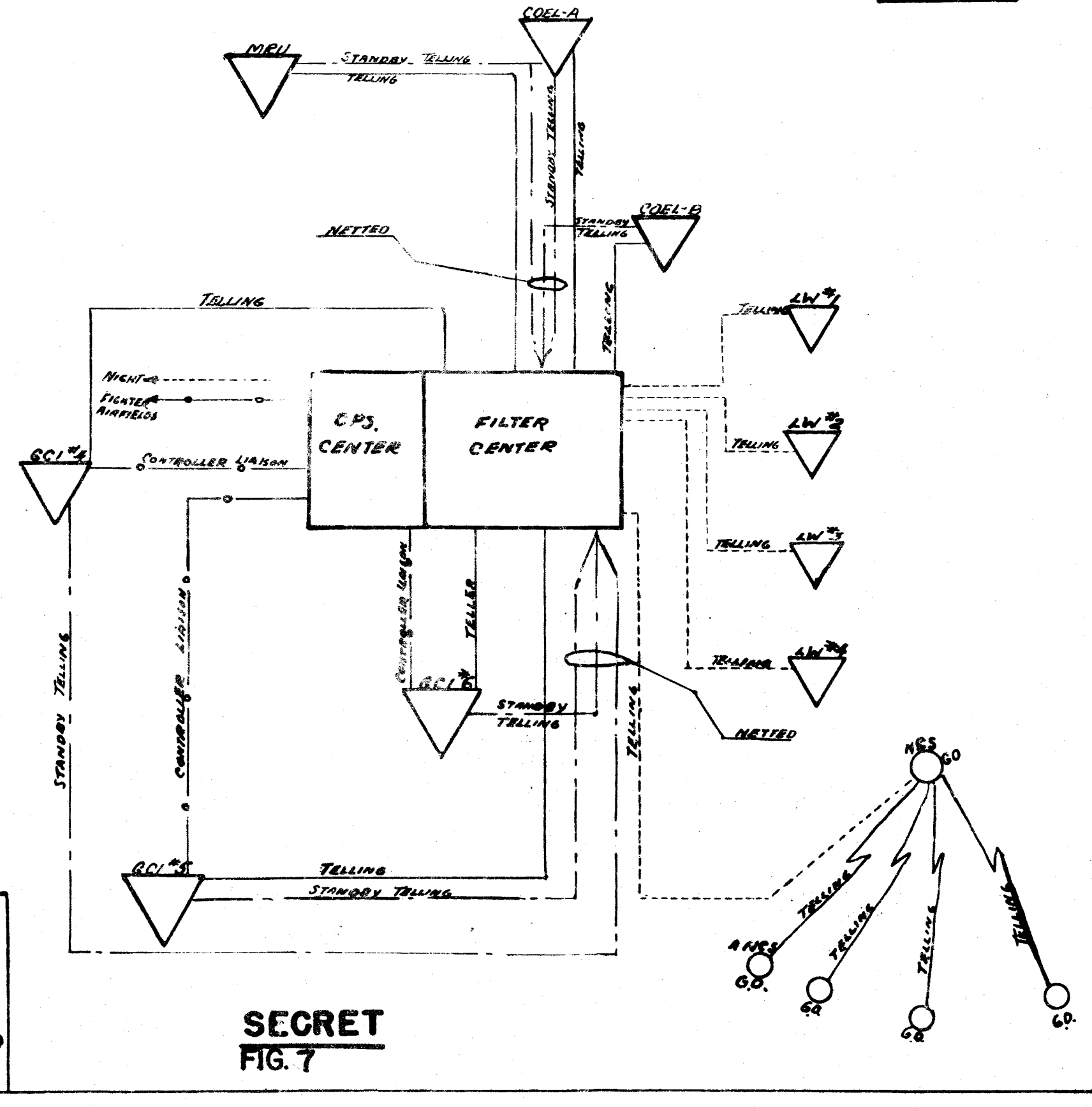
KEY

- SCR 609/610
- WIRE
- LINK 14B
- AN/GRC-3
- SCR 188/COLLINS 18Q

SECRET

FIG. 6

AIR WARNING SYSTEM - 2nd AIR DEFENSE WING (PROV.) SECRET



SECRET

FIG. 7

CHAPTER 2 - SITING

8. Section VI of the First Part of the Air Signal Report on Operation "Neptune" explains in detail the organisation and responsibilities for the selection of ground radar sites prior to D-Day. The Siting Group which was formed in A.E.A.F. made their selection from the best contour maps available, and from photographs. The Group covered all sites in accordance with the estimated lines of advance up to D + 90. This Section of the Air Signals Report is, therefore, concerned with the results achieved from the previously made plans, and the experience gained during the remainder of the European War.

9. Only a small percentage of the pre-D.Day sites were ever employed due to:

(a) the tactical lines along which the battle developed;
(b) inaccessibility due to bombing, mining, and blown bridges.

For the remainder of the campaign, the ground in the North (Second T.A.F.) is in general so flat that the choice of sites was not limited by technical considerations, but by accessibility over dykes and canals, and by the need to avoid flooded ground. The most difficult siting problems arose in the South where First TACAF (XIIth TAC) operated in winter weather conditions in the Vosges mountains. In order to assist in the solution of their problems, they made use of three devices:

(a) Relief models produced for the French Forces, and made with a 2 to 1 vertical exaggeration.
(b) AN/APS-15 (H2X) mounted on a radio truck.
(c) Radar Planning Device (R.P.D.).

Relief models were constructed primarily for the Ground Forces, and were used to good advantage in the selection of every site. Models were covered with 10 metre contour maps to a scale of 1 : 50,000; since they showed all the roads, woods and waterways, they greatly helped in assessing the accessibility. These models were particularly useful in presenting coverage problems, and the relative merits of certain sites, to Senior Officers not familiar with the technical problems. As a result of this, when there were rival claims for the same site the most effective compromise was generally reached.

3. When a site had been pre-selected from a relief model, the AN/APS-15 was driven to the site, the equipment was operated in a number of different spots in the same area, and a photograph of the P.P.I. was taken on each occasion. The mobilised AN/APS-15 had not been designed for such rough usage, and for future operations more robust construction is desirable, but in spite of this, the apparatus performed really useful work. The photographs closely resembled the P.P.I. picture obtained from ground radar centimeter equipments, but it could not be used to site equipments operating in the 100 and 200 mc/s. bands, such as SCR 270 and SCR.527.

4. The radar planning device was not seriously used until January, 1945, when BBRL and USSTAF formed a small section to develop its use in the theatre. Primarily it was used for selecting M.E.W. (AN/CPS-1A) sites for the Eighth Air Force and the Tactical Air Commands of the Ninth Air Force. The greatest difficulty was production of the relief maps. It did prove very reliable in predictions for ground radar sites in addition to showing its adaptability to other problems such as SHORAN and navigational aid coverage.

/5....

5. Aside from siting done with the aid of R.P.D., siting experience in this theatre confirms results elsewhere in Europe, and can be summarised as follows:

(a) A study of good contour maps is essential for the selection of suitable siting areas.
(b) Ground survey is always essential, and the recording of test results by means of light mobile equipment is of considerable value.
(c) A study of simple relief models is desirable in relatively static conditions, or when rival claims exist.

6. The R.P.D. would seem to have much potential value if relief maps of the whole operational area are prepared in advance, and R.P.D. sections are set up in rear areas. Further study and development of this device is recommended.

7. The increasing use of centimetre equipments with their narrow beam widths and quasi-optical properties, is making the siting problems easier, but siting for overland coverage will continue to be a problem until effective equipment to eliminate permanent echoes is incorporated.

/Chapter 3....

CHAPTER 3 - DEPLOYMENT

8. During the early stages of the invasion it was found that the radar equipment which had been allocated to Base Defence Sectors of 85 Group did not entirely meet operational needs to counter the enemy's tactics; enemy aircraft had on very few occasions employed high or even medium height bombing; the vast majority of attacks had been delivered from a relatively low altitude. The targets had been shipping, port facilities and targets near the front line, and the approach was nearly always overland. One of the results of these tactics was that a very short interval of time existed between the detection of the enemy aircraft and its entry into the IAZ. Attempts had been made to site radar control points nearer the front line to extend their range into enemy territory. This, however, resulted in the stations being shelled. The equipment which was established was not mobile enough to allow its erection in a temporary forward site towards nightfall and withdrawal in the morning. In an attempt to overcome this difficulty, a Light Warning Set (with VHF equipment) was borrowed from Headquarters No. 83 Group. This combination was sited nightly in forward positions chosen for their "view" into enemy territory, and withdrawn during daylight. The results were most successful, the score to 1st July, 1944, being eight destroyed.

9. When the Armies broke through from the beachhead and began the sweep across France, the radar systems were stretched to the utmost and put to their greatest tests of mobility. Because of the fluid nature of the war at that stage, targets were very largely targets of opportunity and were discovered by eye, and bombed almost immediately. Missions thus were not of the type which would lend themselves to detailed operational plans for close control from ground stations because of the difficulty of communications and the ability of the pilots to pick out their own targets with greater efficiency than anyone could do from the ground. When the fluid lines finally became stabilised in the fall of 1944, close control began to play a more important part in the operation of tactical fighter bombers.

10. The invasion in Southern France by forces from the Mediterranean Theatre on 15th August, 1944, introduced additional Air Force units into the European Theatre. The XIIth TAC was put under operational control of Ninth Air Force as soon as the Armies joined up. In the middle of October, it was decided to form the First Tactical Air Force (Provisional). This Air Force consisted of the XII TAC and the newly formed First French Air Corps. The XII TAC contained two S.A.W. Battalions, the 582nd and 593rd, and the First French Air Corps contained one S.A.W. battalion, the 553rd formed and equipped under U.S. supervision. These battalions were different from all others in this theatre in regard to type of equipment used, in that they used American radar throughout. They also used a different control system from that employed by other battalions in the theatre. Instead of a single Fighter Control Centre they employed two Control Centers and two Forward Operations Rooms.

11. Figures 8 to 12 show the progressive deployment of the ground radar systems up to the Rhine River. These maps are compiled from the routine location statements furnished by each Air Force. If a move had been made a few days prior to dates shown on the map, the radar unit may be shown in its old location, or it may not be shown at all if it was in transit at the time. The boundaries

/shown....

shown are those assigned to the ground forces and their supporting air forces. The radar units of any one Tactical Air Command (or British Group) were sited where they could most efficiently perform their operational responsibilities so that it was not necessary to keep strictly within these boundaries. These maps afford a good illustration of the considerable density which existed even after the number of units had been reduced.

/Chapter 4....

SECRET

RADAR LOCATIONS AS OF D+56 AUG. 1

SECRET
BY AUTH: C.G. SHAEF
DATE: Oct 7 1944
SIG: [signature]
RANK: Col
COPY NO. 100

AUTHORIZATION FOR REPRODUCTION

NO.	DATE	SIGNATURE & RANK
100	Oct 7	[signature] Col.

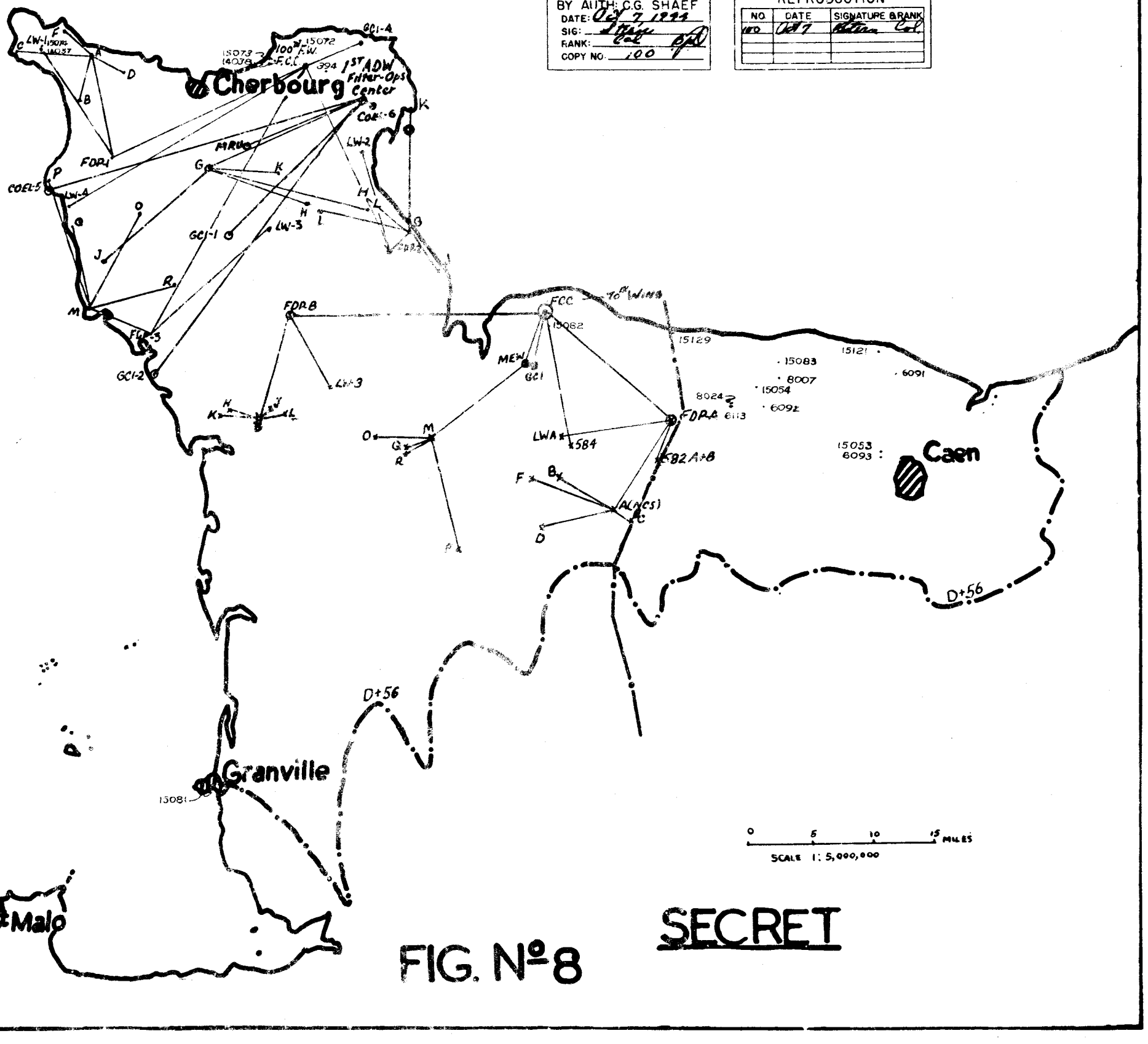


FIG. Nº 8

SECRET

SECRET

RADAR LOCATIONS AS OF AUG. 22, D+77

SECRET
BY AUTH: C.G. SHAEF
DATE: Oct 7 1944
SIG: [signature]
RANK: Col
COPY NO: 100

AUTHORIZATION FOR REPRODUCTION

NO.	DATE	SIGNATURE & RANK
100	Oct 7	[signature] Col

CHERBOURG
GRANVILLE
LE HAVRE
CAEN
PARIS
CHARTRES
FONTAINBLEU
LAVAL
LE MANS
ORLEANS
VANNES
ANGERS
RENNES
1ST ADW FILTER-OPS CENTER 100TH FW. F.C.C.
FCC-TOWG.
MEW
582A
584
D+77

SCALE 1:1,000,000

SECRET

FIG. Nº 9

RADAR LOCATIONS 20TH. SEPTEMBER 1944.

SECRET.

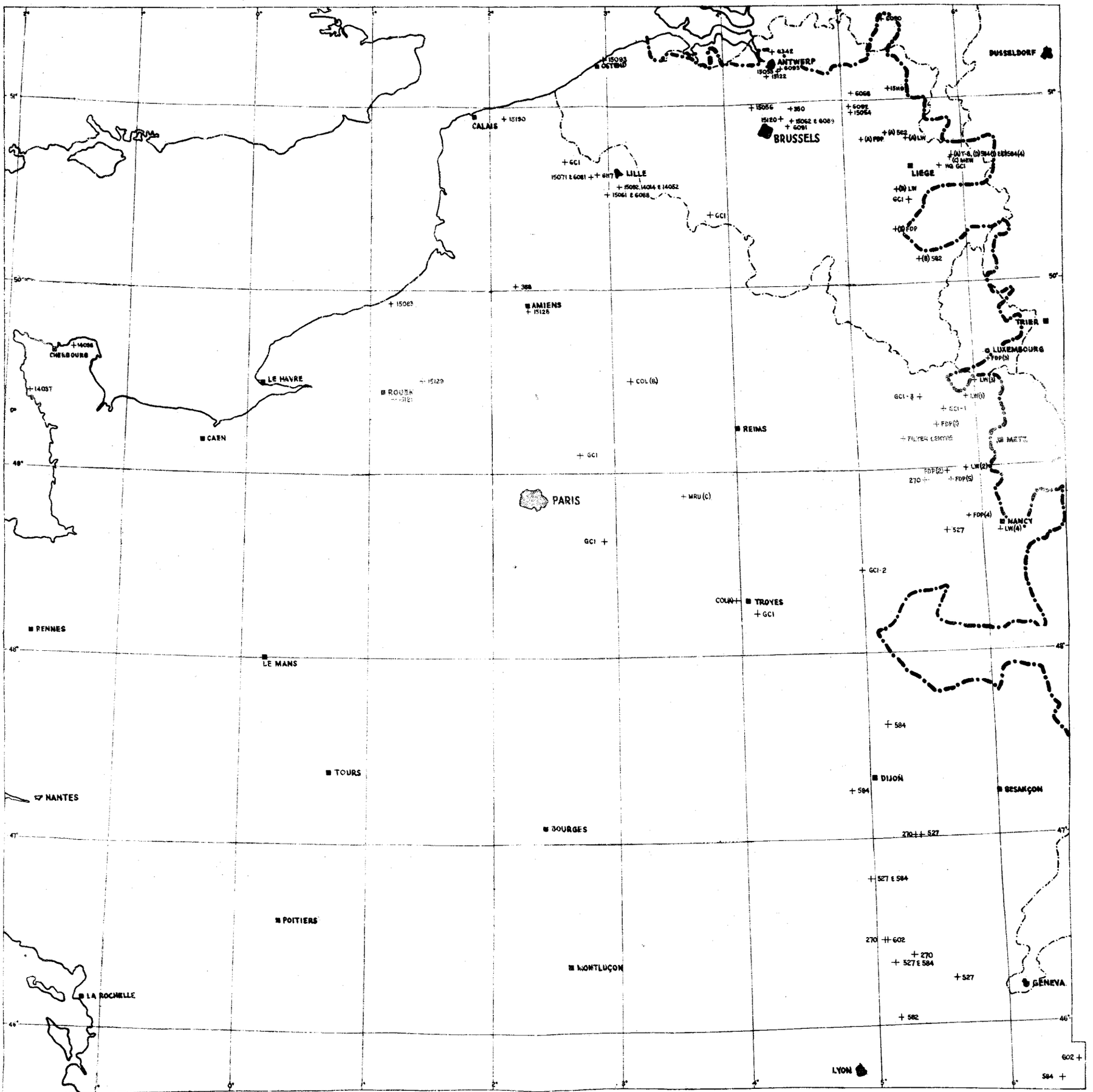


FIG. Nº10

SECRET

RADAR LOCATIONS AS OF 5 JAN. 1945

84 GP.

83 GP.

XXIX T.A.C.

85 GP.

BRUXELLES

IX T.A.C.

XIX T.A.C.

IX A.D.C.

PARIS

XII T.A.C.

XII T.A.C. FOR 1ST French Air Corps

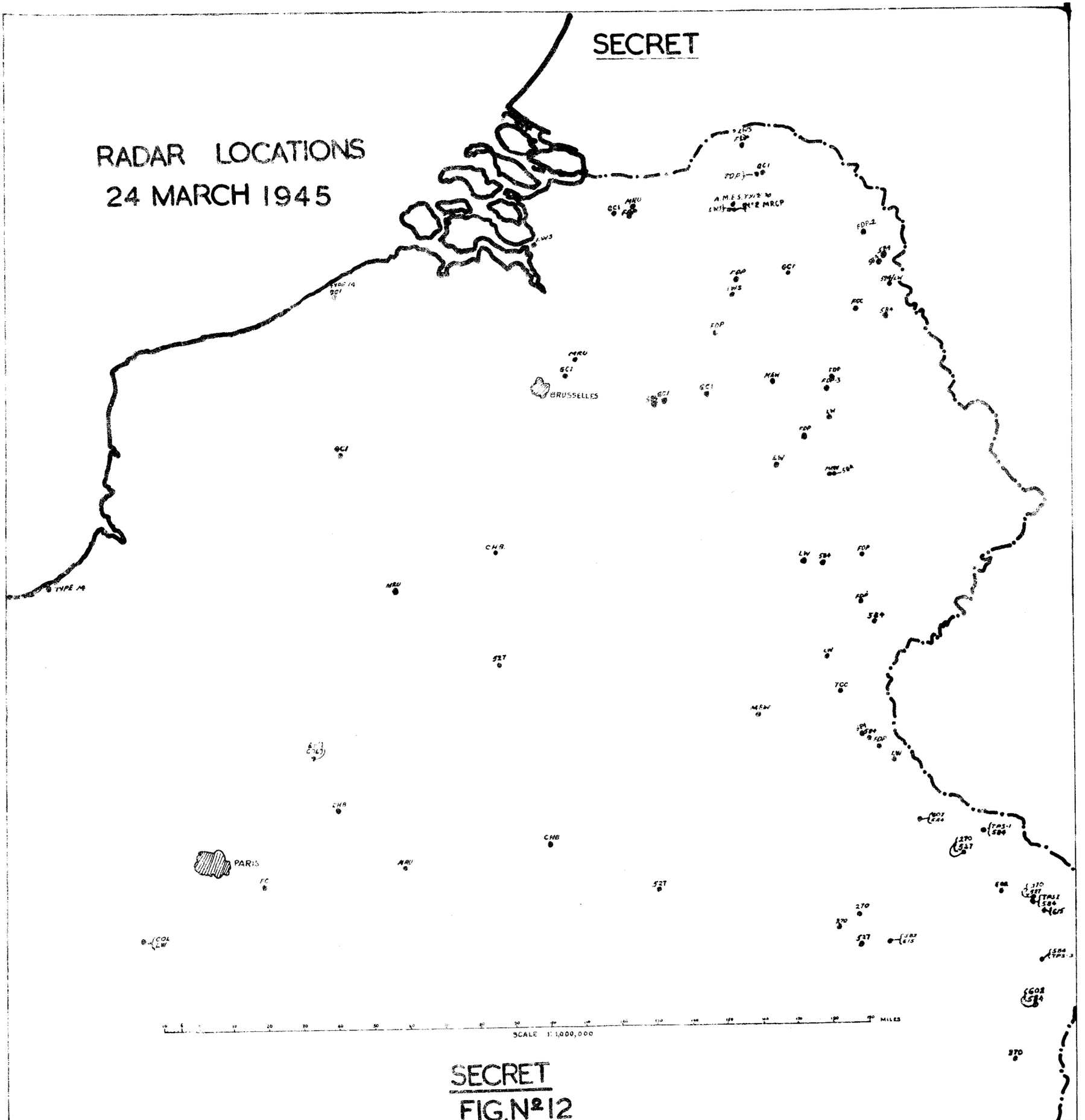
SCALE 1:1,000,000

FIG. Nº 11

SECRET

SECRET

RADAR LOCATIONS
24 MARCH 1945



SECRET

FIG. Nº 12

CHAPTER 4 - AIR TRANSPORTABLE RADAR

12. On 18th August, the Commanding General of First Allied Airborne Army stated that in future operations airborne forces might be landed considerably forward of our main field forces. In such operations it was considered that the provision of effective fighter cover was mandatory. A.E.A.F. were requested to produce Air Transportable Forward Direction Posts (incorporating point to point communication with a range of at least 70 miles) capable of being transported by glider. The equipment was to be ready for operation by 1st September or earlier.

13. After consultation with Air Ministry and D.C.D. Design authorities, air transportable light warning sets and air transportable G.C.I.'s were designed and produced. The crewing up of these units and subsequent technical training was done by H.Q. 60 Group. On the completion of technical training two light warning sets and one G.C.I. were transferred to H.Q. 38 Group for operational training and use in the forthcoming operation "MARKET", which was to be an attempt to outflank the Siegfried Line with airborne operations across the Lower Rhine.

14. Two glider transportable FDP's were supplied by the Ninth Air Force for glider training with the 82nd Airborne Division in case control of Ninth Air Force fighters should be required. Each team was to consist of controllers, technicians, operators, AN/TPS-3 (light weight radar), SCR.188 and 624 (communication radio), and an SCR.634 (portable VHF/DF).

15. At a meeting held at Bentley Priory on 15th September, it was stated by a representative of the First Allied Airborne Army that air transportable radar equipment would not be required for the operation. Subsequently, this decision was over-ruled at a meeting at R.A.F. Station, Harwell, when agreement was reached between General Browning and W/Cdr. L.J. Brown, and on the morning of the 18th, Light Warning Units Nos. 6341 and 6080 were airborne in four gliders destined for Arnhem, to take part in what has since been described as "the bloodiest battle of the war". The four gliders containing the two light warning sets and their crews came under accurate enemy anti-aircraft fire as they approached the L.Z., and severe mortar fire when they had landed. Conditions and casualties were so severe that the radar equipments were never erected. The evacuation of Arnhem took place on the 25th/26th September, and the survivors of the Radar Section of the First Allied Airborne Army, which originally comprised 5 officers and 40 O.R.'s returned to the United Kingdom, this party consisting of 3 officers and 1 O.R.

16. A close study of reports made by the survivors of operation "MARKET" proved invaluable in formulating the requirements of air transportable radar for any future airborne operations. It was decided that air transportable radar for an airborne operation should comply with the following conditions:

(a) A complete radar equipment must travel with its crew in one glider.
(b) The equipment and crew must be able to move swiftly from the glider to cover on a pre-selected site immediately upon making land-fall.

17. In the light of experience during operation "MARKET", the air transportable radar equipments for any forthcoming airborne

/operation....

operation were reviewed. It was decided that if the L.Z.-D.Z. of any operation was sited so that radar cover over the area could not be provided by ground radar within the main Allied lines, it might be necessary to employ one or more of the following units which were being formed and trained.

	Description
A.M.E.S. Type 6 Mk. IX	A light warning set mounted in a four-wheel drive vehicle with a trailer H.F. communication equipment. 4 Channel VHF is supplied. Equipment works on 209 mc/s. and gives equal performance to the standard Light Warning Set. A beacon for the use of night fighters is also included. The whole unit is carried in a Hamilcar glider and can be brought into use within 30 minutes of touchdown. Four units were formed and two additional equipments were made as reserves.
A.M.E.S. Type 6 Mk. VII	A light warning set in a G.C.I. Cabin. The performance of this equipment is approximately equal to that of a mobile G.C.I. Mk. III I.F.F. facilities are provided. The unit requires four aircraft Type C.47 for transport, and it is unlikely to be brought into full operation in less than 24 hours after touchdown. Three units had been formed prior to "MARKET", and were kept available.
A.M.E.S. Type 65	This equipment known as "Dinner Wagon", consisted of an L.W. Set and AN/TPS-3 early warning equipment in a Horsa glider with special operations room incorporating additional displays with facilities for linking up H.F., V.H.F. and external land-lines. In order to avoid tying up unnecessary personnel it was decided to treat the "Dinner Wagons" as alternative equipments for the A.T. G.C.I. crews. Two equipments were ordered and constructed.

18. These different types of equipment were produced in order to meet the varying operational requirements that might arise. The function of these Radar Control Units in an operation was as follows:

(a) To take over from the V.C.P. the interception of enemy aircraft during daylight.
(b) To direct fighters on to Army Support targets beyond the range of V.C.P.'s.
(c) To give homing vectors to fighters which might be needing assistance.
(d) To take over from the V.C.P. the normal R/T contact with patrols arriving at and leaving the area.
(e) To assume control of night fighters.

/(f)....

(f) To provide warning to the ground troops and A.A. Units of the approach of enemy aircraft.

19. The secondary functions which were to be undertaken by these ground radar units were as follows:

(a) Provision and operation of A.I. beacons on which night fighters could home and orbit.
(b) Reception and dissemination of friendly aircraft movements as received by the Movement Liaison Network.
(c) Pinpointing of mortar firing location by plotting of mortar trajectories at times when activity was low, or other times when another unit had taken over primary responsibilities.

20. The Radar Units listed above are set out in order of vulnerability and consequently in the order in which they are likely to have been taken in. Experience with gliders in the past had shown that, even when apparently deserted, they were targets for enemy ground and air forces, and could be quickly set on fire. A.M.E.S. Type 65 ("Dinner Wagon") therefore, would not be used in an operation until a site had been chosen which would be reasonably secure against observation and the fire of enemy ground troops.

21. Volunteers to man these air transportable radar units were obtained by H.Q. 60 Group who were also responsible for the technical training. On completion of technical training the units, complete with crews, were transferred to H.Q. 38 Group, who were responsible for the operational training, which was to be carried out under the most realistic conditions that could be arranged. In the spring of 1945 it became evident that the only operation in which these units might be employed would be operation "ECLIPSE". With this operation in view, H.Q. 38 Group carried out exercise "CONWAY" which was to give interception practice to the air transportable radar control units under operational conditions. The exercise took place at R.A.F. Stations Cranfield, Acklington, Coltishall and Brentwaters, during the period between 17th April and 30th April, 1945. Unfortunately, owing to an accident, one A.M.E.S. Type 6 Mk. IX was lost, two of the crew being killed and others injured.

22. Operation "ECLIPSE" was not put into operation as planned owing to the rapid advance of our land forces. Accordingly, on the 12th May, Air Ministry were informed that there was no longer any requirement for air transportable radar within this Command.

/Chapter 5....

CHAPTER 5 - RADAR FOR THE CONTINENTAL CROSSBOW INTELLIGENCE ORGANISATION.

23. In September it was decided that the rocket watching organisation in the United Kingdom was unable todetect the flights of rockets launched from territory then remaining in German hands, for the purpose of public warning and site location. It was, therefore, decided to set up an advance organisation on the continent under the control of R.A.F., Fighter Command. The radar equipment required to provide this service was two A.M.E.S. Type 9 Mk. V's to be supplied by Air Ministry, and three G.C.R.'s to be provided and manned by the Army.

A.M.E.S. Type 9 Mk. V

24. The equipment comprised a megawatt amplifier added to a standard MB2 transmitter, an RF8 receiver, and a special photographic console (Oswald) which recorded range of the V2 against time. The units all worked on 42.5 mc/s. using aerial arrays on 105 ft. towers.

25. It was desirable to site these stations so that:

(a) their main lobes were raised sufficiently to eliminate permanent echoes and the echoes from aircraft at medium altitudes;
(b) they were sufficiently far apart to give good range cutting.

26. The receivers were originally intended to record range and bearing, and were accordingly modified for CRDF working, but this was later abandoned. The fixing of the V2 was dependent upon getting accurate range cuts from two stations and the most accurate timing was necessary. To achieve this, land-lines were provided down which time signals were fed from a master clock and all station times were synchronised.

27. In October, it was appreciated that the major threat existed from long range rockets against the port of Antwerp, and with this in mind, the Chiefs of Staff were asked to agree to hand over to SHAEF control the organisation and equipment deployed on the continent for the protection of the U.K. It was further requested that a team of officers from Fighter Command be loaned to advise on the detailed organisation and handling of information within the new proposed organisation.

28. The Supreme Commander directed that the Chief of Air Defence Division, SHAEF, should be responsible for the co-ordination of all countermeasures, either active or passive, against V-1 and V-2. At the request of Maj.Gen. A.M. Cameron, Chief of Air Defence Division, SHAEF, a Radar Officer of the Air Signals Staff was attached when necessary to his staff to provide technical advice on all matters appertaining to radar in the continental "Crossbow" organisation.

29. The radar requirement of this new Continental "Crossbow" Organisation was six A.M.E.S. Type 9 Mk. V's. These stations were to be deployed to give the coverage as represented in diagram No. 1. The technical maintenance of these stations was originally undertaken by 72 Wing, but later, on the 7th December, responsibility was transferred to 33 Wing of 85 Group.

/30....

30. The reporting procedure for these stations was as follows. The Type 9 station would pass immediately to the Information Room of the "Crossbow" Forward Intelligence Unit situated at Malines, the range - time data on any suspected incident of which they obtained visual record. The Information Room staff would be responsible for recording this information, and passing it to the plotting room. As soon as the films were developed at the Type 9 stations, they would pass any range - time data obtained from them by the station personnel. This was to be handled in the same way as data obtained visually.

31. By 18th February, the last of these stations was operational, unavoidable delay having occurred in the final commissioning owing to adverse weather conditions and enemy action. At first faults were encountered mainly with the megawatt amplifier and the photographic consoles. After these initial faults had been cleared, the equipment settled down and gave extremely useful service, and played a major part in the location of V-2 launching sites.

32. The stations remained sited in their original positions except for a slight move of one station owing to the military situation in December. At the end of March, it was decided to re-deploy the stations to cover the possibility of "Big Ben" launching sites being set up farther back in Germany and against a change of target possibly from Antwerp to the Rhine bridgehead crossings. Owing, however, to the rapid advance of the ground forces, the last V-2 was launched on 28th March, and on 19th April, all six stations were closed down.

33. During the period of their operation, these Type 9 Mk. V's formed the most reliable of the various V-2 detection devices. The largest percentage of failures was due to the stations being off for daily maintenance as is shown by the following overall results achieved.

	Visual	Film
Observed	82.8%	83.3%
Failures during maintenance	8.4%	8.4%

SCR.584 Equipment for Tracking "Big Ben" Projectiles

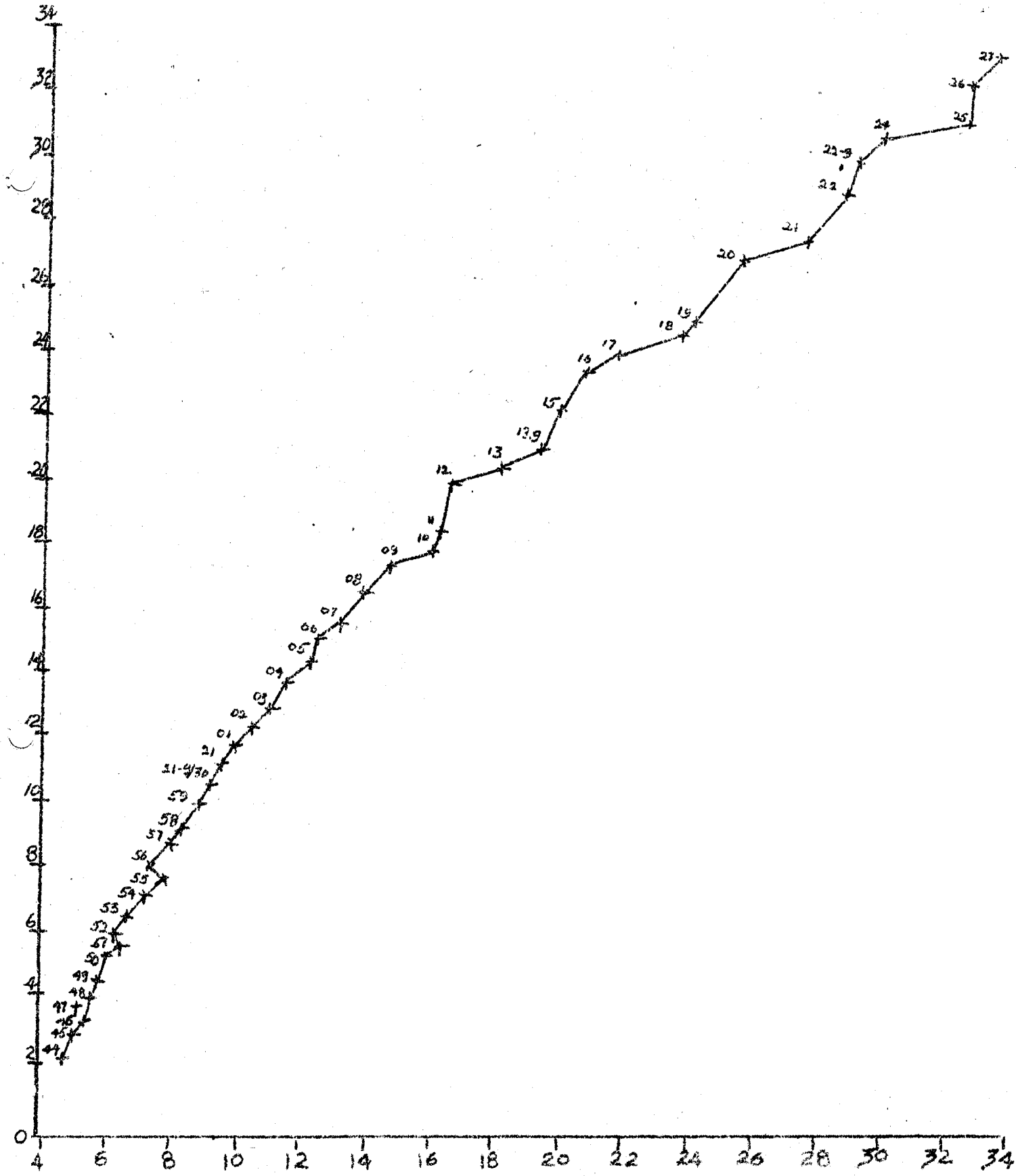
34. The policy in regard to the location of V-2 launching sites was to correlate the information from all sources such as AMES Type 9 Mk. V, G.L.3, sound ranging, and flash spotting organisations etc., and pass the relevant grid references of launching sites to Air Staff for photo reconnaissance and strike action.

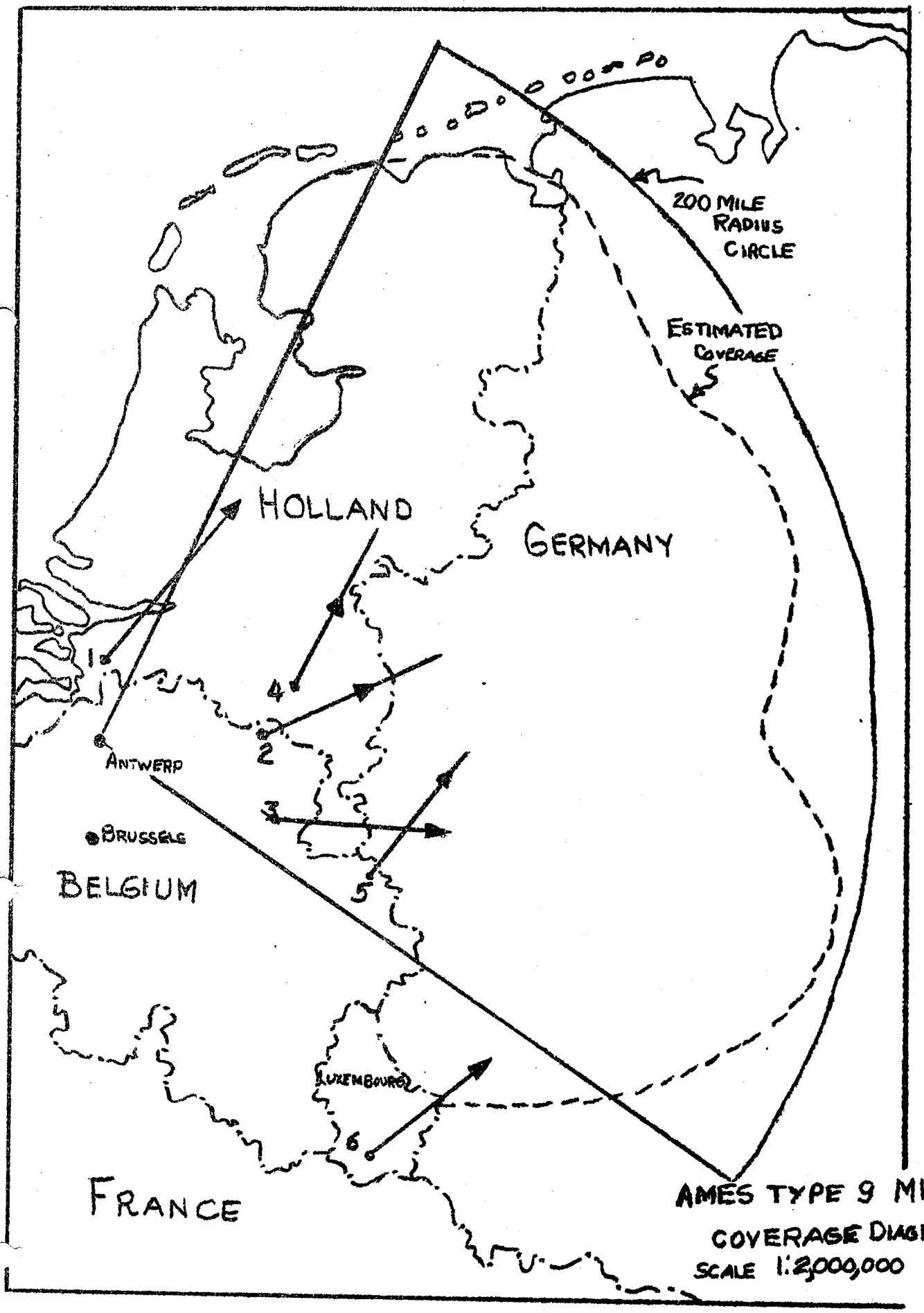
35. In the past, considerable experience had been gained in the location of mortar firing points by light warning sets and SCR.584 equipment. In view of this fact it was suggested that an SCR.584 equipment should be used in the locating of V-2 launching sites. It was considered that in the event of a launching area being discovered within the range of the automatic tracking and plotting features of the SCR.584, it would be possible to obtain rapid and accurate determination of the trajectory and launching site, and it was believed that it might then be possible to control aircraft from this SCR.584 to strike the site.

36. To carry out experiments and trials, a unit called the Special Radar Party was formed, manned and controlled by the Army through the Special Defence Headquarters at Brussels. Certain small

/modifications....

SAMPLE TRAJECTORY UNSMOOTHED FIG. 1





AMES TYPE 9 MK5
COVERAGE DIAGRAM
SCALE 1:2,000,000

modifications were made to enable the equipment to "lock on" the new fast moving targets, and at the beginning of February, the unit was set up at Steenbergen, Holland, and commenced a rocket watch over the Hague area.

Recording Results

37. In order to record the results, a Westex recording van was connected to the output of the SCR.584. This van incorporated remote bearing range and elevation dials which could be automatically photographed. In order to obtain accurate timing of the records, a stop-watch was included in the photograph, which was synchronised every half-hour from the standard pendulum clock located at the headquarters in Malines.

Results

38. Analysis of the results achieved by the unit, covering the period 26th February, 1945, when it first came into operation, until 11th March, 1945, showed that of 127 possible engagements from the area covered, the number of V-2's detected was 112, the number followed 102, and the number photographically recorded 91. This showed that, provided the launching area was within range of the SCR.584, it was capable of detecting nearly 90% of the launchings. The initial signal/noise ratio of the target was approximately 5 : 1; as the angle of elevation increased above the point at which ground reflection was effective, this signal/noise ratio fell to 2 or 3 : 1. From this point the signal remained substantially constant until the range started to increase rapidly when the target was lost due partly to the rapid rate of change of range, with which the range motor could no longer cope, and partly due to the decreasing signal strength.

Controlled Attacks

39. Once it had been proved that the SCR.584 was able to locate the launching sites accurately, it was decided to investigate the possibility of controlling aircraft to strike or photograph these sites. After investigation, this plan was abandoned since:

(a) 70% of the launchings were at night;
(b) only 10% of the launchings were from sites within the range at which the SCR.584 could control aircraft, (no airborne beacons for the aircraft were available);
(c) firing from the Hague sites was abandoned by the enemy while the proposals were still under consideration.

/Chapter 6....

CHAPTER 6 - SCR.584

General

40. In April, 1944, Ninth Air Force formed a board of officers to investigate the possible operational use of the SCR.584 for close support based on a set that had been modified by the British Branch of the Radiation Laboratories, Massachusetts Institute of Technology (B.B.R.L.). This board witnessed the operation of the set while controlling aircraft and submitted a report on the 14th May with the recommendations that two teams be formed to conduct further tests to determine the suitability of this equipment on photographic and bombing missions. If the results of these service tests proved satisfactory the project would be increased to a total of eight sets. The R.A.F. Air Support Development Unit, later called the Central Fighter Establishment began conducting trials at Millfield, and contributed much to the early development of the SCR.584 close control technique.

41. A meeting was held at AEAF on 9th June, 1944, to:

(a) Decide on a plan of employment based on the tests that were being conducted by these two individual groups.
(b) Prepare a T/O and E for the operating team.
(c) Discuss the availability of equipment.

A requirement was later established for eight sets for Ninth Air Force and four for 2nd TAF. The first two sets and crews were given to IX Tactical Air Command and trials were conducted at Middle Wallop, England in order to:

(a) Work out the technique for level bombing.
(b) Assess the accuracy of the system.
(c) Train the crews.

The procedure looked promising but the results at best were inconclusive. The sets were then moved to France before the crews or pilots had time to learn the capabilities or limitations, and one was in operation by 16th July, 1944.

42. On 22nd May, 1944, a statement had been received from 2nd TAF to the effect that there was no requirement for an SCR.584 within that Command. This decision, however, did not alter the requirement for four modified SCR.584's, and in anticipation of a requirement arising within 2nd T.A.F., an establishment was raised within A.E.A.F. and a team was formed on the 10th July, 1944. The anticipated requirement arose, and in October, 1944, arrangements were made for the first set to be phased in with No. 83 Group and it was used operationally in November.

Supply

43. USSTAF was requested to modify fifty SCR.584's on requisition from the United States and build plotting tables for each of the modified sets. B.B.R.L. was requested to provide technical assistance for these modifications and the construction of plotting tables. A great deal of delay was encountered in the supply of this equipment due to difficulty in obtaining truck tractors for each set, and the delay in modification at AAF Station 590. The modifications were held up beacuse of:

/(a)....

(a) Last minute changes introduced as a result of experience gained on the first few sets.
(b) Delay in B.B.R.L. providing someone to supervise the modifications.
(c) Lack of vital parts, such as selsyns, gears etc. which had to be procured from the U.S.
(d) Lack of a sufficiently high priority being given to the work at the depot.

By 1st October only six modified sets had been delivered.

44. In addition to the use of this equipment for close support, it was planned to make two sets available to Ninth Air Defence Command to make one improvised G.C.I. station. If this proved successful the entire three battalions of the Defence Command would be equipped with a total of nine pairs or eighteen sets. Subsequently, A.M.E.S. Type 21 equipment became available and the project was limited to only two sets forming one pair. Later these two sets were turned over to XIX Tactical Air Command to replace an SCR.582 that had been lost due to enemy action. Another set was to be modified for 100 miles range and used by Ninth Bombardment Division as a substitute for Oboe.

45. The final status as at 15th January, 1945, for the entire programme of SCR.584 supplied by USSTAF, including the number of SCR. 584's in this theatre procured by the Air Forces, the established requirements for the modified equipment for close support, and the distribution of both modified and unmodified SCR.584's is shown on the following table:

(a) SCR.584	Required	Delivered
1. RAF 60 Group (Oboe ground station, modified by BBRL).	4	4
2. RAF 60 Group (Oboe ground station, unmodified).	4	4
3. Eighth Air Force (bomb assessment) unmodified. * (One on loan to RAF Fighter Command. One on loan to RAE, Farnborough).	8	8 *
4. (IX Air Defense Command - 2 unmodified sets for GCI, now transferred to XIX TAC for modification to CSB are listed below).		
5. IX Bomb Division - modified for 100 mile Oboe frequency close support.	1	1
	17	17

(b) SCR.584 Close Support Units and Modification Kits

/Ctd..(Table)....

Unit		Required Sets	Required Kits	Delivered Sets	Delivered Kits	Balance Required Sets	Balance Required Kits
Ninth Air Force	(IX TAC	6		6			
	(XIX TAC	✱6	2	✱4		2	2
	(XXIX TAC	6		2		4	
First TACAF (Prov)	(XII TAC	6		2		4	
	(1st French AC		6				6
RAF	(TRE			1			
	(2nd T.A.F.	4		2			
	("Big Ben"			1			
	BBRL	2		2			
	(RAF Fighter Command Trg. School)			2			
	MAAF		12		3		9
		30	20	22	3	10	17

✱ Including 2 unmodified transferred from IX ADC.

(c) Recapitulation of Programme to 15th January, 1945

1. SCR.584's

Total AAF quantity in theatre 50

Required - CSB (table (b)) 30
Other (table (a)).. 17

Not specifically required but on indefinite loan from BBRL to Fighter Command Training School 2
49

Delivered - CSB 22
Other.. 17
39

Balance committed to CSB not yet modified or delivered 10
49

Balance on hand, unallocated 1

2. Modification Kits

Required 20
Delivered 3
Balance 17

Modification

46. When the SCR.584 is used for aircraft control the following modifications are made:

/(a)....

(a) The range unit must be modified to permit automatic tracking out to greater ranges involving changes in both circuits and gearing. For close support use, the range of 32,000 yards is increased to 96,000 yards (54.5 miles).

(b) The pulse repetition rate is lowered and the output power is increased in order to make satisfactory performance possible at the increased range.

(c) An anti-jamming device known as an "N squared gate" is added.

(d) An additional modification not included in those originally made was to modify the set so as to work with a transponder beacon carried in the aircraft. The diameter of the parabola could also be increased to eight feet, providing additional range in tracking beacons. (This last modification had been experimented with but not finally adopted for all sets).

47. Automatic plotting boards are added to portray the information in a usable form.

(a) The 90 degree board was first used but it was soon found to be unsatisfactory.
(b) A 180 degree board was then designed in which the azimuth arm was capable of being swung through 180 degrees. Range adjustments could be made to accommodate 1 : 50,000 or 1 : 100,000 maps giving range limitation of 48,000 and 96,000 yards respectively.
(c) The latest model of plotting board was the "X-Y" board described in the section on SCR.584 used with medium bombers.

Training

48. Arrangements were made that the training of crews would be undertaken by R.A.F. Fighter Command to be done by the Central Fighter Establishment at Millfield or Brunton and later at Drem. This training included operational training of the crew and controllers while working with aircraft. The technical training of the mechanics was to be done by B.B.R.L. at Great Malvern.

Employment

49. Six missions were controlled by IX TAC from the first site in the bridgehead area with no information of any kind available to assess the success of the bombings. When it moved to its second site on 1st August, the front lines were already out of range so no controlling of any kind was attempted. The first real operational use was over the Falaise Gap where four missions were run with moderate to good success. The unit operated by 83 Group successfully took part in operation "Veritable" (the advance through Cleve to the Rhine) where 54 close support missions were controlled. 409 aircraft flying between 8,000 and 10,000 ft. with 7/10 to 10/10 clouds dropped 348 tons of bombs on targets between 14 and 32 miles from the station.

50. The procedure for the use of the SCR.584 close control varied in each Air Force. The types of missions most frequently used were:

/(a)....

(a) Navigational Assistance: In the case of Ninth Air Force controllers received a copy of the day's field order showing what aircraft were to be airborne giving the time and the areas in which they would be working. They then monitored the air support VHF channel and listened to find out what targets a particular formation was told by the air support party to strike. Then the SCR.584 located the formation by VHF D/F and continued to track. If at any time they heard the flight leader say that he was unable to locate the target, the controller broke in, identified himself and vectored the formation around flak areas to the target. They usually brought the leader within visual range and told the leader to call for smoke marking. The identical system was not employed within 2nd T.A.F. The controller did not provide navigational assistance until the pilot requested it by calling on the SCR.584 guard frequency.

(b) Level Bombing: Blind level bombing was accomplished by any of three methods for setting up the plotting board:

(i) Use of the Norden bomb-sight computer synchronised with the plotting board presentation to determine the release point.

(ii) Use of the Craig Computer (Trail-Travel Computer) to pre-set known and predicted data to determine the release point.

(iii) Calculate the release point mathematically without resort to a semi-mechanical device.

(c) Night Photo Reconnaissance: Control of night photographic planes enabled superior cover to be obtained when compared with other methods.

(d) Night Intruder: In U.S. areas missions were generally run in close co-operation with an F.D.P. This involved controlling the planes up and down main roads and railroads, over towns and large road junctions. If the pilot of the controlled plane sees any traffic or activity below he drops down to bomb and strafe the target. On clear nights two planes fly in an element. The lead plane has flares which are dropped over the target to provide illumination for the other plane to bomb and strafe.

(e) Dive Bombing: The first missions attempted and controlled by an SCR.584 were dive bombing. In this type of mission the controller vectors the aircraft to the proper predetermined coordinates and controls the flight into the dive. In determining the point for the beginning of the dive such factors as the position of the sun, the size and shape of the target are considered, in addition to the normal flight and meteorological data, so that the most desirable direction of approach may be used.

/Results....

Results - Ninth Air Force

51. The Tactical Air Commands of Ninth Air Force have analysed their results, and their reports have been collated, (reference Ninth Air Force Operational Research Section Report No. 5 dated 10th May). This analysis shows that fighter bombers, according to the most reliable information, achieved an operational accuracy of between 500 and 700 yards, (this was before the introduction of the X-Y plotting board). On the basis of an operational accuracy of 500 yards, the following bombing percentages would be achieved.

95%	of	the	bombs	within	2,000	yards.
64%	"	"	"	"	1,000	"
38%	"	"	"	"	500	"
4%	"	"	"	"	50	"

Conclusions

52. The conclusions drawn as a result of operations are as follows:

(a) Using the level blind bombing technique control enables bombs to be dropped on area targets when weather conditions would otherwise prevent this being done with any hope of success.

(b) Targets can be accepted close to our forward troops. 1,500 yards is considered to be a reasonably safe margin, but even this margin cannot take care of gross errors which are bound to occur from time to time.

(c) For targets of opportunity when Radar Navigational assistance is required, the SCR.584 can undertake control and render this assistance much more quickly than any other method of Radar Navigational Aid.

(d) Though the equipment is itself highly mobile, its absolute mobility is limited by the ancillary facilities that it requires. It is therefore more successful when the front is static than when it is fluid.

(e) Its present limitations are its relatively short range, the limited weather conditions under which it can be used effectively and the limited type of target against which it can be used with reasonable prospects of success.

(f) The most hopeful line of development to increase the effectiveness of this system in the near future appears to be that directed towards the introduction of the airborne beacon to give the instrument increased range, and allow aircraft flying lower to be better tracked, particularly in an area where permanent echoes are serious.

The SCR.584 with Medium Bombers

53. After three months using the SCR.584 for controlling fighter bombers of a Tactical Group, H.Q. 2nd TAF found that an analysis of the targets attacked by aircraft of No. 2 Group during that period showed that a considerable number had been within 30 miles of the front line. At this range, control by modified SCR.584 equipment was possible and on occasions would prove to be of more value to No. 2 Group than G.H. Accordingly, trials and operation with No. 2 Group medium bombers under control of SCR.584 took place and it soon became apparent that the chief limitation was that of range of control. It was considered that this could best be overcome at

/that....

that stage by the installation of a beacon in the aircraft. Owing to the inability to provide suitable beacons this limiting factor was not overcome. It was, however, found possible to increase the range of control to a limited extent by replacing the normal antenna with an 8 foot parabola.

Results - 2nd T.A.F.

54. An analysis (ref: TAF/5/21/6/ORS) was taken on a smaller number of missions than those of the Ninth Air Force, and this showed a mean error of approximately 350 yards. That this combination of equipments could be extremely useful was shown when 38 out of 40 enemy guns were silenced while they were harassing the Allied bridgehead on the Eastern bank of the Rhine.

Use of SCR.584 with Aircraft Beacon

55. The Ninth Bombardment Division was equipped with Oboe as a blind bombing aid. Since they had not been assured that adequate Oboe coverage would be provided when movement to the continent was completed, and due to the desire on their part to have a bombing aid as an integral part of the division, work was started by BBRL to modify an SCR.584 for this purpose. Preliminary experimentation was carried out in England but the equipment was moved to France in the latter part of September and trials were continued at Beauvais during October on a practice bombing range. Because of sickness and absence on the part of several technicians, work on the project stopped in the middle of November after controlling several practice bombing missions. The set was then moved to Reims in December and with the addition of the X-Y plotting board in January, practice trials continued on into February. The set was then moved to a site near Verviers, Belgium on the first of March, and several operational missions were run before the month was over. The set was moved on to Gotha, Inselberg, and Hof, Germany but no missions were run due to the rapid advance of the Ground Forces. Due to the many technical, operational, and organisational difficulties encountered in the development of the system it did not contribute to any really successful operations against the enemy before all bombing stopped.

56. This system uses an SCR.584 and an automatic plotting table to control medium bombers using Oboe pathfinder technique. The course signals are the same as those used in Oboe except that they are given by the ground controller with a manual control. By using an aircraft beacon, the maximum range is 196,000 yards (111 miles) and the expected probable radial error is 200 to 300 yards at 50 miles and about 400 yards at maximum range. The plane is under control for about eight minutes with a straight bomb run of about $3\frac{1}{2}$ minutes. Targets can be attacked from any direction and secondary targets can be attacked in case of failure on primary ones.

57. The equipment necessary for this system is:

(a) An SCR.584 modified as follows:
  (i) Special antenna for tracking the airborne transmitter.
  (ii) Change of frequency to work with the airborne transmitter.
  (iii) Extension of range by:
    (a) Altering the pulse recurrence frequency to 569 cycles per second.
    (b) Range unit expanded to 196,000 yards.
    (c) Expansion of sweep on indicators.

(iv)....

(iv) New equipment for azimuth settings.

(b) Automatic plotting board.
(c) Equipment for producing dot-dash control signals.
(d) Communication equipment with adequate range.
(e) Airborne transponder similar to the AN/APA-9 (commonly called Cboe).

58. A considerable improvement in accuracy of control from an SCR.584 is obtained by the use of the X-Y board (D-170500) instead of the original 180° board designed by BBRL. This board is mounted in a separate van which when backed up to the open side of the radar trailer provides a convenient operations room. It was designed by Bell Telephone Laboratories specifically for use with the SCR.584 incorporating many of the circuits from the M-9 gun director. Some of the more desirable features incorporated in the X-Y board are as follows:

(a) The ground track is drawn continuously on paper with an ink pen which produces a 5-second marker pip used for measuring ground speed.
(b) Smoothing circuits are built in to eliminate the jitter inherent in automatic tracking devices.
(c) An additional expanded scale can be used when the aircraft approaches the target.

/Chapter 7....

CHAPTER 7 - AN/CPS-1A(MEW)

59. The introduction of six laboratory, preproduction AN/CPS-1A's into the European Theatre has had a great effect on the system of ground control for aircraft. It was originally designed to be a microwave early warning set (from which it derives the common name MEW). But before the first production set came off the assembly line the laboratory models became engaged in an important role in an offensive which required little warning of enemy aircraft. It was soon apparent that it would need certain modifications to enable a number of groups to be controlled simultaneously and at the same time keep up with the rapid movement of victorious Armies. It was necessary to:

(a) Provide more facilities for control in the way of communications, off-centre P.P.I.'s, plotting screens, data boards, housing, etc.
(b) Provide a suitable height finder.
(c) Mobilise to a degree consistent with the mobility of the Ground Forces.

60. As a result of the experience gained in mobilisation and operation of the first three sets a committee of two U.S. and two R.A.F. officers was sent to Headquarters Army Air Forces in Washington in December, 1944, for the purpose of personally pressing the urgency for more MEW's and to obtain modifications in the production models which were supposed to be soon coming off the production line. Plans were already underway to have the Radiation Laboratories at M.I.T. contract for and assemble four additional preproduction sets to fill the urgent demand from USSTAF to be allocated to:

Set No. 6 for XXIX TAC
" " 66 " XII TAC
" " 67 " First TACAF (For the First French Air Corps)
" " 68 " Eighth Air Force.

Two of the first few production sets were scheduled for the R.A.F. but the priority on the remainder of the production was for the Pacific Theatre and not the European. It was agreed that the four handmade sets would be assembled as nearly as possible to conform with ETO requirements for mobility and layout, but it was too late for changes in the production sets to be made. These four sets were to be made mobile and supplied with Jamesway shelters, RC-127 IFF equipment, and AN/TTQ-1 Operations Center equipment.

61. Six production AN/CPS-1 would be allocated to USSTAF and mobilised, involving a 6 weeks' delay in delivery. A modification centre was to be set up to accomplish this and the remainder of the work of the committee was with the Army Air Forces Board to settle on the operations room layout, additional modification kits, and the degree of mobility. The delivery of these equipments and No. 68 preproduction model was cancelled on cessation of hostilities.

62. The second preproduction model made by the Radiation Laboratories was brought over to England and set up at Start Point, Devon to be used as a fighter direction station prior to and during the invasion. Work began on assembling the equipment in the

/middle....

middle of January, 1944, and the station was technically ready for operations in the latter part of February, but did not officially start working until 1st April. From this location the MEW had excellent coverage over the invasion area and a complete series of still photographs were made showing troop carrier, bomber, and fighter operations on D-Day. The primary mission of the station was controlling aircraft and the secondary duty was reporting in to 10 Group as part of the radar chain of Air Defence of Great Britain.

63. When the V-1 menace became serious in the London area, Ninth Air Force loaned the MEW to A.D.G.B., and the set was closed down on 23rd June and moved to Fairlight near Hastings. The purpose of moving to Fairlight was to provide a special station for the analysis of "Diver" (V-1) attacks, and in particular to help in finding enemy firing points on the French coast by radar means. It was subsequently found that the station could be used for both control of aircraft and raid reporting purposes without interfering with its primary role of analysis. After it had been in operation for a short while, A.D.G.B. came to the conclusion that the performance of the set on V-1's was superior to any other radar equipment on the South coast of England in the following respects:

(a) The range was estimated to be approximately 15% in excess of other equipment.
(b) A noticeable superiority in continuity of tracking.
(c) High track handling capacity.
(d) Mobility which would enable the set to be moved at reasonably short notice if a change in enemy tactics rendered this necessary.

Accordingly, A.D.G.B. made strong bids to retain this set for use in anti-"Diver" work rather than return it to XIXth Tactical Air Command for use on the continent.

64. When "Diver" activity increased still more, T.R.E. began construction of a new radar set to take the place of the MEW so that it might be released. This set was to be made up of the antenna turning gear from an A.M.E.S. Type 20, the antenna and transmitter of an MEW (to be shipped by air from the U.S.), a modulator from an A.M.E.S. Type 16, and receiver and display units from other R.A.F. centimetre equipment. This set was to be known as an A.M.E.S. Type 26 and construction was to be completed by the 14th August. (Mobile versions of this were later furnished to Second T.A.F. and called A.M.E.S. Type 70).

65. Originally, it had been intended that the MEW would be used by A.D.G.B. for a period of approximately one month and that it would then be turned over to XIXth TAC. However, the "Diver" defence had a noticeable weakness in two areas, first in the Straits of Dover, and second in the Eastern approaches to the Thames Estuary. It was proposed, therefore, to bolster this by moving the MEW to the St. Margaret's Bay area as soon as the Type 26 became operational.

66. The requirement for this MEW to be used for anti-"Diver" purposes or for tactical control by XIXth TAC was the subject of much high level controversy and was finally decided at a meeting of Air Chief Marshal Tedder, Air Chief Marshal Leigh-Mallory, General Spaatz and General Vandenberg. The decision was to release the set to XIXth Tactical Air Command on 27th August.

/67....

67. Work had been progressing on mobilising the equipment while it was still in operation at Fairlight. Vehicles had been provided for mounting the indicators and the antenna. Telephone facilities were installed to provide all of the internal communications for the equipment. An A.M.E.S. Type 13 was added to provide height reading. It was then moved to the continent and was in operation with the XIXth Tactical Air Command Control Centre near Vigneulles by the latter part of September. From 22nd September to 31st October, a total of 261 missions, including patrols, night fighters and photo reconnaissance, had been run. At the beginning of the German offensive in the middle of December the MEW was sited east of Nancy at Morhange. With the shift of the Third Army to the North it moved to a new site near Longwy to get the necessary cover over the bulge in the front line. This site was occupied on 4th January and proved to have the least objectionable permanent echo pattern and best low cover over both air bases and target area of any site occupied. After the next move the Third Army swept across Germany and the mobility of the MEW and the associated communication net was stretched to the utmost. At times, operations were carried on by radio and situation reports were dropped by plane. During this push the MEW moved an average of 100 miles each week.

68. MEW No. 6 was assigned to XXIXth Tactical Air Command. The equipment arrived by ship at Antwerp on 20th February. It was unloaded and the convoy was rolling down the road 24 hours later. It was located on site by 24th February and in operation on 5th March. Inclement weather prevented any operations until 8th March, but 69 missions were controlled during the following week representing 909 sorties. Several successful single plane reconnaissance missions were carried out in which the pilot orbited the target while the controller marked the tube and a squadron of fighter-bombers were then vectored to the same area. On 16th March it was moved forward about 65 miles to Aldekerk, Germany and was on the air again in about 4 days. During the next 3 days 103 missions totalling 1,327 sorties were controlled in preparation for operation "VARSITY". For the 17 days in that location 313 missions totalling 3,691 sorties were controlled before the Ninth Army advanced out of range, necessitating another move. During the 25 days that missions were controlled by this set, a total of 452 missions representing 5,455 sorties were run with an equally impressive number of claims for ground targets.

69. MEW No. 66 arrived at Le Havre on 19th March, 1945, and at the initial site near Saverne, France on 27th March. The unit was in operational condition and crew training was begun on 1st April. After a brief training period the set was shut down on 7th April, and was back in operation near Wurzberg, Germany on 12th, the first mission being performed on 13th April. During the remaining three weeks one hundred night intruder missions and 149 day fighter missions representing 1,200 sorties were controlled. An SCR.615-A was used for height finding with this set. Since it incorporates a spark-gap modulator identical with the one used in the MEW, interference trouble was experienced. Subsequent modifications were made to blank the P.P.I. trace of the SCR.615 during the main pulse of the MEW. This worked well enough to enable the SCR.615 to be placed within 300 yards of the MEW. Satisfactory heights were obtained up to a maximum of 90 miles and constantly up to 60 miles. A beacon kit was installed and operational on 21st April, but the airborne beacons (AN/APN-7) were not installed in the aircraft in time to be used.

70. MEW No. 67 did not arrive in time to participate in the War.

CHAPTER 8 - A.M.E.S. TYPE 70

71. The outstanding operational successes of the M.E.W. with a Tactical Air Force prompted A.E.A.F. on 11th August to inform Air Ministry of a requirement for 12 of these equipments for use in the British area on the continent, and in the Home Radar Chain.

72. After the assault stage and breakthrough from the bridgehead it became obvious to Second T.A.F. and visiting Staff Officers of A.E.A.F. that a very urgent operational requirement existed for an M.E.W. or similar radar equipment in the British area. Experience gained in the operation of ground radar since the initial landing on the continent, had demonstrated that the restricted range of existing equipment imposed severe limitations on the ground control and airborne organisations. Up to the present the Group Control Centre or Sector Operations Room had been dependent upon a number of dispersed ground radar units for its air information. In the initial phase it was possible to provide adequate communications between the radar sites and the Group Control Centre, and in the main the system functioned smoothly and efficiently. Later, however, the rapid advance of the armies necessitated frequent and rapid moves of the radar sites in an endeavour to provide radar cover over enemy held territory. The Group Control Centre was compelled to remain in close proximity to the airfield, and subsequently communications between the radar stations and the G.C.C. were stretched to breaking point. Frequently, satisfactory communications could not be maintained, and the G.C.C. was compelled to function without an adequate air picture. Fortunately, the enemy air action was on a small scale, and the lack of adequate radar information was not of very serious consequence. Further, in the past, fighters operating with heavy bombers had been controlled by Type 16 stations situated on the English coast. This, however, was now impossible, and some form of substitute was required to be sited in Holland as close to the German border as possible. On 22nd September, a definite request was received from Second T.A.F. to provide facilities to meet these operational requirements. At this time, the anticipated delivery date for the M.E.W. was not expected to be before late January, and accordingly a decision was taken to provide a British equivalent of the M.E.W. Air Ministry were informed, and the decision was taken that the equipment provided for producing the next static A.M.E.S. Type 26, should be used in the fabrication of radar equipment which was to provide the same facilities as the M.E.W. This new equipment was to be called A.M.E.S. Type 70.

73. The major difficulty encountered in the original design was the necessity to provide an aerial system which would give the required gapless cover, and at the same time, be sufficiently light in weight to enable the existing design of mobile aerial turntables to be employed. This was not found possible to achieve, and a decision was taken to use two aerial systems which were to be synchronised. The A.M.E.S. Type 70 was to comprise high and low beam centimetre sets giving plan position displays, and two associated centimetre height finding sets. Multiple displays were to be available, and Intelligence and Combat Ops. Planning facilities were required. The entire unit was to be as mobile as possible.

74. To provide the facilities required, the following equipment was found to be necessary:

(a)....

(a) Two modified Type 14 aerial vehicles.
(b) Two A.M.E.S. Type 13 height finding equipments (one for controlling and one for reporting).
(c) A lower beam reporting vehicle containing five 'B' scopes.
(d) One upper beam reporting vehicle containing two variable off-centre P.P.I.'s.
(e) Two vehicles with a plexi-glass side containing two variable off-centre P.P.I.'s.
(f) One additional variable off-centre P.P.I. was to be carried in a load carrier for fitting to a platform erected between the two operations rooms for use by the supervisor.

75. On 23rd January, the first A.M.E.S. Type 70 arrived on the continent, and was erected on a prepared site near Erb, under the operational control of 83 Group. Operations took place during the night of 28th/29th January. At the commencement, considerable "teething" troubles were experienced, but these were eventually cleared by members of the Post Development Service, which proved how essential it was to have assistance of engineers when new and untried equipment is introduced into operational use. The weather at this time was extemely poor, and hence the number of test flights which could be carried out was extremely limited. When flights were undertaken results were reasonably satisfactory, the ranges being within 10% of those obtained from the MEW.

76. The first A.M.E.S. Type 70 had been a prototype fabricated by T.R.E. and it was decided that the remaining four equipments which were required to be produced to meet Second T.A.F.'s requirement, should be similar except that British variable off-centre P.P.I. display units were to be used in place of the U.S. 'B' scans used in the first convoy. The anticipated delivery dates for these equipments which were to be properly engineered were as follows:

Number 2 - 1st April
" 3 - 1st May
" 4 - Late in May
" 5 - Mid-June

Unfortunately, these target dates for delivery could not be met owing to production difficulties. The second A.M.E.S. Type 70 was brought to the continent on 28th April, and no additional sets were made available between then and the cessation of hostilities.

/Chapter 9....

CHAPTER 9 - MISCELLANEOUS RADAR

77. Other radar equipment introduced subsequent to the invasion but which did not have the opportunity of playing such a vital role as those mentioned before are described below.

A AN/MPN-1 (G.C.A.)

78. Another important contribution of radar to help make an "all weather Air Force" is the AN/MPN-1 (Ground Control Approach). This is a very precise radar set capable of bringing a plane into the approach to the runway close enough so that safe landings can be made at almost zero visibility. It was introduced to the Tactical Air Forces in France in January, 1945 and five had arrived on the continent by May. During that time over 500 approaches were made in First TACAF and Ninth Air Forces. Of these, 45 were emergencies and the remainder indoctrination approaches. Several of the emergencies were in zero visibility. One of the extreme emergencies was the case of a set operated in Watton, England when a landing was made in conditions so bad that a jeep had to lead the way to the dispersal area because the pilot couldn't see the edge of the taxi strip. These units were supplied complete with crews belonging to the Army Airways Communications System (AACS). The team and equipment were under operational control of the Air Forces to which they were allocated.

B ACR. Mark II (AIRFIELD CONTROL RADAR)

79. For some considerable time there has existed an urgent requirement for a radar set which could be set up on an airfield and could see aircraft at 500 ft. at 2 miles without serious interference from permanent echoes. Telecommunication Research Establishment commenced working on the design of an equipment for Radar Flying Control and produced the ACR. Mk. II equipment; this was a prototype model and was taken to France with the mobile Flying Control Unit on 1st October. In order to speed construction T.R.E. made use of equipment which was readily available. The ACR. Mk. II used an SCR.717B ASV equipment which operated on "S" band and was mounted in a 3 ton vehicle, the parabola being inverted and mounted on the roof of the vehicle.

80. Originally this equipment was used at BUC airfield which was used by Air Staff Communication Flight whilst SHAEF was at Versailles. During its stay at BUC training was undertaken and a standard form of operating instruction formulated. It was, however, considered that there was insufficient aircraft activity at this airfield to enable the equipment to be put to a fair test and accordingly the unit was transferred to 2nd T.A.F. for use with No. 34 Wing at Melsbrook.

81. As has been stated, the ACR. Mk. II was in the nature of a "mock-up". The manufactured equivalent, with certain improvements, was called the ACR.Mk.IIM of which six were ordered. The first ACR.Mk.IIM was moved to the continent as a Special Flying Control Unit on 8th April, and set up at Eindhoven Airfield (B.78). The ACR.Mk.IIM equipments were produced as an interim measure until G.C.A. could be made available to serve the same purpose with greater accuracy of control and improved operational facilities.

/C - Light Warning....

C LIGHT WARNING

82. Second T.A.F. and Ninth Air Force were originally equipped with Type 6 Mark III and V L.W. sets. Some of these were replaced in Ninth Air Force when the AN/TPS-1, 2 and 3 arrived. The introduction of this equipment was delayed considerably by several factors:

(a) The equipment arrived at a time when Ninth Air Force Service Command depots were being moved from the U.K. to the continent and many of the packing cases were misplaced.

(b) Rough handling in transportation resulted in many of the components being unserviceable when unpacked.

(c) The operational units were reluctant to exchange an L.W. set mounted on a vehicle for a better one in transportable form. Therefore, the sets had to be mobilised before being issued.

83. The AN/TPS-2 was used by Anti-Aircraft Battalions to supplement the ground observer system. The AN/TPS-1 and 3 was substituted in several of the Tactical Air Commands for the Type 6 to be used for low cover in forward areas and to fill the gaps in the cover of the larger radars at the F.D.P.'s.

D LIGHT WEIGHT RADAR EQUIPMENT FOR SURFACE VESSEL WATCHING

84. The advance of our forces through the Low Countries revealed the possibility of making improvements in the arrangements for providing the Royal Navy with surface vessel radar cover. No good sites for equipment such as A.M.E.S. Type 14 were available owing to the low lying nature of the coastline, and consequently the ranges obtained from these stations were short. H.Q. 85 Group saw the possibility of installing some form of radar equipment in a building such as a lighthouse or a tower, in order to increase the ranges obtained. Accordingly, experiments were made with a modified Mark X A.I. (SCR.720) equipment installed in the tower of the Casinn at Blankenberghe.

85. The main modifications made to the A.I. Mk. X were the elimination of the vertical scan and reduction in speed of the horizontal sweep. Thus modified, the set gave satisfactory performance though it had the disadvantage of no P.P.I. display, and lacked certain definition due to an unnecessarily wide horizontal beam.

86. It became apparent that there was a real requirement for a light weight radar equipment which would meet the following requirements:

(a) Each section must be portable by, at the most, two men, and be capable of installation in sites inaccessible to normal radar equipment, e.g. lighthouses, towers, and high buildings.

(b) The dimensions of each separate unit, when contained in its case, should be such as to allow passage through narrow doors, corridors, staircases, etc.

/(c)...

(c) A narrow horizontal beam of the order of 3° to 4° width is required. In order to achieve this, and at the same time, keep the aerial dimensions within the acceptable limits, an "X" band equipment is necessary.

(d) Aerial tuning gear should provide low speed revolution with inching facilities.

(e) Display should be provided on a P.P.I. and "A" scope.

/Chapter 10....

CHAPTER 10 - TECHNICAL AND OPERATIONAL DEVELOPMENT

Radar Development Unit

87. In the past, the investigation of the value of any modification to R.A.F. ground radar equipment, suggested from any source within the R.A.F., was the sole responsibility of H.Q. 60 Group. Sufficient personnel of a specialised character were established on Headquarters, 60 Group in order to provide a pool of experts who could determine whether a suggested modification was of any value.

88. This system was entirely satisfactory as long as the equipment was static. With the Tactical Air Force a number of difficulties arose which made it impossible to continue on the same lines. The problems encountered were those connected with:

(a) the use and deployment of mobile equipment;
(b) providing the necessary facilities for trials of suggested modifications which arose as a result of operational experience.

During August a proposal was put forward to establish within A.E.A.F. a Radar Development Unit which would devote its attention to the solution of radar problems encountered by Second T.A.F. and Ninth Air Force.

89. After much discussion of the problems arising out of the formation of such a unit, it was decided that a Radar Development Unit was a "long term" rather than a "short term" measure, and in view of the fluid state of the war at that time it was decided to wait before continuing with this problem until the situation was a little clearer. The need was never again stressed sufficiently to consider seriously the formation of this unit.

Post Design Service

90. The decision regarding the Radar Development Unit did not alter the fact that a requirement for specialised assistance in the field still existed and would have to be met as quickly as possible. With this object in mind the services of the Directorate of Communications Development were asked, and readily given in the form of a Post Design Service. The P.D.S., as it was referred to, consisted of personnel from Telecommunications Research Establishment and the Royal Aircraft Establishment. The D.C.D. representative in charge of the Post Design Service acted in an advisory capacity to the A.S.O.-in-C. and later to the C.S.O. 2nd T.A.F., on all technical training and supply problems associated with the application of radar in A.E.A.F. It was also the responsibility of P.D.S. to provide specialised technical assistance on British radar irrespective of whether it was manned by British or American personnel. The terms of reference of P.D.S. were as follows:

(a) Assist in planning, siting and installation of all British ground radar equipment, where specialised knowledge is necessary and is not available from R.A.F. sources.

(b) Assist in planning and installation of all British airborne radar equipment, where specialised knowledge is necessary and is not available from R.A.F. sources.

/(c)....

(c) Assist units in the organisation of radar maintenance sections and in the solution of any technical difficulties.

(d) Review performance of equipment and advise on the action to be taken in the event of poor performance.

(e) Scrutinise suggested modifications to radar equipment.

(f) Advise on any necessary trials.

With New Equipment

(a) Assist with new equipment to obtain full operational use, giving training and compiling relevant technical information for guidance and instruction of R.A.F. personnel.

(b) Assist in determining operational methods to be employed with radar equipment, taking into account its technical limitations.

British Branch Radiation Laboratories

91. The majority of the research and development on microwave radar equipment in the United States was done at the Radiation Laboratories at Massachusetts Institute of Technology. Since the battle field rapidly became the proving ground for this equipment, a branch of the laboratories was set up at Great Malvern, England near T.R.E. and was called the British Branch, Radiation Laboratories (BBRL). In general this organisation was staffed by physicists and technicians from the Radiation Laboratories who had been instrumental in the early design work on the various types of equipment. From time to time representatives of the manufacturers were attached for field work on one of their sets.

92. Therefore, this group was well equipped with qualified technical personnel who rendered valuable assistance to the entire Air Force radar programme in the following way:

(a) They enabled laboratory models of equipment to be used in action by providing the necessary technical assistance. Major benefits to the using units as a direct result of this were:

(i) More rapid development of operational technique in the use of radar.
(ii) Better equipment and better techniques sooner permitted more targets to be hit.

(b) They enabled more rapid progress to be made in the development of radar by providing the necessary liaison between designers and military users. This was accomplished by:

(i) continually rotating personnel to the U.S., and
(ii) maintaining constant communication with the laboratories.

(c) Conducted development and trials in the field by having workshop facilities available and direct supply channels through to the Radiation Laboratories who made contracts

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direct with manufacturing concerns in the U.S.

(d) Contributed greatly to "selling" radar by obtaining audiences and sympathetic ears of high ranking officers on the basis of being civilian experts.

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

O N

O P E R A T I O N 'O V E R L O R D'

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CESSATION OF HOSTILITIES

S E C T I O N XXII

RADIO COUNTER MEASURES

GENERAL

1. Inasmuch as the original plans and provisioning action for Airborne R.C.M. were completed prior to the assault phase of the invasion, most R.C.M. activities were of a routine nature and were not referred to A.E.A.F. or Air Staff, SHAEF.

2. The intense use of airborne R.C.M. caused considerable interference with our own radar and communications. Since this headquarters exercised supervision over the use of R.C.M. on the continent by the Allied Air Forces, a policy on the use of R.C.M. was published as Policy Memorandum Number 10. This incorporated the following basic points:

(a) "Radio Counter Measures will, in general, be applied against enemy radar or air-ground communications only when Allied aircraft are operating at a tactical disadvantage.

(b) "Allied bomber aircraft may be supported by those radio counter measures which are normally adopted for their protection, subject to any restrictions imposed by authority of the Supreme Commander to safeguard vital radio facilities.

(1) Airborne jammers, including Window, may be employed against enemy radar.

(2) Airborne jammers, including Window, directed against enemy early warning and fighter control radar and communications may be employed.

(3) Such airborne jamming may be supplemented by ground-based jamming from the United Kingdom.

(c) "Radio Counter Measures Units of No. 80 Wing which are capable of taking effective jamming action against enemy radio navigational aids and blind bombing systems may be employed in the United Kingdom. Any proposal to use such equipment on the Continent is required to be submitted to the Chief Air Signals Officer of Air Staff SHAEF (Main) so that it can be properly studied in advance by the Combined Signals Board where necessary. Ground-based jamming of

/enemy....

enemy radio navigational aids and radar and ground-to-air radio control of enemy fighters on the continent will be adopted whenever and wherever this can be done without interfering with vital radio facilities.

(d) "Ground-based jamming of radio-controlled rocket projectiles may be employed subject to any restrictions imposed by the Supreme Commander to safeguard radio facilities.

(e) "The effects of Airborne and Ground-Based R.C.M. upon vital radio facilities within the theatre will be kept under continuous review by Air Staff so as to ensure that, as operational conditions change, the restrictions to the use of Airborne and Ground-Based R.C.M. are revised to satisfy current conditions.

(f) "Four aircraft in the Eighth Air Force have been fitted with high powered Jackal jamming transmitters and may be called upon to jam enemy tank communications in the band 27 - 33 mc/s. in support of ground operations."

3. The policy of R.C.M. taking precedence over ground communications was maintained up to the time when unbearable interference to sufficiently important links warranted a change in policy. Due to the rapid movement of units after crossing the Rhine River 90% of the communications existing between the major headquarters of Ninth Air Force was VHF/FM radio circuits in the 70 to 100 megacycle band. As a result of a very strong protest from Ninth Air Force against any interference to these channels, operation of R.C.M. was restricted in this frequency band within the area bounded by 1° East and 12° East and 48° North and 53° North. Otherwise R.C.M. activities continued unabated until the actual bombing operations ceased.

R.A.F. BOMBER COMMAND

4. By far the largest user of R.C.M. was R.A.F. Bomber Command. Each normal operation involved the following types of radio and radar countermeasures by aircraft of the main force:

(a) Airborne Cigar - a 60 watt, noise modulated, spot jammer, with a frequency range from 38 to 42 megacycles which is monitored on to the enemy control frequency.

(b) Special Tinsel - a 50 watt, noise modulated, spot jammer, with a frequency range from 3 to 6 megacycles which was monitored on to the enemy control frequency.

(c) Jostle - a 2000 watt, noise modulated, spot jammer from 3 to 42 megacycles. Normally it is used as a barrage jammer over the band from 38 to 42 megacycles and is carried in about 7 aircraft.

(d) Carpet II - a 2 watt, noise modulated, spot jammer from 510 to 580 megacycles automatically monitored on to the enemy radar frequency carried in approximately 25% of the main force.

(e) Piperack (Dinah, AN/APT-1 with amplifier AM-14/APT) - a 25 watt per megacycle, noise modulated, barrage jammer from 87 to 93 megacycles carried by only a small number of aircraft in the main force.

(f) Air Grocer - a 2 watt per megacycle, noise modulated, barrage jammer from 530 to 590 megacycles carried in only a small number of aircraft of the main force.

/Mandrel....

(g) Mandrel - a 2 watt per megacycle, noise modulated, barrage or spot jammer from 60 to 220 megacycles. This was used in only a few aircraft and they orbited an area jamming the enemy long range, early warning radars.

(h) Window - Large quantities of window covering the frequency range from 60 to 600 megacycles were dropped by the main force and by diversions so that enemy radar would be unable to plot accurately or count the number of aircraft. According to intelligence reports this was very successful in confusing the enemy.

(i) Dartboard and Drumstick were also available in limited quantities.

5. In the middle of November, 1944 Air Ministry proposed that a system of ground based R.C.M. stations be set up in the forward areas of France to jam enemy night fighter defences as it would assist considerably in keeping bomber losses down and would increase the scope of bomber approach tactics. This proposed organization, known as 80 Wing, would operate 8 radar jamming centres and 6 communication jamming centres sited on high ground and situated between Holland and Switzerland. This plan was examined by the Technical Working Group of the Mutual Interference Sub-Committee of the Combined Signal Board to determine the interference which would result to our own radio facilities. Air Ministry proposal was finally agreed to on 18 December, 1944 subject to the following restrictions:

(a) Sitings:

(1) These stations would not be located closer than 15 miles to the front lines or 10 miles from any major headquarters.

(2) That the Main Interference Advisory Party co-ordinate the sites with the units concerned in case further restrictions were necessary.

(3) That the initial system be set up in the British zone to study the adequacy of the restrictions prior to deployment over the entire front.

(b) Control.

(1) Control of 80 Wing would be delegated to Second Tactical Air Force as long as the jamming centres remained in the British zone.

(2) 80 Wing would be authorized to turn on at the request of Bomber Command such R.C.M. as produced tolerable interference with our own communications and radar.

(3) R.C.M. which produced serious interference could only be applied by 80 Wing on orders from Second T.A.F. issued as a result of a Bomber Command request through 80 Wing. In case Second T.A.F. was unable to approve the Bomber Command request the matter would be passed to SHAEF for final decision.

6. A copy of the directive is attached as Appendix "A".

/U.S. EIGHTH AIR FORCE....

U.S. EIGHTH AIR FORCE

7. The Eighth Air Force conducted Carpet, Window and continual investigational operations without reference to SHAEF. The only operations that were co-ordinated through SHAEF were those involving Jackal.

8. Jackal (AN/ART-3) is a barrage jammer covering the 27-34 megacycle band using a frequency modulated carrier with about 500 to 1000 watts spread over the band. The jamming signal produces interference to enemy tank communications. Seven of these sets arrived from the U.S. and four were installed in B-17's of 803 Squadron which was to be under operational control of 100 Group, R.A.F. Bomber Command. Technical difficulties prevented the installations from being ready for operation until 11 August instead of 1 July 1944 as originally planned. Trials were performed by AEL-15 to determine the jamming effect on German tank radio sets and our own radio and navigational aid equipment. All Army Groups were notified of the method of application, implications of use, availability of equipment, channels for requests, and possible results that might be obtained by the use of Jackal on 14 August 1944. The command and signal channels for co-ordinating and expediting Ground Force requests for Jackal were later revised to eliminate the confusion caused by Jackal interference to our G-H bombing missions. The final instructions were as follows:

(a) The request is initiated by the Army G-3 and passed to the appropriate Tactical Air Command/Group.

(b) The Tactical Air Command/Group will pass the request to the Tactical Air Force including a requirement for fighter escort if necessary. The Tactical Air Command/Group will also co-ordinate the means for communicating with the jamming aircraft from the ground on the Eighth Air Force Fighter-Bomber VHF channel so that the mission can be changed or cancelled at the request of the Army concerned.

(c) The Tactical Air Force will then secure clearance from the senior Operations Office at Supreme Headquarters, AEF, Air Staff, who is aware of all proposed bombing operations and the priority attached to them.

(d) On receiving clearance for the request, the Tactical Air Force will deal directly with Eighth Air Force to complete the details for the operation.

9. During the Ardennes Offensive operations occurred on the 21, 28, 31 December 1944, 2, 3, 5 and 7 January 1945 at the request of the Third Army at a time when they were meeting considerable enemy armoured opposition. In addition to the four B-24's another plane was fitted with an SX-28 receiver incorporating a noise silencer to minimize the effect of the jamming for the purpose of monitoring the German communications in an attempt to determine the efficiency of the operations. Examination of the operators logs did not provide proof that enemy communications were jammed or were not jammed although a reasonable amount of German traffic was intercepted. Monitoring by a ground station disclosed only moderate interference to our own radio stations during these operations. According to Twelfth Army Group prisoner of war interrogation there was indication that the Jackal jamming was effective and some tactical benefit was obtained.

U.S. NINTH AIR FORCE

10. 9th Bombardment Division (Medium) conducted Window and

/limited....

limited Carpet operations without reference to SHAEF. However, with the increasing use by the enemy of electronic apparatus in his defence against medium bombers operated by the Tactical Air Forces, it became necessary to initiate a programme to investigate the deployment and tactical use of this equipment so that the necessary countermeasures could be employed properly. In addition to investigating the Fire Control, GCI and AI radar of the enemy it was hoped that this would enable a close check to be made on enemy jamming and mutual jamming interference to the communication links and navigational aids. Accordingly, USSTAF was requested to supply adequate equipment to equip and maintain two medium bombers for pulse analysis and two for automatic frequency recording to be expanded later to six planes for each purpose. Only one plane was equipped and used before the end of the war.

FIRST TACTICAL AIR FORCE (PROVISIONAL)

11. Window was the only R.C.M. used by 42nd Bombardment Wing (Medium).

APPENDIX "A" SECTION XXII

AIR STAFF
SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE
APO. 757, U.S. ARMY

Reference : A/S/SHAEF/S.14274/Sigs. 18th December, 1944.

Subject : USE OF GROUND BASED RADIO COUNTERMEASURES IN SUPPORT OF BOMBER COMMAND OPERATIONS

To : Air Marshal, Commanding, 2nd Tactical Air Force (2)
Commanding General, Ninth Air Force, APO 696, U.S. Army (2)
Commanding General, First Tactical Air Force (Prov), APO 371 U.S. Army (2)

Air Ministry have requested the Supreme Commander to allow R.A.F. Bomber Command to install in this theatre an R.C.M. organisation comprising a Headquarters, at a site so far not selected, six communications jamming centres, and eight radar jamming centres. It has been decided to introduce this system in the theatre subject to siting and operating restrictions.

2. The R.C.M. equipment which will be introduced is designed to interfere with enemy radar, radio beacons and ground-air communications. It is intended at present to use this equipment only by night in support of British Bomber Command night attacks. It may be possible, as a result of experience gained, to extend its use to daylight hours in support of British and American bomber operations.

3. Control:- The equipment which is to be introduced is listed in Appendix "A". A theoretical study based on tests conducted and experience obtained in the United Kingdom has been made by the Mutual Interference Advisory Party of S.H.A.E.F. on the degree of interference likely to be caused to communications and radar in use by operational forces in this theatre. As a result of these studies and by virtue of the limited communications that can be provided for the Control of R.C.M. activities, the principles that will be adopted in the initial stages for the operation of this equipment will be as follows:

(i) The control of No. 80 Wing R.C.M. activities will be delegated to 2nd Tactical Air Force, as long as the jamming centres are situated only in the British Zone. 2nd T.A.F. will represent the interests of 21 Army Group in exercising this control.

(ii) The controlling Headquarters of No. 80 Wing on the continent will be authorised to turn on at the request of Bomber Command such R.C.M. as produces no interference or tolerable interference with communications and radar in use in this theatre.

(iii) R.C.M. which produces serious interference will only be applied by No. 80 Wing in this theatre on orders from 2nd T.A.F. issued as a result of a request from Bomber Command through 80 Wing. In the event of 2nd T.A.F. being unable to approve the Bomber Command requirement, the matter will be passed to S.H.A.E.F. for final decision. Instructions concerning the channels within S.H.A.E.F. through which the matter will be referred, will be forwarded at a later date.

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4. Siting Restrictions - It has been decided that the following siting restrictions are to apply to all ground-based R.C.M. equipments introduced in this theatre.

(i) Not to be nearer than 15 miles to the line of forward battalion command posts.

(ii) Not to be less than 10 miles from any major Headquarters of Divisional level or higher, or from Fighter Control Centres or Group Control Centres.

(iii) To be sited in relation to other communications and radar equipment in accordance with restrictions imposed on the siting of all signals and radar equipment in the theatre as defined in S.H.A.E.F. "NEPTUNE" Signal Instruction Part I, Appendix "G". In this respect R.C.M. equipment is to be included in the same category as the SCR.268.

5. Siting and operating restrictions imposed in the initial stage of the introduction of this equipment are necessarily based on theoretical study to a considerable extent. A layout of an R.C.M. system is, therefore, to be made initially in the British zone, where a preliminary study has indicated that suitable sites can be found. This layout is to be operated under the supervision of the S.H.A.E.F. Mutual Interference Advisory Party to examine the adequacy or excess of restrictions initially imposed. While this first part of the system is in use, selection of sites for the whole chain of the system down to the Swiss border is to proceed.

6. Communications - In the initial stage the following communications will be provided:-

(i) One teleprinter circuit between H.Q. No. 100 Group in the U.K. and H.Q. No. 80 Wing on the Continent. Arrangements for the allocation of these channels are being made.

(ii) One speech circuit and one teleprinter circuit between H.Q. No. 80 Wing and Base Signal Centre, to be provided by 2nd T.A.F.

(iii) Frequencies for the following W/T and R/T channels, which will be allocated by S.H.A.E.F.

(a)	Operational broadcast from 80 Wing operations Room to all Jamming Units.	Medium frequency broadcast.
(b)	Standby W/T channel from 100 Group to 80 Wing Operations Room.	1 low power H.F. channel.
(c)	W/T channels from 80 Wing Main to jamming centres.	2 low power H.F. W/T nets to communication jamming centres with very low power H.F. W/T links from communication jamming centres to radar jamming centres on the same frequencies. VHF R/T links from communication jamming centre to satellite radar jamming centres.

(d)....

(d)	Standby W/T channel from 80 Wing Main to Base Signals Centre.	1 low power H.F. W/T channel.

7. Administration - 2nd Tactical Air Force is to make administrative arrangements with Air Ministry for the introduction of this R.C.M. system on the Continent.

8. The Units will remain under the administrative control of 80 Wing. They will, however, be under 2nd T.A.F. for local administration.

(Sgd.) J.M.ROBB
Air Marshal
Deputy Chief of Staff
(Air)

Copies to: 21 Army Group (2)
Twelfth Army Group (2)
Sixth Army Group (2)
Bomber Command (5)
Air Ministry (5)

APPENDIX "A"

EQUIPMENT	PURPOSE	FREQUENCY COVERAGE	POWER	COMMUNICATIONS AND RADAR WITHIN FREQUENCY RANGE	REMARKS
Normal Mandrel Equipment	Radar C.M.	60-220 mc/s.	50 watts or less	AN/TRC in use on Army Group, Army Corps, Divisional Command channels, Air Force Command channels, Fighter Control. Air-ground and Air-Air Communications, Tank Communications. Radar AA No. 1. Mk.2 AA No. 2. AA No. 4. SCR.268 AMES Type 15, Type 6, Rebecca, Eureka, AI Beacons, IFF Mk.III, GEE-H, SCR.729.	To be operated as spot jammers only. Relatively low power. Interference under siting restrictions expected to be tolerable.
GMC Mandrel	Radar C.M.	20-80 mc/s.	500 watts	Armored Forces, Artillery and Infantry Combat Communications Fighter Control Reporting. AN/TRC in use in Army Group, Army Corps, Divisional Command channels, Air Force Command channels, Fighter Control. Radar AA No. 1. Mk. 2 GEE, GEE-H AMES Type 9.	To be operated as spot jammers only. Output power not to exceed 100 watts. Interference under siting and power restrictions expected to be tolerable.
Mandrel (Modified Rug)	Radar C.M.	530-600 mc/s.	20 watts	AMES Type 11.	No serious interference expected.

SECRET
SECTION XXII
APPENDIX "A"

EQUIPMENT	PURPOSE	FREQUENCY COVERAGE	POWER	COMMUNICATIONS AND RADAR WITHIN FREQUENCY RANGE	REMARKS
Purple	Radio C.M.	3-6 mc/s.	1000 watts	All HF Communications in range for all Tactical channels in combat area.	To be operated as spot jammers only. Blocking of from 10-15 channels within 5 miles, of 3-4 channels at any distance expected. Normal use involves very short transmission on channel in use by enemy. Anticipated interference is so serious that Purple may be turned on only by order of 2nd TAF or SHAEF.
MSU Type SJ	Radio C.M.	38-42 mc/s.	500 watts	Armoured Force, Artillery, Infantry Fighter Control reporting communications, GHQ.	To be operated as spot jammers only. Relatively small portion of tactical band affected.
MSU Type SM (M 24)	Radio CM and Meaconing	0.15-1.00 mc/s.	2000 watts	Beacons, Radio Range, Air Force 'Y' and 'MLS' Broadcasts, Royal Navy and Air Ministry circuits on following frequencies: 0.230 0.238 0.256 0.265 0.267 0.270 0.282 0.347 0.353 0.360 0.394 0.412 0.417 0.420 0.430 0.500 0.520 0.545 0.547 0.550 0.570 0.645 0.675 0.685 0.700 0.720 0.850 0.940	To be operated as spot jammers or meacons subject to avoidance of frequencies listed in previous column, and such other frequencies as may be notified from time to time, by not less than 5 kc/s.

A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

O N

O P E R A T I O N 'O V E R L O R D'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

S E C T I O N XIII

RADAR NAVIGATIONAL AID SYSTEMS

1. Radar Navigational Aid Systems employed by "OVERLORD" Air Forces consisted of:

(a) Gee
- For Tactical Air Forces Medium Bombers -
  U.S. - Ninth Air Force, 1st TACAF.
  Br. - Second T.A.F.
- For Strategic Air Forces Heavy Bombers -
  U.S. - Eighth Air Force.
  Br. - Bomber Command.
- For Troop Carrier and Transport Aircraft -
  U.S. - Ninth T.C.C.
  Br. - 38 Group, 46 Group.
- Night Photo Recce. Aircraft -
  U.S. - 155th Night Photo Recce Squadron.
  Br. - 34 Wing of Second T.A.F.

(b) Gee-H
- For Tactical Air Force Medium Bombers -
  Br. - No. 2 Group in Second T.A.F.
- For Strategic Air Forces Heavy Bombers -
  U.S. - Eighth Air Force
  Br. - Bomber Command
- Pathfinder and Resupply Aircraft -
  Br. - No. 38 Group

(c) Oboe
- For Tactical Air Force Medium Bomber Pathfinders
  U.S. - Ninth Bombardment Division.

  For Strategic Air Force Pathfinders -
  Br. - No. 8 Group of Bomber Command.

(d) Loran
- Used only to a limited extent on operations by IXth Troop Carrier Command, RAF Bomber Command, Eighth Air Force.

(e) Shoran
- Used only in the latter stages of the war by

/U.S. Tactical....

U.S. Tactical Air Force Medium Bombers. (Ninth Air Force and 1st TACAF).

(f) Rebecca/H - Eureka-H — For RAF Night Photo Recce Aircraft of Second T.A.F.

PLANNING RESPONSIBILITIES

2. Responsibility for planning and operating radar navigational aids during Operation "OVERLORD" was ultimately held by the Supreme Commander, A.E.F. for all aircraft operating directly in support of Operation "OVERLORD". (This did not include R.A.F. Coastal Command, R.A.F. Bomber Command, and U.S. Eighth and Fifteenth Air Forces except on specific close co-operation missions). Initially this responsibility was delegated to the Commander, Allied Expeditionary Air Force. Allied Naval Commander, Expeditionary Forces was to be consulted where common facilities could be used (i.e. Gee). With the disbandment of A.E.A.F., and the creation of Air Staff, SHAEF, this responsibility was assumed by the Deputy Supreme Commander.

3. Planning of Shoran and Rebecca-H/Eureka-H systems was delegated to the Tactical Air Forces who each had their own systems. Air Staff, SHAEF was responsible only for controlling frequency allocations for the former and code allocations for the latter, in order to avoid interference with other like systems or with the normal Rebecca/Eureka systems.

4. It should be noted that the planning responsibilities for R.N.A. for Air Forces other than tactical was not placed on any single organisation in the theatre. Hence, Air Ministry represented all R.A.F. requirements other than for the Second Tactical Air Force, and USSTAF represented all E.T.O. U.S.A.A.F. requirements other than for the Ninth and First Tactical Air Forces. Unofficially, however, the co-ordination of all requirements for R.A.F. operated R.N.A. systems for those Air Forces not under direct control of the Supreme Commander, was undertaken by Air Ministry. Therefore, SHAEF represented Tactical Air Force requirements and Air Ministry all other requirements. In reality, until December, 1944 all plans for the deployment of R.A.F. operated R.N.A. systems was done by Air Ministry.

5. After December, 1944, the normal procedure for planning new Gee Chains, Gee-H pairs, or Oboe pairs on the continent was as follows:

(a) Air Staff, SHAEF would put forward a tentative plan for further development of these aids based on SHAEF estimate of ground to be uncovered in the near future.

(b) This plan was passed to Air Ministry who ascertained if it would fit in with their requirements.

(c) The plan was then formulated and passed to R.A.F., 60 Group (through Air Ministry) for execution (siting, installation, and operation).

DEVELOPMENT OF R.N.A. ON THE CONTINENT (GEE)

6. In tracing the development of the Gee Chains it has been convenient to divide up the latter parts of the narrative into the phases selected by the ground forces which will most probably be used in the official history covering their activities.

/Gee Chart....

Gee Chart Production

7. When a site had been selected which was satisfactory technically and tactically, the site was surveyed by the engineers of the Army group in the area concerned. It was the responsibility of the Map & Survey Section, SHAEF to co-ordinate the production of the necessary lattice charts in accordance with a priority agreed between Air Staff, SHAEF and Air Ministry. In the early stages of the campaign there were sometimes serious delays in the production and subsequent distribution of charts, but in 1945 the average time to produce and distribute the first series of maps required was seven days. The responsibility for co-ordination of the production of charts did not rest with the Air Signal Division. The operational dates given for the various Gee Chains are the dates when the stations were transmitting and does not include the availability status of the various Gee charts.

8. As indicated in "Air Signal Report on Operation 'Neptune' - Planning and Assault Phase", the first step in the expansion of Gee coverage on the continent was to establish the so-called Channel Gee Chain. This Chain consisted of a Master station at Truleigh Hill (U.K.), a 'B' Slave at Canewdon (U.K.) and a 'C' Slave near Cherbourg on the continent. This deployment of stations gave an approximate cover as shown by Map No. 1. The final operation of this Chain was held up pending the erection and operation of the 'C' Slave on the continent. It was originally planned to be shipped across the Channel on D + 30, but due to a delay in allocation of shipping space, and to the sudden breakthrough from the bridgehead, it was not until approximately D + 78 that this station, and hence the entire Chain, finally became operative.

9. Planning on the basis of a slowly steadily advancing front from the bridgehead through France, a total of five other Gee Chains was tentatively planned, with the understanding that certain Chains might prove unnecessary if the front should suddenly move forward rapidly.

10. With the breakthrough at St. Lo and the collapse of all German resistance in Northern France and Belgium, the need for any of these five Chains became redundant with the exception of the last one. This Chain was radically revised and became known as the Reims Chain. Almost simultaneously another Gee Chain (the Louvain Chain) was planned primarily for the northern sector of the front (in the Lowlands) to give better cover over the Ruhr Valley. Because the battle had developed almost into a rout at this stage, all the prediction of sites was done by photo interpretation and maps.

11. The Reims Chain (Master, 'B' and 'C' Slaves), using heavy Gee mobile equipments eventually got on sites by 4th October, and became operational on the 5th, giving the coverage shown on Map No. 2. However, immediately thereafter the Master of this Chain caused intolerable interference to a Com-Z FM (AN/TRC-1) site in the immediate vicinity. This difficulty was finally resolved by turning off the Chain until October 11th while Com-Z found a new FM site outside the interference region. The 'D' Slave for this Chain became operational by 24th October. Gee lattice maps were not available, particularly in the base areas, for some considerable time because priority had been placed on map production for the Louvain Chain. As a result of the above-mentioned interference trouble, the policy used afterwards in establishing R.N.A. stations was that before installing any station at a particular location, the 60 Group

/unit....

unit charged with deploying these stations obtained technical clearance from the Army Group and Air Force in whose area the site was located.

12. The enemy eventually made a determined stand along the Moselle, the German - Belgium frontier, and in Southern Holland. As the 'B' Slave site planned for the Louvain Chain remained well within German-held territory, it became necessary to resite this Slave after nearly all of its maps had been produced. This revised Chain was known as the Ruhr Chain on the 19th October, and finally became operational on the 23rd October, using heavy equipment. Maps were produced on a high priority for this Chain while the Reims Chain (already operating) still had practically no charts available to the users. By the 2nd November, charts were finally available for the operational area of the Reims Chain, but even at this date, the charts for the base airfields in the Paris and Dijon sheets were not produced.

13. Through technical difficulties with the equipment on the 'B' Slave of the Ruhr Chain Air Ministry suggested closing down the Channel Chain to make the 'C' Slave station at Cherbourg available to replace this defective equipment. The Ninth Air Force objected to this as this Chain provided the only usable (charted) coverage in the base areas of Ninth Air Force. To resolve this difficulty Air Ministry suggested shipping a light mobile equipment from the U.K. to replace this Channel 'C' Slave while they moved the heavy Channel 'C' Slave up to the defective 'B' Slave of the Ruhr Chain. This procedure was agreed to by Air Staff, SHAEF, but unfortunately things did not work out as planned. Due to difficulties in shipping this replacement light mobile station to Cherbourg, the Channel Chain was missing its 'C' Slave, and hence provided only single "line-of-position" coverage (from the Master and 'B' Slave in the U.K.) for roughly the first half of November. This meant that there was no base area coverage for the Ninth Air Force until the 13th of November as the base area charts for the Reims Chain did not become available until the 18th November. On the same date, to eliminate breakthrough interference between the adjacent Ruhr (on 80·5 mc/s.) and the Reims (on 83·5 mc/s.) Chains, the frequencies were spread to 83·5 mc/s. and 74·5 mc/s. respectively.

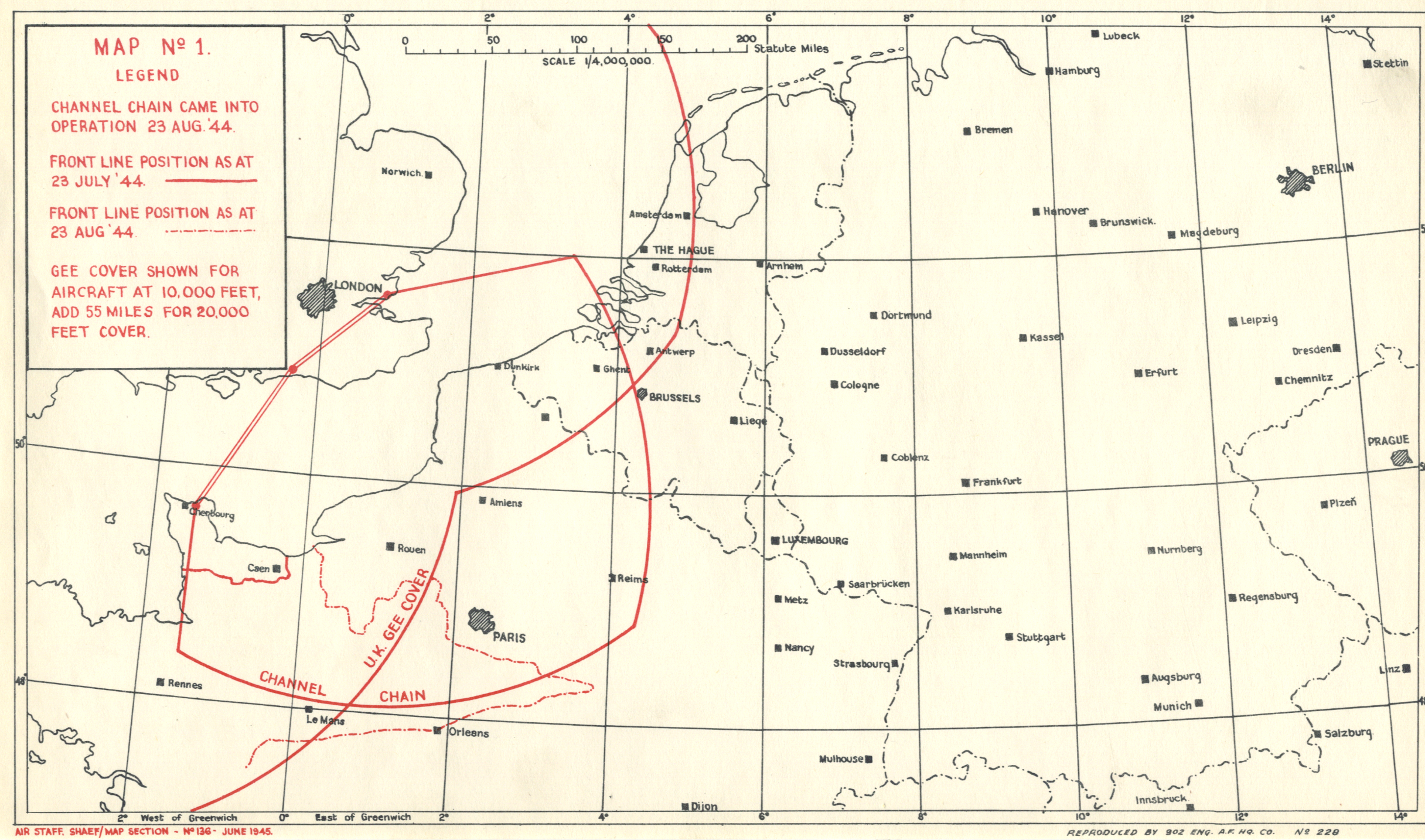
14. On 26th November, Air Staff, SHAEF finally agreed to shutting down the Channel Chain as it then did not contribute to the necessary continental coverage. The Chain actually went off the air on 2nd December. The 'C' Slave of this Chain was moved to the Brest peninsula (St. Nicholas) to work with another U.K. Chain (the South Western) to improve coverage for anti-U boat work to the South West of England. This Chain continued in operation throughout the remainder of the European war.

15. To meet an operational requirement of the Ninth Air Force, planning was started on 3rd December for a light mobile Chain called the "Saar Chain". The main function of this Chain was to provide low cover for night photo-reconnaissance aircraft working in the Saar Valley. Unfortunately the desired 'C' Slave site for this Chain was near Saverne on a hilltop already occupied by some XIIth TAC FM (AN/TRC-1) radio equipment. To effect compromise sites for both these equipments interference trials with Gee and AN/TRC-1 were made to determine exactly the interference problem involved. Field trials were finished in early January and results proved very helpful later on in siting Gee and FM equipments in the U.S. area. Interference results are shown on Figure 1.

Phase VI - 16th December to 7th February

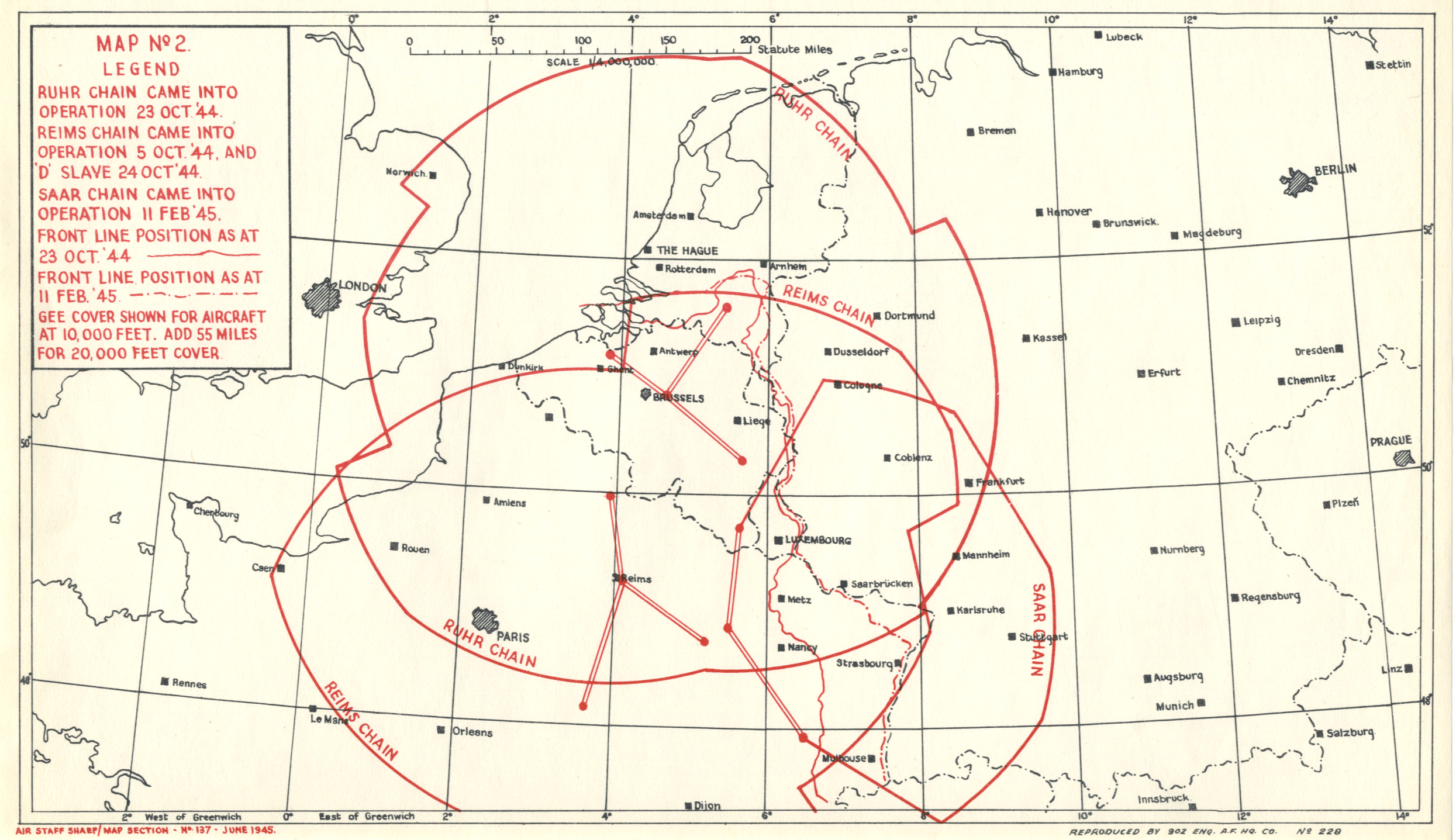
16. This period covered the enemy's offensives in the Ardennes and the Saar region. These offensives temporarily held the Saar Chain project in abeyance for more important work. This work was the

/forced....



AIR STAFF, SHAEF/MAP SECTION - Nº 136 - JUNE 1945.

REPRODUCED BY 902 ENG. A.F. HQ. CO. Nº 228



AIR STAFF SHAEF/MAP SECTION - Nº 137 - JUNE 1945.

REPRODUCED BY 902 ENG. A.F. HQ. CO. Nº 228

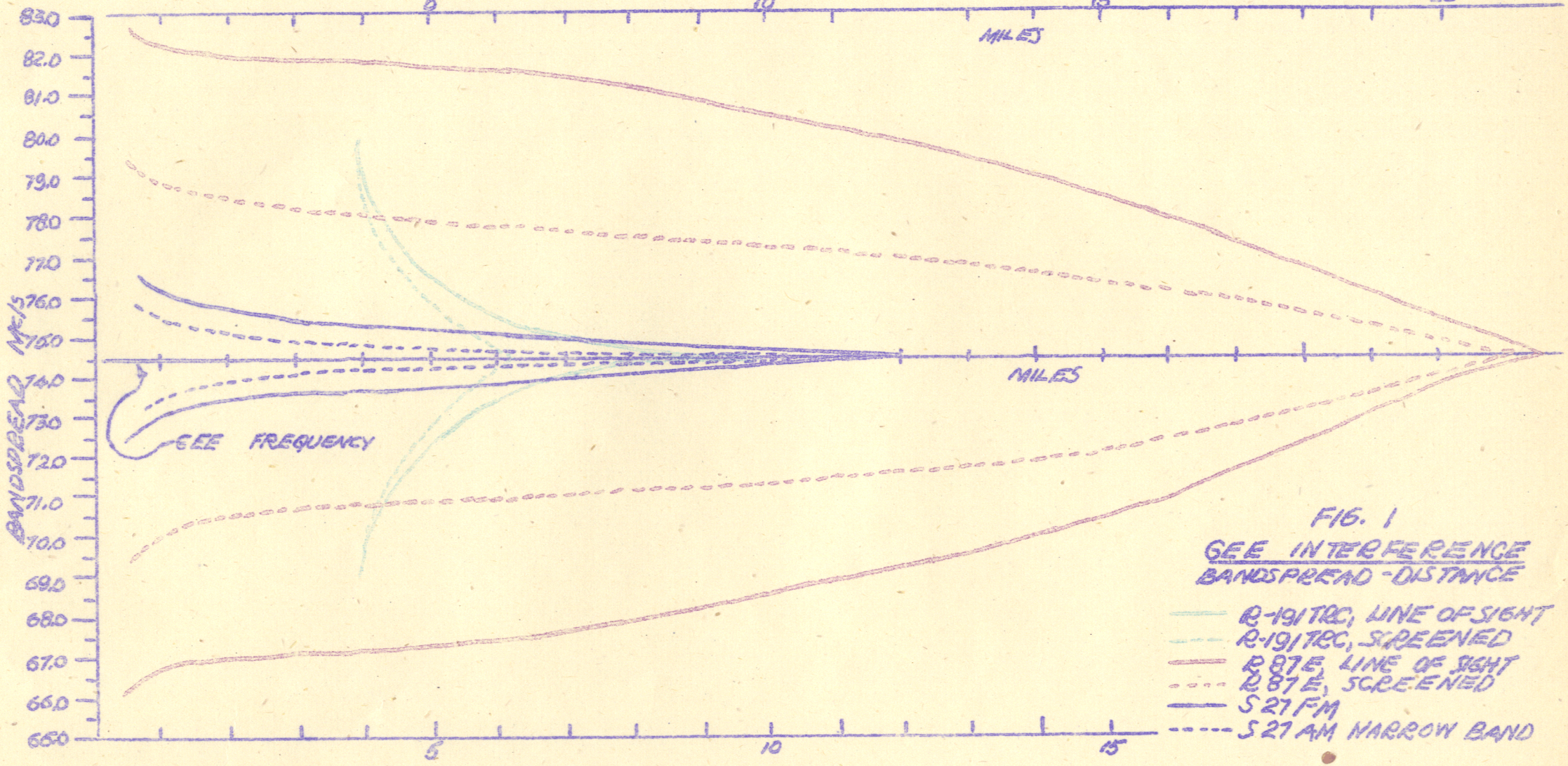


FIG. 1

GEE INTERFERENCE

BANDSPREAD - DISTANCE

forced withdrawal of the 'C' Slave of the Ruhr Chain from the La-Roche site in the Ardennes. An alternative 'C' Slave site was picked for this Chain on an old R.N.A. site at Florennes in Belgium, which fortunately had already been surveyed. The Chain was renamed the Cologne Chain, and lattice charts of the operational area in the Ardennes were produced on high priority and were available in the latter part of December. This improvised Chain proved invaluable for night photo work in the area of the enemy spearhead as well as for medium bomber work on communications centres immediately in their rear. The coverage provided by this Chain is shown by Map 3A.

17. When the enemy penetration was reduced, the former Ruhr Chain again came into operation on 20th January, 1945. The Cologne Chain then became redundant and was closed.

18. The first time that enemy jamming of Gee became serious enough to affect operations was on the 7th January. Methods most commonly then used to locate the jammers were:

(a) taking simultaneous phase readings on the jamming signal from the Gee ground stations;
(b) taking bearings from suitably sited ground stations and from A-J units;
(c) collecting Gee operator reports from the various Air Forces.

60 Group assumed the responsibility for co-ordinating all activity for determining location of enemy jammers and passing results on to Air Ministry. Air Ministry in turn checked these results with P/W interrogation results etc., then if a likely jammer site was found they would arrange for photo cover. Depending upon results of the photo cover, strike action would be arranged with the Tactical Air Forces or R.A.F. Fighter Command.

Phase VII - 8th February to 22nd March - Advance to the Rhine

19. In the months of February and March the general plan called for the Allied Armies to close up to the Rhine. The contribution required from the Air Forces was well summarised in the following extract taken from a subsequent SHAEF Press Release.

> "Prior to launching the attack it had been the task of the Allied Air Forces to weaken the enemy by breaking down his administrative organisation and interfering with his ability to move reinforcements into and within the battle area. This was achieved by a synchronisation of strategic and tactical air operations. The Eighth and Fifteenth U.S. Air Forces and R.A.F. Bomber Command undertook a carefully planned systematic series of heavy attacks on targets designed to immobilize and prevent the reinforcement of the German Armies, whilst Second Tactical Air Force in the North, Ninth U.S. Air Forces in the centre, and First Tactical Air Force in the South, kept up unremitting medium bomber and fighter bomber attacks against all movement in the battle area and the bridge and rail systems behind it.
>
> The transportation plan involving the employment of all air forces in the destruction of railway centres, railway facilities, bridges, rolling stock and locomotives, was intensified. The oil battle continued unabated, and, at

the last moment, heavy attacks were made on the fortified areas and communications centres such as GOCH and CLEVE in the immediate battle areas."

To meet these operational requirements the following Gee Chains were operating: - Reims, Ruhr, Metz, and Munster - giving the coverage as shown in Map No. 3.

20. On 14th February, the Saar Chain became fully operational using light transportable equipment operating on 50·5 mc/s., a frequency in Band II which had so far not been pulse-jammed by the enemy.

21. In the middle of the month a second clash of interests occurred in connection with the Saverne site. This site had been abandoned for use as part of the Saar Chain but was now required for the Southern Slave of a new Chain - to be known as the Metz Chain which was being planned as a result of the advance of Twelfth and Sixth Army Groups towards the Rhine. Saverne had become the critical point on the First TACAF/6th Army Group axis of communications, and was therefore planned to be used in connection with future operations, as a cable termination point on one of the main trunk routes. With VHF installations on the Saverne site, First TACAF were not anxious to release the site for the Gee Chain. Air Staff, SHAEF asked them to re-consider their decision as this new Chain would provide an additional 100 miles of cover towards the east. In view of this, First TACAF and Sixth Army Group agreed to look for alternative sites. On the 10th March alternative sites for their VHF equipment had been found, so that the Saverne site could be cleared for the C-Slave of the Metz Chain after 15th March.

22. As a result of the clearance, the Metz Chain became operational using light equipment on the 21st March, and its D-Slave became operational three days later. At this stage it was decided to release the heavy equipment from the Reims Chain for use on the Metz Chain which was now of greater importance.

23. The difficulties with the Saverne site provide a good illustration of the difficulties which were to arise for the remainder of the campaign through the rival claims of the communications and radar equipment for the tops of hills which were accessible and well situated tactically. In this case there was a delay of a month before the site was cleared.

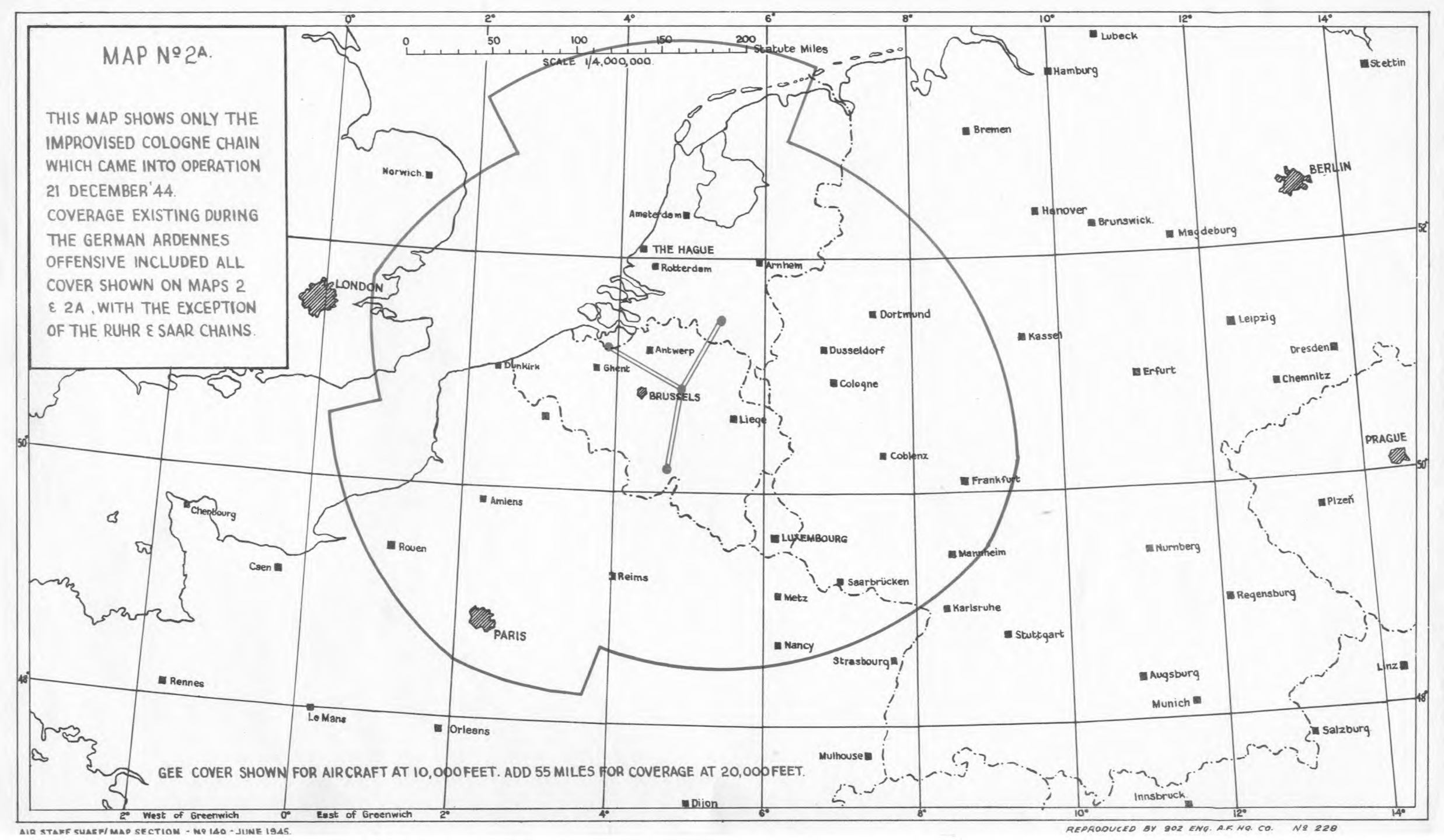
24. Pulse jamming by the enemy on Band III which had started on January 7th, reached a climax of intensity on 2nd March. On this date Bomber Command attacked Cologne and only their most experienced operators were able to make any use of Gee. As a result of investigations by 60 Group during the second half of February, the principal source of jamming had been found to be pre-war television station on the Feldburg (near Frankfurt-am-Main). XIXth TAC fighter-bombers carried out a successful attack on the jamming station which blew the upper three floors off the television building. Henceforward no further trouble was encountered from this site.

25. Some delay had occurred between the fixing of the jamming site by 72 Wing, the photographic reconnaissance, the interpretation of the photographs by Air Ministry, and the resultant strike action taken. It was therefore decided that henceforward photographic cover would be undertaken by U.K. based squadrons, and the photographs would be sent direct to Air Ministry (A.D.I. Science) for immediate interpretation. It was stressed to A.D.I. Science that speed of remedial action was essential, and that it was not necessary to be absolutely positive about the site

/of....

MAP Nº 2A.

THIS MAP SHOWS ONLY THE IMPROVISED COLOGNE CHAIN WHICH CAME INTO OPERATION 21 DECEMBER '44.
COVERAGE EXISTING DURING THE GERMAN ARDENNES OFFENSIVE INCLUDED ALL COVER SHOWN ON MAPS 2 & 2A, WITH THE EXCEPTION OF THE RUHR & SAAR CHAINS.



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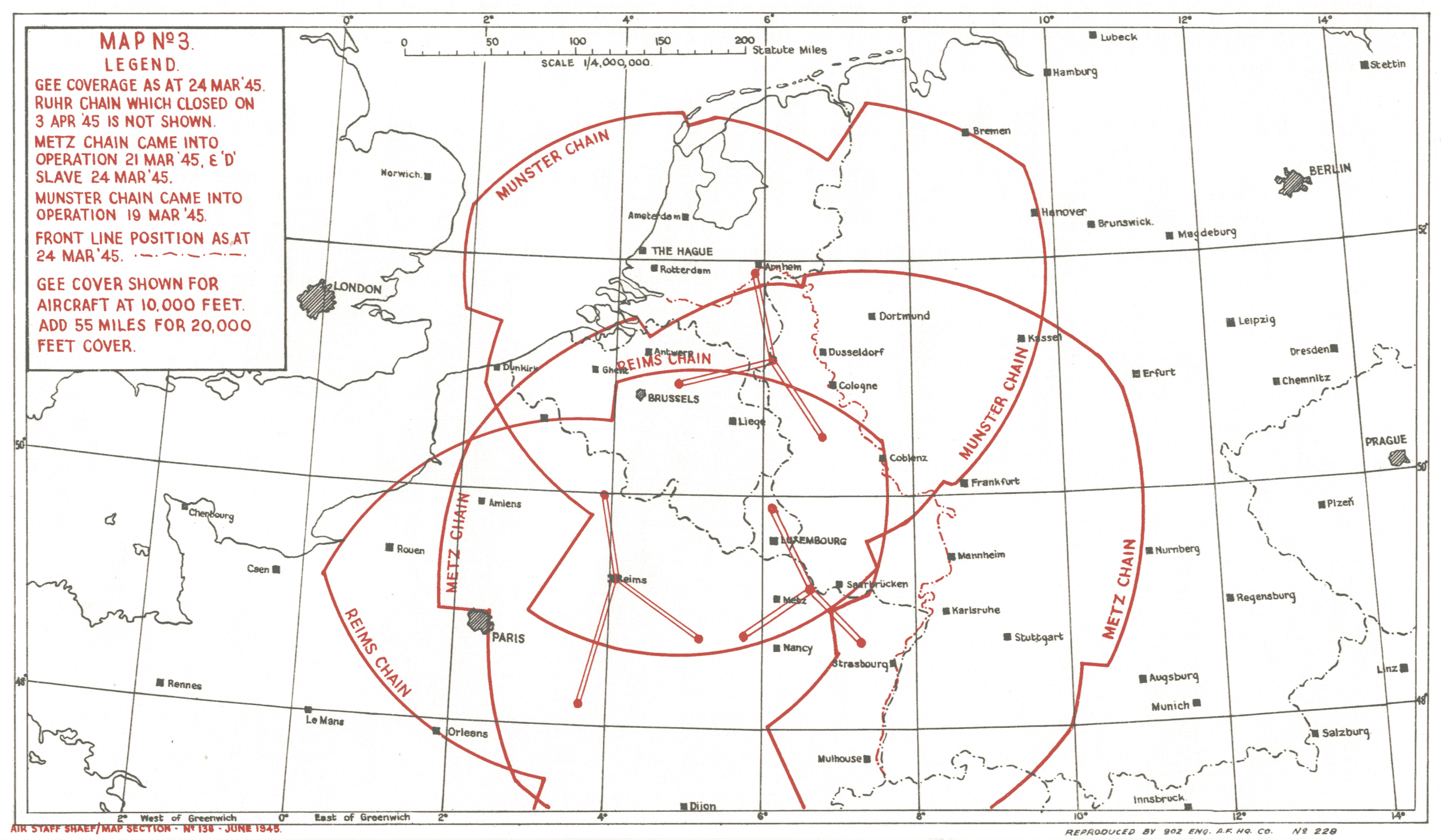

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of a jammer as sufficient strike effort was then available to attack sites classified only as "suspicious".

26. Some spurious pulses of varying degrees of intensity were encountered throughout the rest of the month, which it was believed came from a jammer at Ludenschied near Cologne. In this case greater difficulty was met in fixing accurately the jamming site, as the signals, although strongly received by aircraft, were poorly received by 72 Wing's ground stations. Air Staff, SHAEF therefore arranged with USSTAF for a "Ferret" aircraft to be made available to 60 Group on request, for airborne investigations.

27. Early in March, 2nd T.A.F. stated that they had an operational requirement for a Gee Chain to provide low cover for their intruder Mosquitoes in the Munster area. After some consideration it was agreed that a Munster Chain would meet the general operational requirement of all Air Forces for improved Gee cover to the North-East of the Ruhr, and would provide best possible Gee cover for operation "VARSITY II", which was an airborne operation planned to secure a bridgehead across the Rhine at Wesel.

28. On 11th March, a meeting was called at SHAEF, at which the Air Ministry and 60 Group were represented to consider the R.N.A. plans for the remaining stages of OVERLORD and subsequent stages of ECLIPSE. The Gee plans drawn up at this meeting are given at "Radar Figure 2". These plans had to be considerably altered as will be seen later.

29. The Munster Chain became operational on light mobiles on the 19th March and VARSITY II was launched on 24th March. The weather was ideal so that little difficulty was encountered with navigation, and the majority of the glider-towing aircraft used the Ruhr Chain with which all operators were familiar rather than the new Munster Chain, charts for which had only become available two days previously.

Phase VIII - 22nd March to 1st April

30. During this phase First U.S. Army broke out from the Remagen bridgehead, and the Third U.S. Army crossed the Rhine at Worms proceeding to encircle the Ruhr from the South. The airborne crossing of the Rhine at Wesel took place on March 24th, and British and American forces started to outflank the Ruhr from the North. These two forces completed the encirclement of the Rhur when they met on the 1st April. Meanwhile, British and U.S. Forces had been advancing to the North East and East respectively.

31. Coverage which existed on 24th March is shown at Map No. 3. The Ruhr Chain coverage is not included in order to avoid confusion, but this Chain did in fact remain in operation until 3rd April as some of 2nd T.A.F.'s squadrons did not receive the Munster Chain maps until 2nd April.

Phase IX - 2nd April to 18th April

32. During this period the armies advanced to the Elbe and eliminated the Ruhr pocket. It had been planned at the conference on 11th March to put in a Frankfurt Chain, just to the west of the Rhine, but because the advance was so rapid it was decided to send the siting parties straight to the proposed Kassel and Munich Chain sites. Unfortunately, two of the sites (the Bad Homberg and Willengen sites) were required for the VHF-FM communications of Twelfth Army Group, who stated that they could not give clearance for any new stations

/operating....

operating within 5 mc/s. of the band 70 - 100 mc/s. In order to explain the Air Forces' viewpoint, and to effect a compromise, a conference was called on the 12th April at SHAEF with Air Staff and Twelfth Army Group represented. Clearance was obtained to operate the Master of the Munich Chain on 50·5 mc/s. at Bad Homberg immediately. (This Chain actually came into operation on the 15th April). It was agreed that this site should not be used for the 83·5 mc/s. 'D' Slave station of the Kassel Chain until 15th April, by which time the Army VHF units would have found an alternative site. Twelfth Army Group cleared the Willengen site (Kassel Master) for operation after 17th April, on which date the Kassel Chain came into operation. The Chief Signal Officer, SHAEF agreed at this conference to give the Air Forces priority in an area one mile around sites specified in the R.N.A. OVERLORD/ECLIPSE Plan, but if the sites were changed, this priority would not automatically cover any such revisions. It was, therefore, decided to submit all planned sites to the Signal Division, SHAEF so that they could obtain prior reservation from the Army Groups and Armies. This plan appeared satisfactory, but further difficulties were experienced, examples of which are tabulated below:

(a) When a ground survey took place it was sometimes found that the sites within a mile of the reserved pinpoint were either unsuitable technically or inaccessible. An example occurred at Fulda which was required for the D-Slave of the re-orientated Nurnberg Chain, and the 'B' Slave of the Munich Chain.

(b) A re-site of several stations sometimes became necessary as a result of a change in the direction of attack. An example occurred when the planned Nurnberg Chain had to be re-orientated to provide better cover Southwards.

(c) A requirement arose for a new Chain as a result of unpredicted delay in the advance. Under these circumstances no sites had, of course, been reserved. An example of this occurred when the need arose for a Bremen Chain.

(d) A re-site of one of the stations was sometimes necessary due to the enemy occupation of one of the sites required. An example occurred for the site selected for the 'B' Slave of the Bremen Chain.

33. As the line advanced deeper into Germany organised jamming of the Gee frequencies came to an end. One of the last reported cases of jamming was during Bomber Command's raid by 970 aircraft on Heligoland on 18th April, when the Munster Chain was quite unreadable near the target.

Phase X - 19th April to V-E Day (8th May)

34. This phase covered the junction with the Soviet Forces and the final mopping up. On the 18th April, a meeting was called with 60 Group, as Air Staff, SHAEF (A-3) had stated an operational requirement for Gee cover over the Austrian Redoubt, where resistance was expected. At this conference it was decided:

(a) to re-orientate the Nurnberg Chain;
(b) to survey for a Bremen Chain to cover possible operations against Denmark, and

/(c) to....

(c) to plan a Jutland Chain which would provide cover over Southern Norway, the Skaggerak and the Kattegat.

35. On 22nd April, ANCXF (Allied Naval Commander of the Expeditionary Forces) warned Air Staff, SHAEF that they would probably be submitting an operational requirement for a Gee Chain to provide sea cover off Northern Denmark. This Chain would be required for their planned minesweeping operations, and this requirement was borne in mind when making plans for the Jutland Chain, but never in fact arose owing to the capitulation.

36. The new Munich Chain was giving good results as shown by the reception obtained at a range of 275 miles on 2nd May, when R.A.F. Bomber Command attacked Berchtesgarten. On 6th May it was decided to close down the Metz Chain which had become redundant since the installation of the Munich Chain. The Munster Chain using the heavy equipment gave ranges of 300 miles for Bomber Command Mosquitoes, and 220 miles for their Main Force aircraft which flew at lower altitudes. The overall Gee coverage as at 1st May is shown by Map No. 4.

37. Early in May a clash of interests arose over the site for the 'D' Slave of the Nurnberg Chain at Fulda where Sixth Army Group, and later the Advanced Section of Com-Z had VHF-FM equipment. It was not desirable to operate the Nurnberg Chain on 68·5 mc/s. as this produced strong second channel interference on 83·5 mc/s. which was being used by the Kassel Chain. As Com-Z could not agree to operation within the 70 - 100 mc/s. band, it was decided, late in May, to use 65·5 mc/s. as the Gee frequency. Owing to these difficulties the Nurnberg Chain did not come into operation until 26th May.

38. The final Gee layout as proposed at the end of May is given in Map No. 5. At this stage the operational requirements had somewhat changed, Gee being required to:

(a) serve the occupational Air Forces, and
(b) aid transport aircraft operating in Europe.

DEVELOPMENT OF RADAR NAVIGATIONAL AIDS (SHORAN)

39. Shortly after the formation of First Tactical Air Force (Prov.), the lack of any navigational or precision bombing aid in the 42nd Medium Bomb Wing of that Air Force became a matter of primary importance, particularly in view of the approaching winter and bad flying conditions. Rumours of the development and production of SHORAN equipment in the U.S. reached their ears via the Mediterranean Theatre which had a few preproduction models installed. By the 11th November, the First Tactical Air Force had decided on their requirements for SHORAN on a basis of three aircraft fitted per squadron and a total of six ground beacons.

40. Ninth Air Force, attracted by certain inherent advantages of SHORAN over their OBOE system also set up a programme by 11th December.

41. Both the above programmes went to USSTAF for supply action and immediately the question arose as to which Air Force should have priority on delivery. This was decided between USSTAF and Air Staff SHAEF in favour of First TACAF in view of their total lack of electronic bombing and navigational aids.

42. Along with this there appeared suddenly a requirement for

/frequency....

frequency allocations for the various systems. These requests for frequencies were made prior to obtaining any equipment, with little knowledge of production equipments, and with no knowledge of possible interference between adjacent or overlapping systems. Therefore, the allocations, when made, were really only guesses. They were sent to the respective Air Forces on 7th January. As it later turned out, the production sets had peculiar frequency characteristics, i.e., only certain pairs of air-to-ground frequencies would work from the APN-3 transmitter (T-11/APN-3). Ninth Air Force frequencies turned out to be completely unusable while First TACAF frequencies worked perfectly. This situation resulted in tests being run by First TACAF. The characteristics of the sets were finally determined by these tests and became available on 21st April. The attached chart summarises these characteristics and should prove valuable to any headquarters responsible for allocating frequencies to several SHORAN systems in the same general area.

43. Equipment began to arrive from the U.S. in the latter part of January. First TACAF set up a training system for operators, mechanics, and complete bomber-crews in the South of France. Their operational missions started in earnest in March, and the Ninth Air Force on a small scale in early April.

44. In the latter part of March, information was received that both RAF Bomber Command and the U.S. Eighth Air Force were scheduled to get a certain amount of SHORAN airborne equipments. They then put the question to Air Staff, SHAEF of sharing the tactical SHORAN beacons belonging to the Ninth and First Tactical Air Forces. To settle this problem, and to outline a workable procedure for sharing these beacons, a meeting of representatives from all interested headquarters was held under the chairmanship of the Chief Air Signal Officer. A procedure was evolved (see attached letter - Radar Figure 3), which was satisfactory to all and still left the owners of the beacons the power to move them and operate them primarily in accordance with their own requirements. However, this procedure was only issued one month prior to the termination of hostilities, and the only "sharing" that actually took place was that between the Ninth and First Tactical Air Forces.

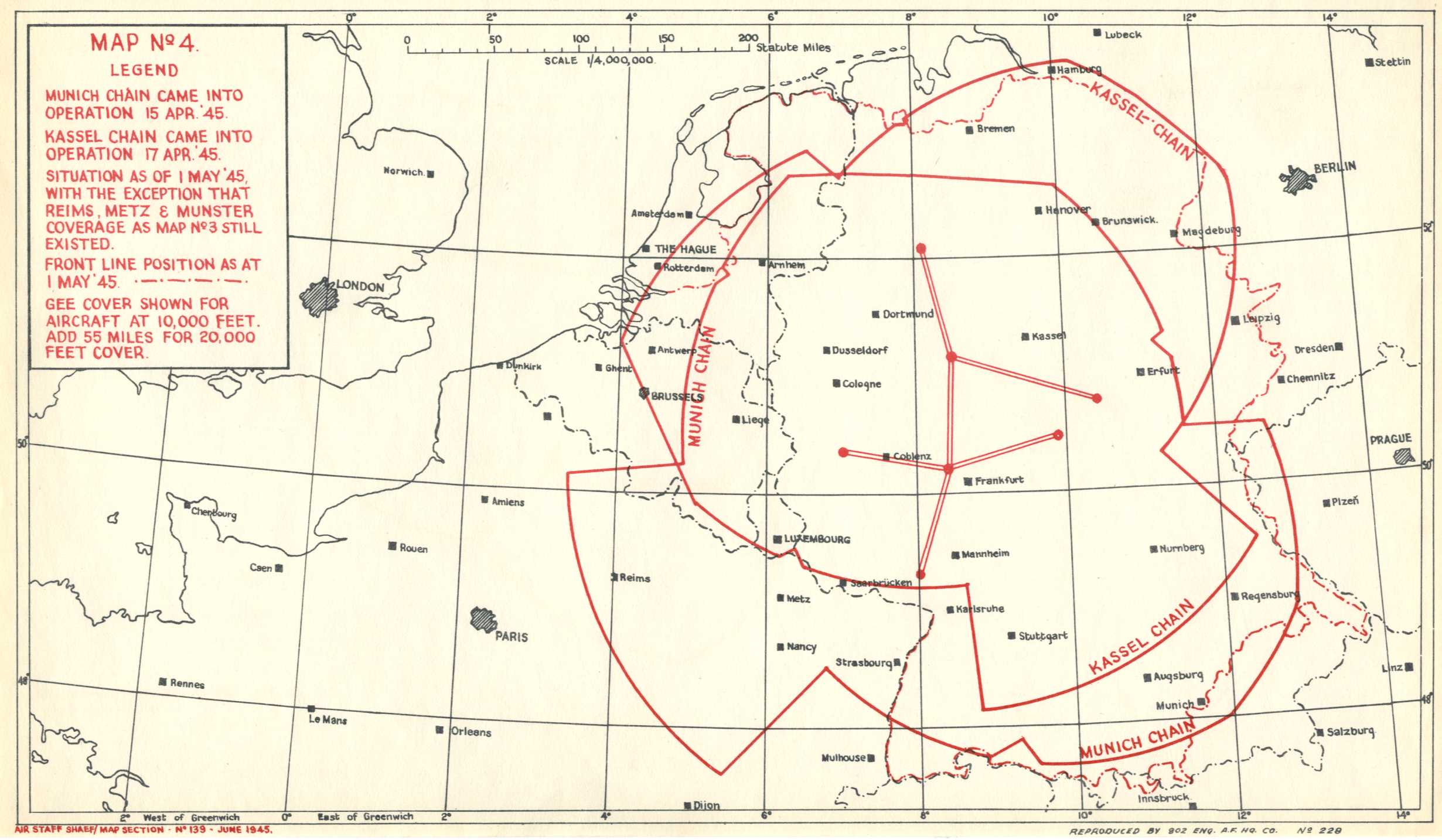
45. Results obtained from SHORAN bombing in this theatre were very satisfactory. It is only regrettable that the system could not have been available sooner to the Tactical Air Forces. The outstanding advantage of SHORAN over G-H and Oboe systems for blind bombing is the high mobility of the ground stations, and the simplicity of the system as a whole. Under conditions of harassing a retreating enemy, these advantages became paramount. Therefore, had it been available to the Ninth Air Force during and after the breakthrough from St. Lo, it is considered that many additional blind bombing missions against the enemy, could have been run to great advantage.

DEVELOPMENT OF RADAR NAVIGATIONAL AIDS (G-H)

46. G-H was used by R.A.F. Bomber Command, Eighth Air Force, and medium bombers of the Second Tactical Air Force. It was later introduced on a relatively small scale, into R.A.F. 38 Group for Troop Carrier, Pathfinder, and Precision-Supply-Dropping work. To meet the G-H requirements of these forces three heavy mobile units had been formed in the Spring of 1944 and two of these were in use in the U.K. for D-Day cover.

47. The first G-H station planned for the continent was to be sited near Cherbourg on D + 45. Shipping difficulties arose, and the station did not come into operation until D + 75.

/48....


MAP Nº 4.
LEGEND
MUNICH CHAIN CAME INTO OPERATION 15 APR. '45.
KASSEL CHAIN CAME INTO OPERATION 17 APR. '45.
SITUATION AS OF 1 MAY '45, WITH THE EXCEPTION THAT REIMS, METZ & MUNSTER COVERAGE AS MAP Nº 3 STILL EXISTED.
FRONT LINE POSITION AS AT 1 MAY '45.
GEE COVER SHOWN FOR AIRCRAFT AT 10,000 FEET. ADD 55 MILES FOR 20,000 FEET COVER.
SCALE 1/4,000,000.
0 50 100 150 200 Statute Miles
KASSEL CHAIN
MUNICH CHAIN
KASSEL CHAIN
MUNICH CHAIN
LONDON
Norwich
Amsterdam
THE HAGUE
Rotterdam
Arnhem
Dunkirk
Ghent
Antwerp
BRUSSELS
Liege
Amiens
Cherbourg
Caen
Rouen
Reims
PARIS
Rennes
Le Mans
Orleans
Dijon
LUXEMBOURG
Metz
Nancy
Strasbourg
Mulhouse
Saarbrücken
Coblenz
Frankfurt
Mannheim
Karlsruhe
Stuttgart
Dortmund
Dusseldorf
Cologne
Kassel
Hamburg
Bremen
Hanover
Brunswick
Magdeburg
Lubeck
Stettin
BERLIN
Leipzig
Dresden
Chemnitz
Erfurt
PRAGUE
Plzeň
Nurnberg
Regensburg
Augsburg
Munich
Innsbruck
Salzburg
Linz
2° West of Greenwich
0° East of Greenwich
2°
4°
6°
8°
10°
12°
14°
50°
48°
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SECRET

MAP Nº5

PROPOSED GEE CHAINS AND THEIR COVERAGE FOR THE POST-HOSTILITIES PERIOD.

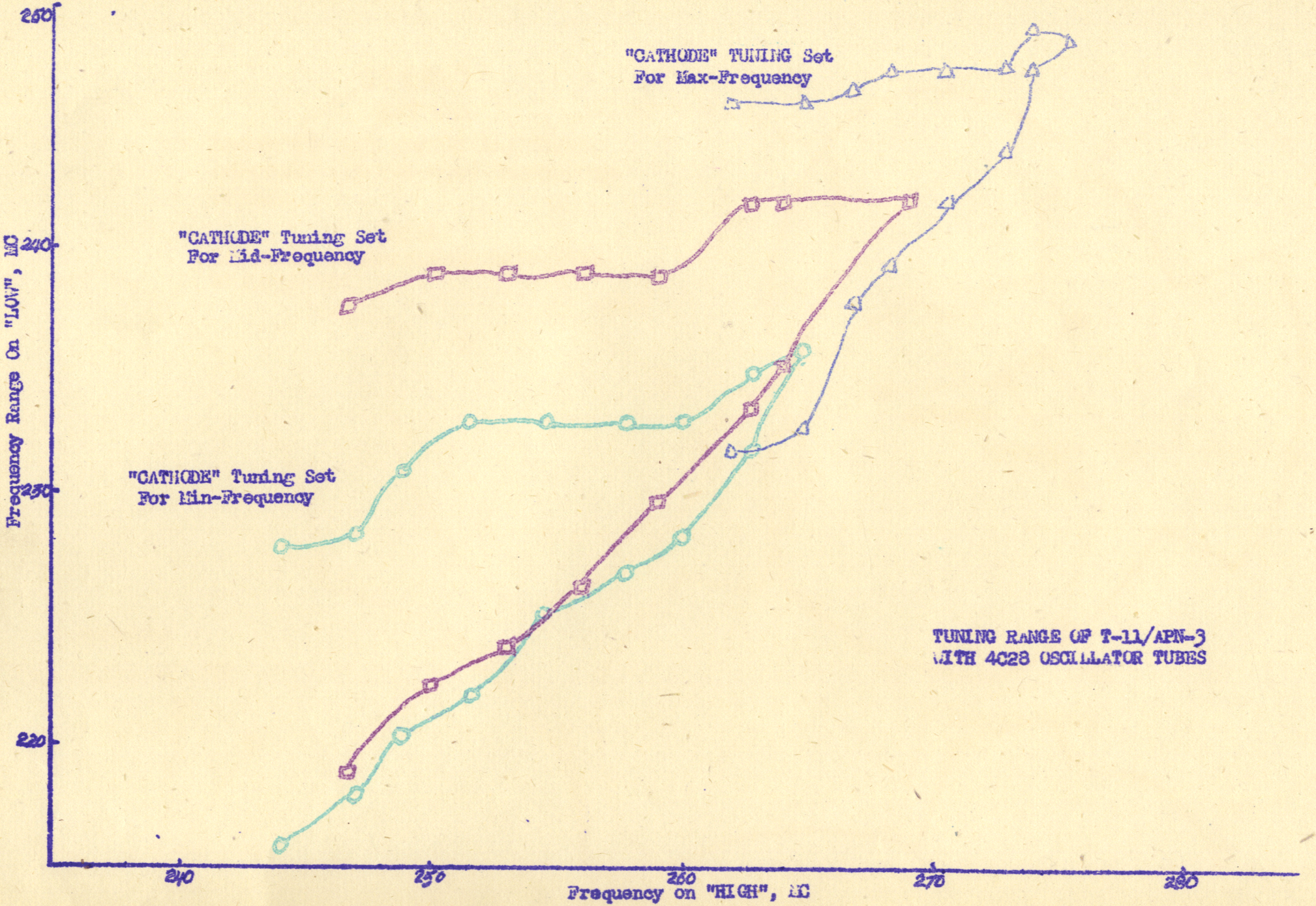
NOTE.
COVERAGE SHOWN FOR AIRCRAFT FLYING AT 5.000 FEET.

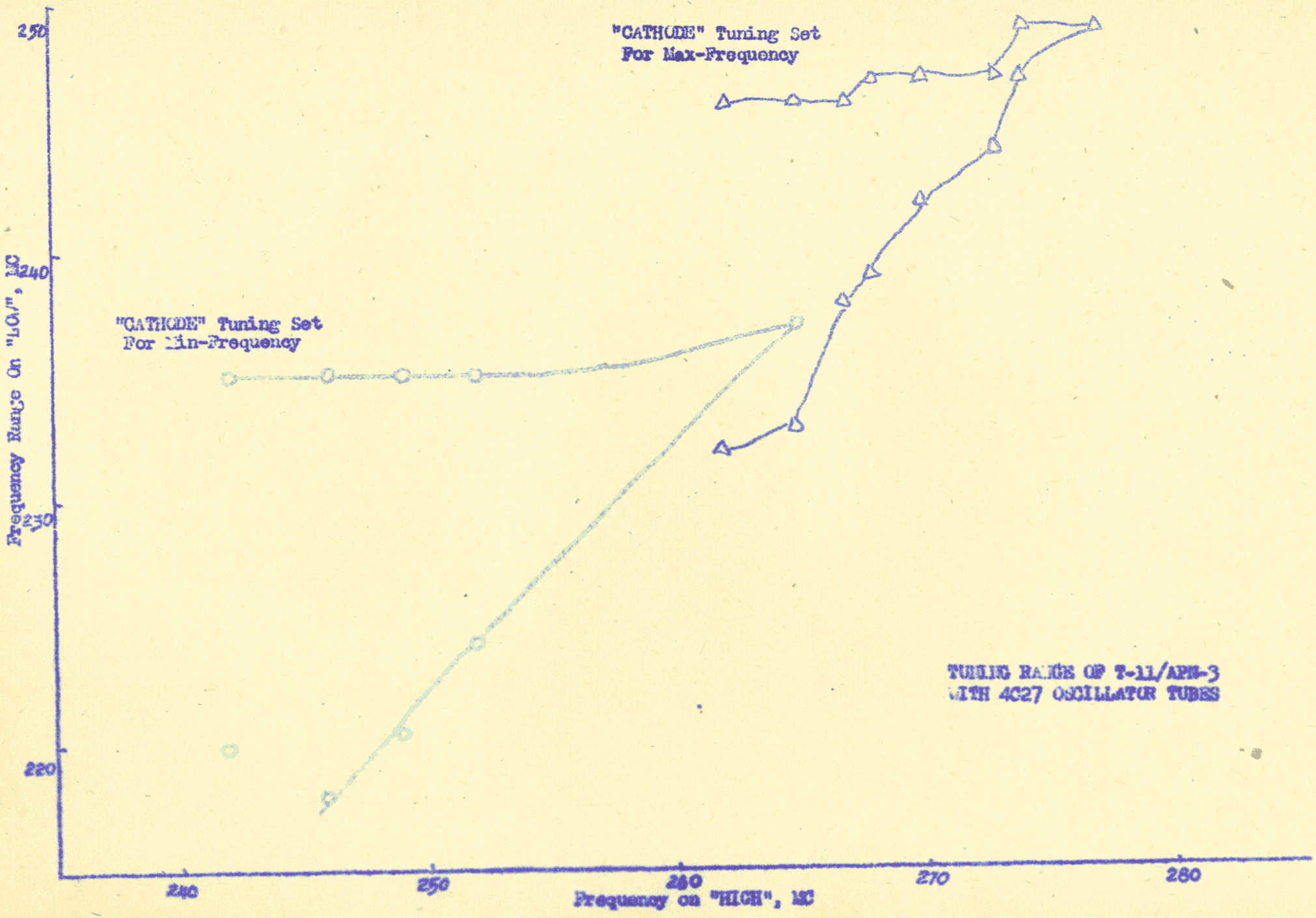
JUTLAND
EASTERN
SOUTHERN
REVISED KASSEL
NURNBERG
PARIS
CARCASSONNE-RHONE

Christiansand, Göteborg, Jönköping, Aberdeen, Aalborg, Karlskrona, Edinburgh, Newcastle, Flensburg, Kiel, Rostock, Lubeck, Stettin, Liverpool, Sheffield, Hamburg, Groningen, Bremen, Wittenberge, Birmingham, Norwich, BERLIN, Amsterdam, Hanover, Brunswick, Magdeburg, THE HAGUE, Rotterdam, Arnhem, Münster, Bristol, LONDON, Dortmund, Halle, Leipzig, Kassel, Dresden, Antwerp, Dusseldorf, Erfurt, Chemnitz, Calais, Ghent, Cologne, BRUSSELS, Liege, Lille, Coblenz, Frankfurt, Cheb, PRAGUE, Dieppe, Amiens, Cherbourg, Le Havre, LUXEMBOURG, Mannheim, Nurnberg, Rouen, Caen, Reims, Metz, Regensburg, Karlsruhe, PARIS, Nancy, Stuttgart, Strasbourg, Augsburg, Munich, Salzburg, Rennes, Le Mans, Orleans, Troyes, Mulhouse, Konstanz, Nantes, Tours, Dijon, Zurich, Innsbruck, Besançon, Villach, Bourges, BERNE, Chalon-s-Saone, Bolzano, Poitiers, Lausanne, Montluçon, Geneva, Roanne, Limoges, Lyons, Milan, Padua, Angouleme, St. Etienne, Turin, Ferrara, Bordeaux, Bologna, Ravenna, Genoa, Florence, Avignon, Pisa, Leghorn, Nice, Bayonne, Toulouse, Marseilles, Toulon, Bastia, Saragossa, Barcelona, ROME

0 50 100 150 200 250 300 350 400 Statute Miles
SCALE : 1/4,000,000.

AIR STAFF SHAEF/MAP SECTION - Nº 141 - JUNE 1945.
1:5/JUN 45/13 MRS/881


"CATHODE" TUNING Set
For Max-Frequency
"CATHODE" Tuning Set
For Mid-Frequency
"CATHODE" Tuning Set
For Min-Frequency
TUNING RANGE OF T-11/APN-3
WITH 4C28 OSCILLATOR TUBES
Frequency Range On "LOW", MC
250
240
230
220
240
250
260
270
280
Frequency on "HIGH", MC


"CATHODE" Tuning Set
For Max-Frequency
"CATHODE" Tuning Set
For Min-Frequency
TUNING RANGE OF T-11/APN-3
WITH 4C27 OSCILLATOR TUBES
Frequency Range On "LO", MC
250
240
230
220
240
250
260
270
280
Frequency on "HIGH", MC

48. By the 4th of August, Air Ministry had completed plans for deploying G-H stations on the continent up to D + 330. These plans called for a total of three G-H stations to be installed on the continent, but as they were based on the slow steadily advancing front predicted in the overall "OVERLORD" plan, the total quantities proved insufficient, as the battle progressed, and three more heavy mobiles were formed to satisfy requirements. All six units were on the continent by December, 1944, and by early 1945, these six heavy mobile (really transportable) G-H stations were deployed for all users. In addition to the heavy mobiles some twenty-seven light mobile units were allotted for continental use to be used for either Gee or G-H. When used for the latter they saturated with 20 interrogating aircraft as compared with 80 for heavy G-H stations.

49. On 3rd September, R.A.F. Second Tactical Air Force requested that four light mobile G-H stations be assigned directly to their headquarters for operational control. (This differed from the normal arrangement where the stations were installed, operated, and under the direct operational control of R.A.F. 60 Group). This request was based on the lack of G-H cover over targets in the Second Tactical Air Force area, during the German withdrawal from France and Belgium. It was granted and the required four stations were deployed by 72 Wing of R.A.F. 60 Group under the direction of Second Tactical Air Force. It later developed that these stations were not greatly used in this role as the war of movement, except for the final stage, was over.

50. Air Staff, SHAEF took only a minor part in the planning of G-H on the continent, as it was primarily a Strategic Air Force Aid. This was particularly true after Second T.A.F. controlled their own system, for they were the only continental users. Air Staff, SHAEF was kept informed of the location of all sites for these stations on the continent, however, in order to aid in the solution of any mutual-interference problems that might arise. As an example of the deployment of G-H stations on the continent, the following locations are given as of March 24th, 1945, just as the Allies crossed the Rhine.

	No.	Identification.	Location.	Latitude.	Longitude.
Common User	114	No blinks	LaRoche	50-15'N	05-45'E
	115	1 blink	Boekel	51-36'N	05-43'E
	116	2 blinks	Kempenich	50-23'N	07-04'E
	117	3 blinks	St.Avold	49-09'N	06-36'E
	118	4 blinks	St.Nicholas	51-08'N	04-16'E
	119	6 blinks	Croix	47-27'N	06-57'E
2nd TAF.	109	1 kick	Roermond	51-14'N	05-49'E
	110	2 kicks	Boom	51-06'N	04-27'E
	121	3 kicks	Tilberg	51-31'N	04-58'E

51. In the fall of 1944, the quantity of G-H equipped aircraft became so great that, with the limited interrogation-handling capacities of the ground stations, it became necessary to co-ordinate all G-H operations in the theatre. This was necessary to prevent G-H missions becoming abortive due to "saturated" conditions of the ground beacons. The co-ordination was effected by R.A.F. 60 Group. A priority system between the various Air Forces and Commands was set up for day and night operation so that congestion could be resolved in relation to the importance of their operational roles.

/52....

52. An analysis of the overall G-H results during the period is not available but some interesting figures concerning its use by a Tactical Air Force have been received from 2nd T.A.F. for the month of March, 1945. The results concern the Mitchells and Bostons of No. 2 Group of 2nd T.A.F., the attacks being made from between 11,000 and 14,000 feet. 263 boxes (1578 aircraft) were detailed for G-H attacks; 52% bombed on G-H, 45% were able to bomb visually, 1% were abortive. An analysis of representative attacks against area targets shows that 63% of the bombs fell within 500 yards.

53. It should be noted that G-H stations transmitting on 65.5 mc/s., were as much a source of trouble in arranging for installation and operation at a particular location as were the Gee stations. The reason for this was that their frequency interfered badly with AN/TRC-1 and VHF air-to-ground equipment. In one particular location, a G-H station made an entire Fighter Control Center inoperative by jamming all important VHF control channels.

DEVELOPMENT OF RADAR NAVIGATIONAL AIDS (OBOE)

54. Oboe was used during the period covered by this report by No. 8 Group, Pathfinder Force, R.A.F. Bomber Command and the Pathfinder Squadron (Prov.) in the 9th Bomb. Division (M) of Ninth Air Force.

55. Initial plans for extension of Oboe coverage over the continent envisaged establishing two stations (two channels available at each), each of which would pair up with its corresponding station in the U.K. The Oboe technique requires continuous voice contact between the Controllers at "Cat" and "Mouse" stations during operations, This placed a heavy requirement on cross-channel communications. Neither AEAF nor SHAEF could provide these facilities from the small amount of circuits which existed at that time.

56. Finally by the 23rd August, Air Ministry realised the folly of:

(a) mobile Oboe stations depending only on landlines, and
(b) having "Oboe Pairs" separated by the English Channel.

Therefore, AEAF was asked for and provided certain radio equipment and frequencies enabling nets to be set up for the control of Oboe missions. This made Oboe installations less dependent on landlines for operation, although the efficiency of the system using radio channels was much lower than that of the same system using landlines.

57. By 26th August, an Air Ministry plan for the deployment of the first continental Oboe pair appeared, comprising one station in the vicinity of Paris, with the other station in an area 70 - 100 miles southeast of Paris. This plan was finally implemented, as a result of which:

(a) A two-channel station was set up at Florennes in Belgium, and was operating by 17th September.
(b) The second two-channel station came into operation at Commercy, France, on 25th September.

The buildup of continental stations continued until finally there were six Oboe stations distributed from Holland to the French-Swiss border with four channels available at each station. As an example of the deployment of Oboe stations on the continent, the following locations are given as of 24th March, 1945, just as the Allies crossed the Rhine.

/Ctd....

No.	Channels	Site	Latitude	Longitude
1	11B,11C,12A,13A	Molsheim	48-33'N	07-28'E
2	11B,11C,12,13A	La Roche	50-15'N	05-45'E
3	11B,11C,12,13A	Kempenich	50-23'N	07-04'E
4	11B,11C,12,13A	Commercy	48-42'N	05-31'E
5	11B,11C,12,13A	Rips	51-32'N	05-50'E
6	11B,11C,13A	Tilberg	51-31'N	04-58'E

58. In order to show the extent to which Oboe was used during "OVERLORD" there is given below a summary of sorties run by No. 8 Group (R.A.F.) and Pathfinder Group (Prov.) (U.S.) from December, 1944 to March, 1945, using continental Oboe stations only.

Organisation	Dec.	Jan.	Feb.	March.	April.
R.A.F. 8 Group	72	158	336	364	537
✱ % Oboe successes	52%	66%	60%	65%	71%
9th Bomb Division (M)	146	119	195	471	107
✱ % Oboe successes	47%	52%	57%	72%	64%

✱ Note that percentage of Oboe successes does not take into account missions abortive for non-Oboe reasons, i.e. when formation bombed visually, when missions were cancelled, etc. It is only a measure of correct functioning of the Oboe system.

59. The percentage of sortie failures due to interference increased tremendously (100%) in March, 1945. There was reason to believe initially, that this "interference" might be due to some of our own centimetre ground radar stations. However, after an investigation was made of operating frequencies of our centimetre ground and airborne equipments, this possibility was virtually eliminated. Furthermore, the form of the interference indicated the probability that it was caused by some form of enemy operated transponder beacons operating on Oboe frequencies. Interrogation of Luftwaffe Staff Officers after the surrender substantiated earlier intelligence reports that the enemy maintained an extensive organisation near the Ruhr Valley, the sole function of which was the jamming of our Oboe or "BUMERANG" as they called it. It also appeared later that the enemy gained considerable advance warning of our Oboe missions by monitoring the Oboe H/F control nets.

60. Based on information gained since the surrender, it is fair to state that if the war had gone on another six months, the Germans would have been very successful in reducing greatly the efficiency of Oboe, Gee, G-H, and Loran by use of an extensive countermeasure system they were installing.

61. To give some idea of the overall results obtained by Oboe precision-bombing, it was stated by late April that the average M.P.I. for all Oboe dropped bombs of 9th Bomb Division was + 161 yards. For R.A.F. 8 Group, operating at greater ranges and much greater altitudes, the average error was estimated at 300 yards.

62. This war has demonstrated that precision electronic bombing systems are necessary aids to both Strategic and Tactical Air Forces. The Oboe system, the most accurate of the systems that came into general use here, has proved itself a highly satisfactory one for an early development. This is particularly true for the situation when the Air Forces were all operating out of the U.K. over the nearby

/continent.

continent. When the war became more tactical in its concept the emphasis on high mobility, simplicity and flexibility of the system brought out certain weaknesses in the present Oboe system. It is believed that the recently introduced SHORAN system is a great step towards eliminating these difficulties.

RECOMMENDATIONS - RADAR NAVIGATIONAL AIDS

63. As a result of the troubles experienced and errors made in executing plans for furnishing Radar Navigational Aids to aircraft of Strategic, Tactical, Coastal, Troop-Carrier and Transport Air Forces, the following recommendations are made for the benefit of those confronted with a similar problem elsewhere.

(a) It is recommended that the highest Air Force Staff or Headquarters in the Theatre of Operations be made solely responsible for provision of adequate Radar Navigational Aids for all Air Forces prosecuting the War in that Theatre. It is essential that this staff or headquarters be completely familiar with the up-to-date Ground Force situation, and with future Ground Force plans. Amongst other R.N.A. responsibilities this headquarters would be required to:

(i) allot priority to the users of shared R.N.A. systems so as to avoid saturation;
(ii) act as arbitrator when there are rival claims to sites and frequencies.

(b) It is further recommended that whatever staff or headquarters possesses the responsibility described above, has under its DIRECT operational control, an organisation capable of making detailed plans to meet specific coverage requirements, performing reconnaissance for sites, installing and operating complete systems, informing all users of a particular system of its up-to-date status, and working directly with the chart-computing and chart-production agencies.

(c) It is recommended that technical development be undertaken to reduce the mutual interference between adjacent R.N.A. and point-to-point V.H.F. communication equipments as they both require sites of the same nature.

(d) With the increasing mobility of warfare it is clearly desirable further to reduce the time necessary to site, survey and install stations and to publish and distribute the charts. Detailed proposals for reducing the time are contained in R.A.F. 60 Group's history. One point which is worth mentioning is the need to attach, during critical periods, liaison officers to the ground forces at the Corps or Division level. This was done in this theatre by R.A.F. Regiment officers, and enabled the R.N.A. organisation (72 Wing) to have a really up-to-date picture of the battle-line. The liaison officers were able to call forward siting/survey parties as the required area was cleared; during withdrawals these liaison officers are equally valuable if R.N.A. cover and/or equipments are not to be sacrificed.

(e) It is recommended that the need for great mobility be taken into consideration during the earliest R.N.A. planning

stage. In this theatre units were provided so that complete systems could be "leapfrogged", and even then coverage was lacking at certain vital stages. The need for the systems to be independent of landlines for their efficient operation was less well appreciated during the planning stages. It is recommended that VHF-FM or even centimetre radio communicating systems be provided as it has been proved that the enemy made great use of information gained from intercepting our H.F. channels, in connection with Oboe in particular. The greatest Tactical Air Force benefit is obtained from R.N.A. in aiding the Air Forces in their important function of harassing a retreating enemy - it is, therefore, of great importance that the R.N.A. systems be fully geared to mobile warfare.

(f) As an additional technical development recommended particularly for Gee, it is suggested that some form of locking-relay station be developed to permit site selection to be less critical. One of the factors determining any Slave station site is the required radio line-of-sight to the Master station. This factor could be virtually eliminated by furnishing relay stations preferably working in the centimetre waveband.

SECRET

RADAR - FIGURE 2
TO SECTION XXIII

SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE
AIR STAFF (FORWARD)
AIR SIGNALS DIVISION

Reference : AIR STAFF/SHAEF/TS.15582/NAV. 24th March, 1945.

Subject : R.N.A. Plans (OVERLORD and ECLIPSE)

To : (See distribution below)

1. It is necessary for this Headquarters to plan future R.N.A. requirements for continental users, during operation ECLIPSE. The Air Ministry will consult Strategic Forces and will be responsible for co-ordinating all requirements.

2. In view of the fact that it is uncertain at what stage in the Allied advance, the ECLIPSE condition will start, it has been found necessary to produce a plan in a series of progressive stages so that it covers the remainder of the Eu opean war. The plan at Appendix "A" therefore covers the remaining stages of OVERLORD and all stages of ECLIPSE.

3. During the remaining stages of OVERLORD it is planned to continue to provide as complete Gee, G-H and Oboe cover as possible. When the ECLIPSE condition is declared, however, it becomes absolutely essential to effect as much saving as possible in equipment and personnel for use elsewhere or on other duties. It is particularly necessary to economise in communications associated with R.N.A. systems, and as the demands of Oboe are considerable, it is proposed to represent to Air Ministry that under the ECLIPSE condition, it will no longer be required. The fullest practicable Gee, and G-H facilities will continue to be provided.

4. As Ninth Air Force are the only continental users of Oboe, it is requested that they signal this Headquarters their views on its withdrawal during ECLIPSE. It is asked that the remaining addressees consider whether the outline plan at Appendix "A" is likely to meet their needs. If this plan is acceptable it will be submitted to Air Ministry forthwith.

For Deputy Supreme Commander

(Sgd.) H.B.THATCHER
Brigadier General, U.S.A.
Asst.Chief of Staff, A-3

Distribution

C.G., Ninth Air Force.
H.Q. 2nd T.A.F.
C.G., First A.A.A.
A.N.C.X.F.

Copies to:

Air Ministry (D. of Radar)
A.O.C., H.Q. 60 Group
C.G., USSTAF

Internal: C.A.S.O.

PLAN FOR PROGRESSIVE PROVISION OF R.N.A.
ON THE CONTINENT

1. Owing to the difficulties which arise in defining R.N.A. requirements in detail without consideration of the layout of the system, the plan below covers operational requirements in terms of sites. It should be stressed that the details of sites are only included as the simplest method of defining coverage and not as an indication of intention that stations shall be sited on the pinpoints stated. Any alternative siting which provides equal coverage is acceptable.

2. Wherever possible, even at the expense of a small loss in technical efficiency, Gee, G-H and Oboe sites will be combined in order to economise in communication, administrative, and defense personnel.

GEE PROPOSALS

The proposed plans for the various stages are as follows:-

Stage 1

3. Northern cover to be provided by MUNSTER Chain; sited as Master and three Slaves, the Master being heavy equipment and the Slaves light.

4. Southern cover to be provided by METZ Chain. This to be Master and three Slaves - light equipment.

5. Base areas covered by RUHR Chain - heavy equipment, and REIMS Chain - heavy equipment.

Stage II

6. Northern cover provided by MUNSTER Chain, converted to heavy equipment, this equipment being provided by closure of the RUHR Chain. This will considerably improve cover in the direction of BRUNSWICK and HAMBURG, but will reduce low altitude cover over bases in North-East France and Belgium.

7. Southern cover provided by:-

(a) METZ Chain (converted to heavies), equipment being obtained by reducing REIMS Chain to light cover only, and therefore converting METZ Chain to Band 3 operation.

or:

(b) Provision of a new Chain to be known as the FRANKFURT Chain, sited:

Master	-	STIPHAUSEN	49° 52' N 07° 16' E
B-Slave	-	SCHERBORN	50° 27' N 07° 8' E
C-Slave	-	NEUSTADT	49° 21' N 08° 07' E

D-Slave also to be provided on this Chain - site not yet decided.

Stage III

8. This and the following two stages introduce cover from stations based east of the Rhine and would probably follow on the forward movement of armoured forces; they have been designed in such a way as to demand minimum lateral deployment.

9. Northern, Southern and base cover will continue to be provided

by MUNSTER, FRANKFURT and REIMS Chains. Advantage will be taken of the military situation to provide cover over BERLIN by a Chain sited as follows:-

Master	-	WILLINGEN	51° 17' N 08° 33' E
B-Slave	-	HOMBERG	50° 14' N 08° 27' E
C-Slave	-	OSNABRUCK	52° 11' N 08° 3' E

Should the military situation prevent siting at OSNABRUCK, there is an alternative site at:-

MUNSTER \ 51° 56' N
07° 16' E

and if occupation of any site on the east bank of the Rhine, north of the Ruhr, is impossible, there is a possibility of siting on the west bank near DUISBERG. This Chain which is facing westwards gives, by its back cover, good coverage in the direction of BERLIN, and provided the site is possible at OSNABRUCK, will cover LEIPZIG at 10,000 feet and BERLIN at 25,000 feet. Heavy equipment is desirable for this Chain but would have to be obtained by reducing either the MUNSTER Chain or the FRANKFURT Chain to light equipment. This Chain will be known as the KASSEL Chain.

10. The coverage given in the direction of MUNICH is considered inadequate, and it is therefore proposed that a chain should be deployed with:-

Master	-	HOMBERG	50° 14' N 08° 27' E
B-Slave	-	FULDA	50° 30' N 09° 57' E
C-Slave	-	NEUSTADT	49° 21' N 08° 7' E

This Chain should employ light equipment. The retention of this Chain during the succeeding stages would be determined by the necessity for low altitude cover in the direction of MUNICH and NUERNBERG, but would become redundant at Stage 6. This Chain will be known as the MUNICH Chain.

Stage IV

11. Stage IV consists of extension of the KASSEL Chain by providing a D-Slave on the BROCKEN. This immediately extends the coverage of the Chain on both flanks to cover HAMBERG and NURNBERG at 10,000 feet, KIEL, DRESDEN and MUNICH at 20,000 feet and BERLIN and PRAGUE at 25,000 feet. Upon introduction of this Chain, the coverage of both the MUNSTER and FRANKFURT or METZ Chains becomes redundant unless there is still a high priority requirement for low altitude cover over the Ruhr and/or bases.

Stage V

12. Stage V is designed to provide good cover over BERLIN and necessitates the ability to deploy stations on a broad front facing BERLIN centred on the BROCKEN. If this proves to be the military development then provision of a new Chain with:-

Master	-	BROCKEN	
B-Slave	-	SUDERBURG	52° 50' N 10° 28' E
C-Slave	-	WEIMAR	51° 01' N 11° 15' E

provides first rate cover over BERLIN at 6,000 feet. This Chain will use light equipments, and be known as the BERLIN Chain, operating simultaneously with the KASSEL Chain.

13. The decision whether MUNSTER, FRANKFURT (or METZ) Chains will remain open, will depend on base low coverage requirements. SHAEF will inform Air Ministry of these requirements. MUNICH Chain to be retained at this stage.

Final Stage

14. The final stage assumed that access is possible to all parts of Germany. It is planned to give coverage from stations based in the US/British territory and to provide, as far as is possible, a consistent degree of GEE coverage and accuracy over the whole of this area and also the centre and eastern France.

15. This will be provided by three star chains, two heavy and one light, sited as follows:

(i) REIMS Chain

Sites as previously, using heavy equipment.

(ii) HANOVER Chain

Master	-	GRONAU	52° 3' N 9° 38' E
B-Slave	-	BERGEN	52° 51' N 09° 52' E
C-Slave	-	BROCKEN	51° 48' N 10° 37' E
D-Slave	-	WILLINGEN	51° 17' N 08° 33' E

This Chain would use heavy equipment.

(iii) NURNBERG Chain

Master	-	HESSELBERG	49° 04' N 10° 33' E
B-Slave	-	OCHSENKOPF	50° 2' N 11° 49' E
C-Slave	-	PHEINBERG	47° 47' N 11° 1' E
D-Slave	-	EDERBACH	49° 28' N 9° 2' E

This Chain would use light equipment, with the exception of the Master which would have a heavy transmitter in order to achieve locking.

G-H PLANS

16. Any plans for providing G-H cover for the remaining stages of OVERLORD and succeeding stages of ECLIPSE must, of necessity, be more flexible than those put forward for GEE, since G-H involving pairs of stations only, allows greater exploitation of territorial gains, even though they may be of a restricted nature. Therefore, the proposals which are put forward below should be regarded as a general indication of intention rather than a firm plan which will be adhered to. It is, however, supposed that most of the sites selected will be used at one stage or other.

Stage 1

17. Heavy G-H stations sited as follows:-

ST. NICHOLAS
BOEKEL
LAROCHE
ST. AVOLD
COMMERCY
ST. CROIX (BELFORT Area)

This is the present deployment.

Stage II

18. Restricted to siting on the west bank of the Rhine as follows:-

DONGEN	51° 34' N 04° 56' E	
CLEVE	51° 47' N 06° 07' E	
KEMPENICH	50° 23' N 07° 01' E	
LA ROCHE		
MAINZ	50° 01' N 07° 49' E	or alternatively ST.MARTIN 49° 19' N 08° 05' E
COLMAR	47° 19' N 07° 06' E	

The alternative siting of MAINZ or ST. MARTIN is determined by whether maximum cover in the direction of LUBECK at 25,000 feet is preferred to gap-filling in an area contained by 50° N. 10° E. NURNBERG, and 52° N. 11° E., the former bever being provided by MAINZ, the latter by ST.MARTIN. It is considered that the occupation of any of the alternative sites at MAINZ or ST.MARTIN be determined by the military situation at the time.

Stage III

19. As for Stage II except CLEVE Station moved forward to MUNSTER area, 51° 58' N., 07° 22' E.

Stage IV

20. Stations sited:-

CLEVE	
MUNSTER	
WILLINGEN	51° 17' N 08° 33' E
FULDA	50° 30' N 09° 57' E
ST.MARTIN	49° 19' N 08° 05' E
COLMAR	

Stage V

21. As for Stage IV with the exception of WILLINGEN moved forward to GRONAU 52° 4' N, 9° 38' E.

Stage VI

22. This would represent the final stage, assuming access is possible to all parts of Germany, and if it is desired to maintain a military threat which necessitates the provision of G-H facilities. In this case, deployment of stations will be made to sites employed for GEE purposes on Stage VI of the GEE Plan, in order to economise on administrative and communication requirements. It is proposed that the G-H stations should be deployed in such a manner as to give adequate G-H cover over the whole of the US/British territory.

sufficient variety of sites exists to ensure this.

OBOE

23. The same general considerations apply for Oboe as for G-H and no rigid plan is considered advisable. As Oboe will not be used for ECLIPSE the deployment of the stations is only applicable to the concluding stages of OVERLORD; these stages are divided into three as follows. In all these stages, the sites employed with the exception of TILBERG and MULSHEIM have already been proposed in either the GEE or G-H Plans above.

Stage 1

24. Six four-channel Oboe convoys sited:-

TILBERG
CLEVE
LAROCHE
KEMPENICH
COMMERCY
MULSHEIM

With the exception of KEMPENICH, all these sites are already occupied by Oboe, and it is proposed that the KEMPENICH site will be occupied by the four-channel convoy from FLORENNES immediately the military situation permits movement of the site.

25. From the sites given above, the 30,000 ft. cover will embrace HAMBURG, LEIPZIG and MUNICH.

Stage II

26. Stage II assumes movement over the Rhine and calls for five four-channel stations sited:-

TILBURG
MUNSTER
WILLINGEN
HOMBERG
MULSHEIM

This sixth convoy is considered for this stage as being in process of forward movement in preparation for Stage III. Coverage at 12,000 feet embraces HAMBURG, LEIPZIG and NURNBERG, and at 30,000 feet, HAMBURG, BERLIN and MUNICH.

Stage III

27. Six four-channel stations sited:-

TILBURG
MUNSTER
WILLINGEN
FULDA
NORDLINGEN 48° 47' N
10° 16' E
MULSHEIM

A 12,000 ft. cover from this system embraces HAMBURG, LEIPZIG and MUNICH, and the 30,000 ft. cover KIEL, BERLIN and PRAGUE.

COINCIDENCE OF STAGES

28. It should be noted that the stages for the GEE, G-H and OBOE Plans have been expressed in terms of Nos. 1 to 6. Stages of corresponding number for the different systems do not necessarily correspond in time.

SHORAN.

29. Shoran has not been considered in this plan because the responsibility for planning the deployment of Shoran is delegated to the Air Force owning and operating the equipment.

COPY RADAR - FIGURE 3

AIR STAFF
SUPREME HEADQUARTERS
ALLIED EXPEDITIONARY FORCE RHO/HCL/as
APO.757, U.S. ARMY

REF : AIR/SHAEF(F)/S.36550/Radar 9th April, 1945.

SUBJECT : Operation of SHORAN Bombing Systems.

TO : Air Ministry, Whitehall.
Commanding General, U.S. Strategic Air Forces in Europe.
Commanding General, Ninth Air Force
Commanding General, First Tactical Air Force (Prov.)

1. In order to obtain maximum usage from the limited number of SHORAN stations to be operated on the continent, the procedure detailed below will be followed by all Air Forces using SHORAN Bombing Systems on the Western Front.

2. Each Air Force which intends to deploy AN/CPN-2 SHORAN beacons on the continent will notify this headquarters of their intentions using form message as per enclosure No. 1. Further this Air Force should state the general area (at least) in which it is desired to operate any particular beacon, and with which other beacon (existing or planned) it is hoped to pair this beacon. This headquarters will reply giving the air-to-ground and ground-to-air frequency and a code name to be used with this beacon if the installation is approved. It should be appreciated that with what is now known about SHORAN frequency limitations it is believed that no more than five pairs can safely operate in this theater at the same time.

3. After the Air Force has received approval, it may set up the beacons whenever it is most convenient provided actual deployment takes place within ten days after receipt of approval. Upon deployed equipments becoming operational, the owning Air Force will notify this Headquarters by Operational Priority or Urgent message using the form indicated in enclosure No. 2 giving the pinpoint location (as used by SHORAN computing sections) associated with the assigned code name of the beacon. This headquarters will then disseminate this information also by Operational Priority or Urgent message using the form indicated in enclosure No. 3 directly to all SHORAN users indicating the controlling authority for the beacon.

4. Based on information thus received users may request use of beacons as detailed below:

a. "Borrower" will contact directly the controlling authority requesting as far in advance as possible the use of certain-named SHORAN beacons.

b. "Borrower" using the form message as per enclosure No. 4 will state general area to be covered, altitude at which he desires coverage, the number of SHORAN-equipped planes on the mission and the period of time which he estimates the ground stations may be interrogated.

c. Controlling authority will then reply indicating approval or disapproval. If disapproval is given, an alternative period should be suggested if possible. If approval is given, the controlling authority will then contact the borrower giving by code name both frequencies and associated beacons and again repeating the period of time.

5. In order that all SHORAN users may be advised of the present status of ground beacons it is requested that this headquarters be informed immediately of the exact location of every SHORAN beacon now in operational use.

For the Deputy Supreme Commander
(Sgd.) H. C. McDONNEY
Lt.Col., AGD
Adjutant General

4 Incls.

/P.T.O.

Copies to Enclosures to AIR/SHAEF(F)/S.56550/Radar dated 9th April, 1945.

Enclosure No. 1

FROM : (UNIT DESIRING TO DEPLOY BEACON)

TO : AIR STAFF, SHAEF, FORWARD

REQUEST THIS HQ BE AUTHORISED TO DEPLOY CPN-2 BEACON AT (GENERAL LOCATION). THIS STATION WILL BE PAIRED WITH ANOTHER BEACON TO BE LOCATED AT _____. REQUEST FREQUENCIES BE ASSIGNED FOR THIS BEACON.

Enclosure No. 2

O P E R A T I O N A L P R I O R I T Y

FROM : AIR FORCE DEPLOYING BEACON

TO : AIR STAFF SHAEF FOR ARD

SHORAN BEACON BOSTON OPERATING IN LAMBERT ZONE 1 WITH EASTINGS 3723897.4 REPEAT 3723897.4 CHECK TOTAL 39.4 AND NORTHINGS 5691328.0 REPEAT 5691328.0 CHECK TOTAL 34.0. THIS WILL BE PAIRED WITH BEACON CONCORD OPERATING IN FRANKFURT AREA. (OR TO BE OPERATED IN THE FRANKFURT AREA).

Enclosure No. 3

FROM : AIR STAFF SHAEF FORWARD

TO : ALL SHORAN USERS

SHORAN BEACON BOSTON OPERATING AT FOLLOWING LOCATION: LAMBERT ZONE 1 EASTINGS 3723897.4 REPEAT 3723897.4 CHECK TOTAL 39.4 AND NORTHINGS 5691328.0 REPEAT 5691328.0 CHECK TOTAL 34.0. CONTROLLING AUTHORITY HQ. 42ND BOMB WING.

Enclosure No. 4

FROM : BORROWING AIR FORCE

TO : CONTROLLING AUTHORITY

REQUEST SHORAN COVERAGE AT 12000 FEET OVER LEIPZIG-HALLE AREA FOR SIX PATHFINDERS BET HRS 121030B AND 121130B.

AIR STAFF

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

AIR SIGNAL REPORT

ON

OPERATION 'OVERLORD'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

SECTION XXIV

LANDLINES FOR RADAR NAVIGATIONAL AIDS

1. In the early conception of the role of 72 Wing it was emphasised that the Wing could only function effectively with landline communications, but a thorough investigation of the probable movements of the Wing and its stations indicated that the stations would be widely dispersed and would in the main be well within the Tactical areas where good communications could not be guaranteed.

2. Exhibit "A" at the end of this Chapter shows what were the communications desired, and Exhibit "B" shows a modified scheme prepared by 72 Wing to utilise radio where practicable until such time as landlines could be provided to the original scale. This policy was discussed and agreed at a meeting in the Air Ministry held by the Director General of Signals on the 23rd October 1944.

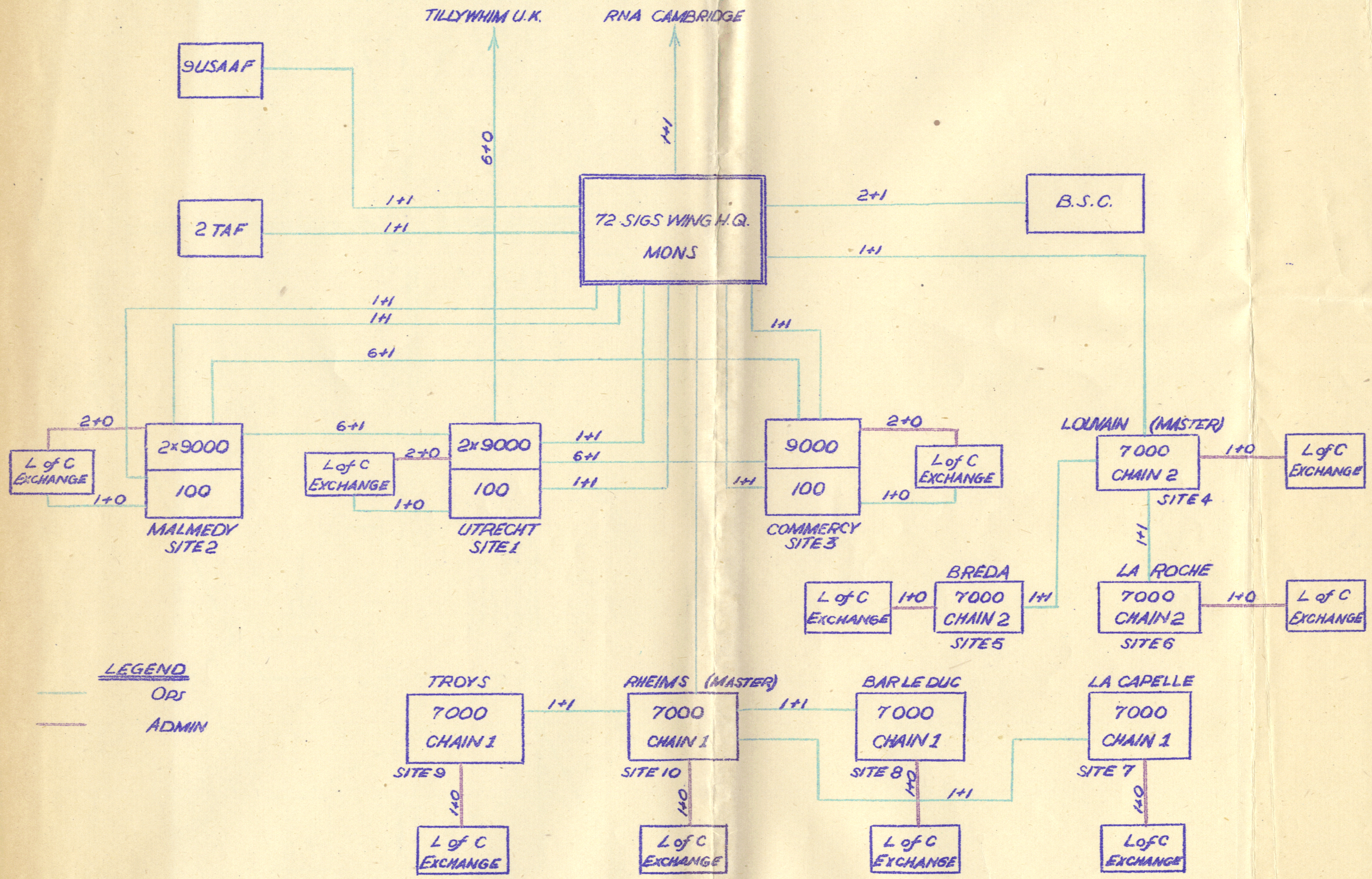
3. No. 14 Air Formation Signals had been allotted to the Wing and would be able to provide local routes, but the long distance circuits would require to be provided through the Long Lines Control organisation, No. 14 Air Formation Signals being called upon to link up the Stations with the Terminal Repeater Stations. Long distance communications in the British Zone were therefore arranged through 21st Army Group, and in the U.S. Zone through Long Lines Control, PARIS. Two main difficulties were soon apparent. The first that due to the fact that the main requirement for long distance circuits was parallel with the front and the main rehabilitation programme had been organised to build up main axes of communications for the advancing armies and army groups, it was difficult, if not impossible, to obtain allocation of circuits. Secondly, the Radar sites themselves were situated without any due regard to the location of terminal repeater stations, with the result that long extensions had to be built, sometimes over mountainous country.

In consequence of these difficulties it was decided to open a switching centre at JEMELLE in the Ardennes, to which all OBOE Stations could be connected to provide a flexible system and to economise in communications. This centre was connected to 72 Wing and Ninth Bomber Division by speech and teleprinter lines, and by teleprinter to 8 Group in the United Kingdom. It proved to be quite effective, but had to be abandoned during the German push in the Ardennes at the close of 1944. The OBOE Stations were then concentrated in the MONS area.

4. With the subsequent advance into Germany by the Allies, the OBOE stations were again redeployed, but by that time JEMELLE could no longer serve them as a switching centre, and the old plan had to be taken up again. Movement was, however, so rapid, and provision of communications so difficult, that nothing more than a skeleton network could again be built up by "V.E" Day. Exhibits "C" and "D" indicate the landlines for 72 Wing before the Ardennes Battle and after "V.E" Day respectively.

LINE COMMUNICATIONS RNA NETWORK

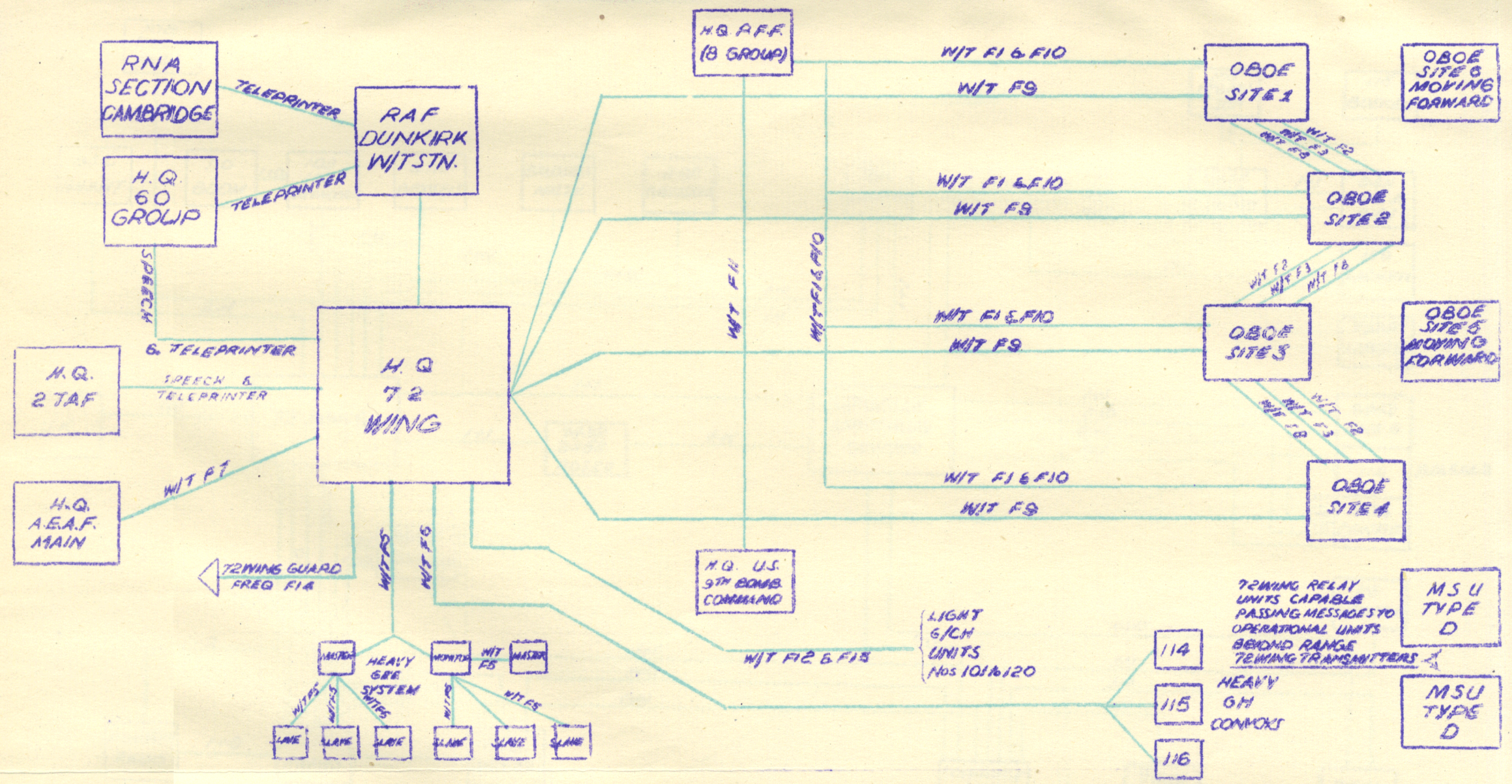
EXHIBIT 'A'



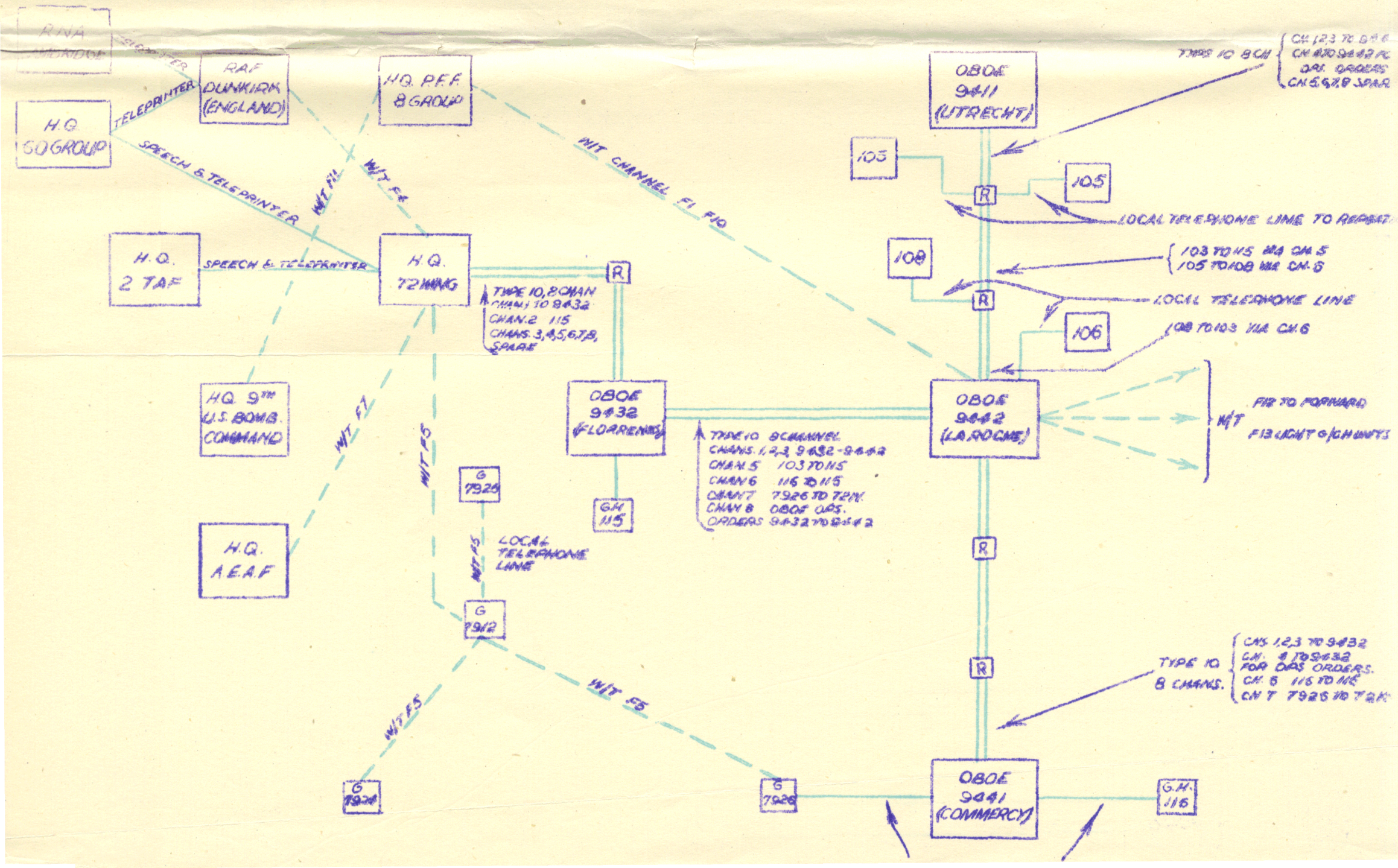
RNA COMMUNICATIONS

EXHIBIT 'B'

BASIC REQUIREMENTS USING W/T WITH MINIMUM SPEECH & TELEPRINTER



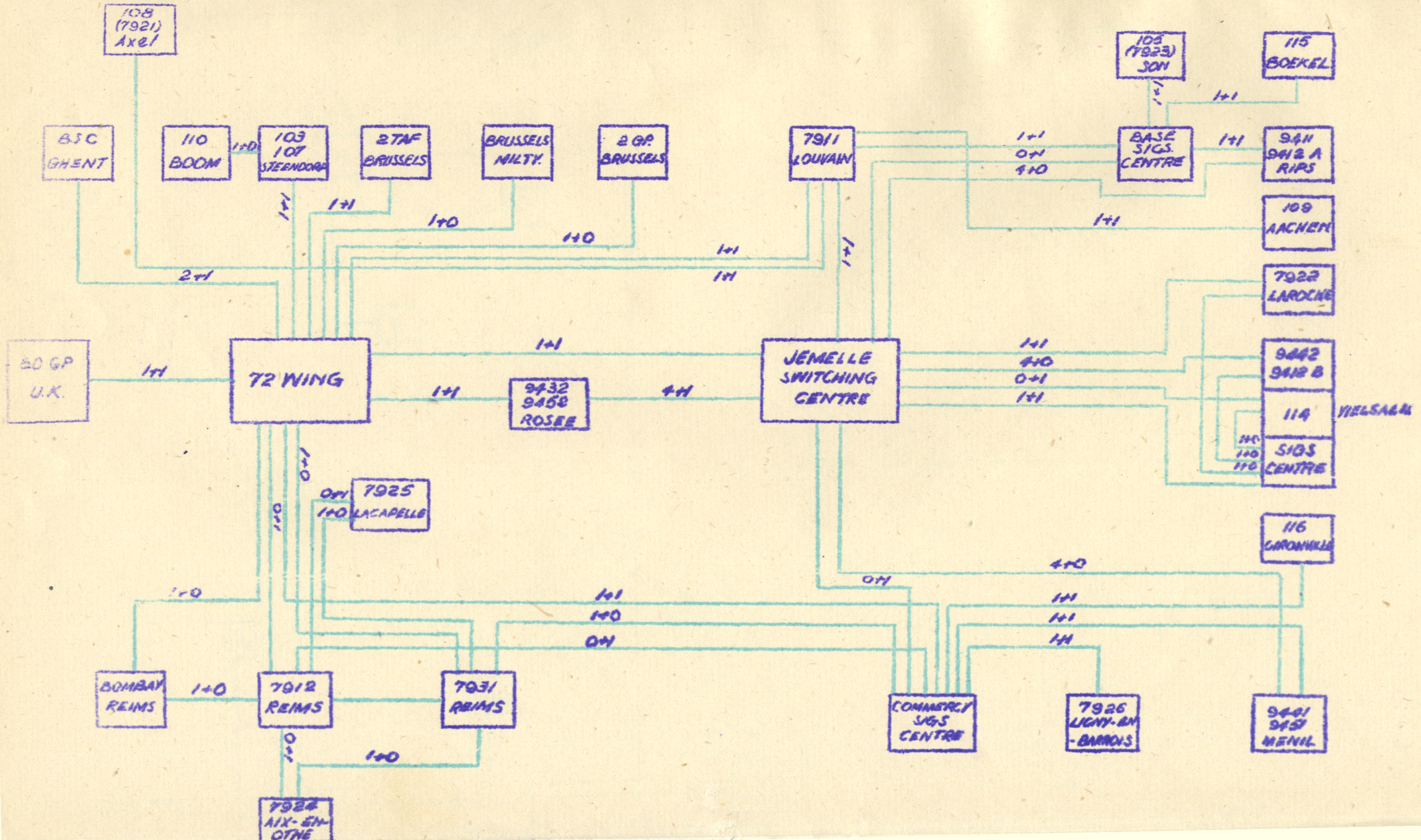
TENTATIVE PLAN SHOWING COMBINED W/T, TYPE 10 R/T & TELEPHONE LINES



72 WING PROPOSED LINE COMMS. DIAGRAM.

AS AT 11 NOV 44

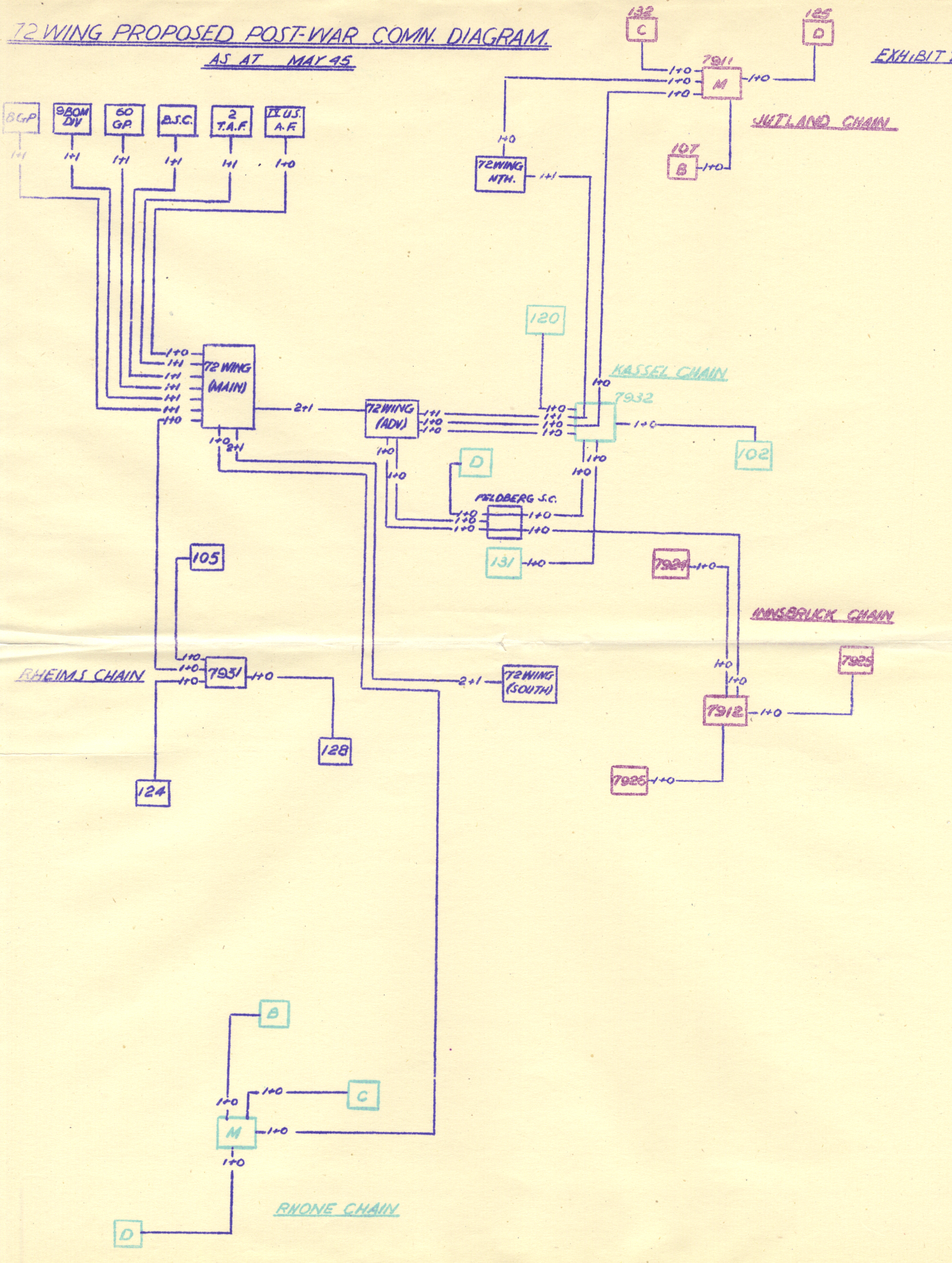
EXHIBIT 'C'



72 WING PROPOSED POST-WAR COMN. DIAGRAM.

AS AT MAY 45

EXHIBIT



A I R S T A F F

SUPREME HEADQUARTERS ALLIED EXPEDITIONARY FORCE

A I R S I G N A L R E P O R T

O N

O P E R A T I O N 'O V E R L O R D'

FROM THE ASSAULT TO THE

CESSATION OF HOSTILITIES

S E C T I O N XXV

I F F

GENERAL

1. In planning for the assault it was foreseen that indiscriminate use of IFF would cause a complete breakdown of the entire system due to saturation because of simultaneous operation of interrogators and transponders by Naval, Air and Ground Forces in Southern England, the channel area, and the assault area. Therefore, certain restrictions in the use of IFF were issued in SHAEF Operations Memorandum No. 19 on Identification and Recognition. These restrictions, primarily due to Naval requirements, were such that IFF was virtually unused during the first nine weeks of the operation except by aircraft operating independent of main concentrations. This was only acceptable because the Allies had overwhelming air superiority over the beachhead. When the beachhead was expanded and the concentration of transponders and interrogators decreased, the restrictions were reviewed on 3rd August 1944 to examine whether they could be relaxed. It was decided that relaxation would be introduced in two stages. If the first stage proved satisfactory, based on reports from interested authorities, SHAEF would then issue instructions for the second stage to be implemented. If both stages proved satisfactory, SHAEF Operations Memorandum No. 19 would be amended accordingly.

(a) The first stage authorized the additional use of the following transponders with effect from 12th August 1944.

(i) Aircraft operating in small numbers on SAS or SOE missions at night.

(ii) All twin engined aircraft operating singly at night on operational missions, including transit aircraft of Transport Command. Leaders only of groups to switch on their transponders.

(iii) Aircraft on minelaying missions which require to fly low in the vicinity of surface vessels.

(iv) Aircraft subjected to attack by anti-aircraft fire.

(v) Aircraft employed on air sea rescue, including search aircraft, when in the vicinity of surface vessels by day or night.

(vi) Single aircraft doing training in anti-aircraft co-operation by day or night.

/(b)....

(b) The second stage allowed the following transponders in addition to those listed in the foregoing:

(i) 'Stragglers' of Bomber formations at night. 'Stragglers' to be defined as under:-

(a) The aircraft is lost, or,
(b) Any aircraft whose flight varies by 30 minutes from the flight plan, or,
(c) The track made good varies by 20 miles from the flight plan.

(ii) Aircraft returning early at night, defined as above, in the case of a formation the leader only to switch on his transponder.

RULES FOR USE OF IFF.

2. These relaxations caused no difficulties, so a proposed draft for a Second Edition of Appendix A to Operations Memorandum No. 19 was sent to all Army Groups and Air Forces concerned for their comments on 13 November 1944. A second draft was sent out on 17th December 1944 incorporating recommended changes in the first draft. A third draft was sent out on 1st March 1945 and finally the Second Edition was published on 15th April 1945 and was in effect for the remaining month of the war. (See Appendix 'A').

INTERROGATORS.

3. The fitting of interrogators was delayed by design and production difficulties as a result of which many of the radar sets used in the assault were not fitted. Installation continued on the continent as relaxations permitted greater use of interrogators. There were several weaknesses inherent in the BSRU scheme which was to be used on such sets as the AMES Type 11 and 15 which provided serious operational drawbacks and prevented the IFF Mark III system from being used to the best advantage. These were:-

(a) Installation of the IFF array on the main radar antenna required a "stop, look and listen" technique (even though the beam width was rather wide)

(b) The BSRU scheme had many technical difficulties in the display of the information. These were never completely eliminated.

The IFF sets used with the AN/CPS-1 and SCR 584 (RC-127 and RC-184 respectively) had separate antennas and displays which somewhat eliminated these disadvantages. The addition of interrogators had not been made to all radar sets by the end of the war.

CONCLUSION.

4. IFF failed to serve its purpose in this theater because of the necessary restrictions imposed in the initial stages, due to technical limitations, and the subsequent delay in relaxing these restrictions to enable wider use of the system. The burden of identification this imposed on the fighter-bomber control networks was alleviated considerably by the lack of enemy activity. However, towards the end of the European war the application of IFF was on the increase; for example the overall (operational and technical) efficiency as given in the records of No. 83 Group's (2nd TAF) Control Centre for March 1945 show that 30 per cent of all tracks recorded by the reporting units showed IFF. **The views of 2nd T.A.F. are given at Appendix "B".**

APPENDIX 'A'
to SHAEF Op. Memo No 19
SECOND EDITION
dated 15th April 1945

SECRET
APPENDIX 'A' TO SECTION XXV

1. AREA

The rules contained in this Appendix apply only to those areas shown below within the Zone of the AEF.

a. Northern Boundary

Latitude 54° North

b. Southern Boundary

(1) 43° North for the area WEST of longitude 7° East.

(2) 46° North for the area EAST of longitude 7° East.

c. Western Boundary

WEST Coast of WALES and ENGLAND to LANDS END, thence to USHANT, then Southwards along the Western border of FRANCE.

2. CODES

a. The "Narrow" pulse (Code 1) of the I.F.F. set will be used on all occasions, except:

(1) The "Distress" Code will be used for the purpose of indicating distress, or by aircraft which have located survivors in the sea and remain orbiting them to assist in their rescue. For the latter purpose its use is limited to one aircraft at a time for each incident.

(2) Code 4 will be used by ships and aircraft fitted with I.F.F. Mk.III or variants of Mk III and engaged in shadowing enemy surface vessels or enemy submarines on the surface while in contact.

(3) Code 6 will be used by all land-based operational fighter aircraft fitted with I.F.F. Mk III or variants of Mk III.

b. Application for use of other codes will be made to Supreme Headquarters, AEF.

3. TRANSPONDERS.

a. By aircraft

All aircraft of the AEF will be fitted for and carry I.F.F. Mk III or III G transponders except, at the discretion of Tactical Air Force Commanders, certain training and liaison type aircraft and P.51 series aircraft when fitted with long range fuel tanks. Transponders will be used by all other aircraft by day and by night in accordance with paragraph 2 above with the following exceptions:-

(1) Aircraft, whose operations are confined to the area of the English Channel between lines drawn from LANDS END to USHANT and from the edge of the port defended area of CALAIS to FOLKESTONE excluding the limits of port defended areas within these two boundaries, need not use their transponders if otherwise ordered by the air command concerned.

(2) Outward bound aircraft proceeding to enemy territory need not use I.F.F. unless specifically requested by ground control. On the return flight transponders will be switched on when within 75 miles of Allied held territory on the Continent.

(3) When formations of three or more aircraft are flying, only two aircraft in each formation will switch on their transponders. For this purpose a formation will be understood to consist of all aircraft taking off from any one airfield for the same mission.

(4) Bomber Command R.A.F. Outward bound aircraft of Bomber Command and their fighter escort proceeding to enemy held territory will not switch on their transponders. On the return flight the following aircraft will switch on their transponders provided they are within 50 miles of Allied held territory:-

Stragglers (defined as those aircraft that are lost or whose flight varies by 30 minutes from the flight plan).
Early returning aircraft.
Aircraft in distress.
Aircraft operating singly.
Aircraft engaged by friendly anti-aircraft fire or searchlights.

b. By Ships.

Transponders will be used by ships only:-

(1) When shadowing or engaging the enemy.

(2) To "Home" aircraft in exceptional cases.

(3) When surface visibility is less than 10 miles, by ships operating singly and by I.F.F. guard ships proceeding in convoy, at a scale not exceeding one I.F.F. guard per 30 ships.

(4) When in distress.

4. INTERROGATORS

a. Interrogators will only be operated for the briefest possible periods.

b. The use of interrogators not fitted with switches is prohibited.

c. Commanders of Groups/Tactical Air Commands on the Continent may designate not more than one ground radar station as I.F.F. interrogator guard station. This station will interrogate continuously subject to the following restrictions:-

(1) Only stations with beamed type interrogator antennae (BSRU Scheme or equivalent) will be designated as I.F.F. interrogator stations.

(2) Frequencies for these stations will be sub-allotted to the Groups/Tactical Air Commands concerned by Air Staff, SHAEF, to avoid mutual interference.

5. FREQUENCIES AND STRENGTHS

Frequencies and Power Limitations are prescribed in Supreme Headquarters, AEF, 'OVERLORD' Signal Instruction Part I, Appendix "D" (entitled "Frequency Allocation of Combined Signal Board").

APPENDIX "B" TO
SECTION XXV

2nd T.A.F./O.R.S. REPORT NO. 41

THE FAILURE OF RADAR IDENTIFICATION

1. INTRODUCTION

(a) It is a well known yet often forgotten fact that the value of an aircraft reporting system depends as much on its ability to distinguish friend from foe as on its efficiency in reporting the position of aidraft. In the United Kingdom identification was attempted by three methods: movement liaison, visual identification by the R.O.C., and radar identification. It was found that even under these conditions, identification remained one of the most important unsolved problems of aircraft reporting.

(b) The field conditions under which a Tactical Air Force has to work are such that only one method of identification can be used extensively, namely radar identification. During the campaign in N.W. Europe there have been so many aircraft in the air that identification of radar plots has been extremely difficult, and everyone concerned with the radar screen has known that the system he was operating was not working at much more than 50% efficiency owing to lack of the power to pick out hostile aircraft. As would be expected in an active theatre of war, few records of the difficulties exist, but in this report an attempt has been made to bring together the evidence that is available. Some of it is in the form of small samples and some as extracts from routine orders: some has already been published by this O.R.S. in reports on other subjects, but it has been collected here in order to give an overall idea of the extent of the identification problem.

(c) During the campaign itself, when it could be accepted that the failure of the identification system would not materially lengthen the war, the assistance that the radar screen could give without identification was welcomed. Now that the campaign is won a review of the situation shows it to be intolerable, for what amounted to a small wastage of effort and flying time in this campaign could have resulted in catastrophe against heavy air opposition. There can be no disagreement with the view that the time is ripe for a redirection of energy to the real problem - that of being able to pick out a hostile aircraft. Some entirely new method of achieving this is urgently required.

(d) The examples given in this paper may serve to provide the background of operational difficulties against which new ideas on identification will have to be tested.

2. EXAMPLES OF WASTED EFFORT THROUGH INADEQUATE IDENTIFICATION

(a) The Allies had so many fighter type aircraft flying on the various tasks included in Army/Air effort that there was little chance of hostile activity occurring unopposed. A constant watch was maintained by radar apparatus, however, and where possible help was given to our fighters in the form of information of the whereabouts of hostile aircraft. Records kept by No. 6 F.D.P. of 84 Group show that over a typical period, Dec. 17th to Jan. 13th, 27 operations under their control were given warning based on radar of the presence of suspected enemy aircraft. Of these, 12 resulted in the recognition of the suspects, of which 5 turned out to be hostile and 7 friendly. In fact over half of the alarms were false. (2nd T.A.F./O.R.S. Report No. 17).

/(b)....

(b) At night superiority was maintained without such overwhelming odds, but records kept by 85 Group show that, from October to March, 60% of interception attempts made by night fighters under their control resulted in recognition of the target as friendly. This waste could have been reduced if the night fighters themselves had had adequate recognition aids, but this was not the case - of the attempts referred to, 64% had to be identified visually. A sample taken over the period of March shows that only 10% of attempts on friendlies were identified by air/air I.F.F., and 11% by Type F. (2nd T.A.F./O.R.S. Report No. 21).

(c) The ground control system of 85 Group provides a similar picture. Over the same period, from October to March, 54% of the attempted interceptions controlled by G.C.I.'s were wasted on friendly aircraft. The ground to air I.F.F. interrogators of A-band responses available during most of the campaign were practically useless, and despite determined efforts by P.D.S. to devise improved equipment, little benefit was obtained from the system. Neither was much help forthcoming from the movement sections at sectors. A sample taken for two months, December and February, shows that of 38 hostiles actually intercepted only 5 were identified as hostile by sector. Similarly, of 108 friendly aircraft actually intercepted, only 34 were identified as Friendly by Sector. In this campaign, the G.C.I. controller has had to rely largely on track behaviour to indicate possible hostiles, and has disregarded identification aids, and utilised the patrol time of his aircraft by intercepting everything that he has had time for. (2nd T.A.F./O.R.S. Report No. 21).

(d) Some idea of the preponderance of friendly traffic during 24 hours in the base area can be seen in a sample of records taken from 24 Sector of 85 Group, covering the period October 15th to November 30th. During this period, of a total of 16,609 filtered tracks, 99.23 % were identified as friendly, and only 0.5% hostile or X-raid. The remainder were hostiles or X-raids which were re-identified as friendly. Under such conditions, the task of picking out hostile aircraft is certainly formidable. Further doubt is thrown on the reliability of identification by another sample taken for one week in November. This shows that only 1% of tracks identified were identified by I.F.F., 46% were identified by movement information, and 18% as fighters under G.C.I. control, whilst the remainder again relied on track behaviour, an even more dubious method when air information is only obtained second-hand. The difficulty of identification by movements at Sector is illustrated by records taken over the same week, which showed only 31% of incoming movements and 52% of outgoing movements that could be allotted to tracks appearing on the table. Reasons for failure show that 12% of movements were subsequently cancelled, whilst 30% of incoming and 2% of outgoing movements arrived too late to be of value. The remainder of the tracks were not seen or were outside the Sector area.

(e) As an example of the weakness of a negative identification system, the following tests may be quoted, showing the efficiency of the "Canary" or Mark IIIG I.F.F. used by fighter aircraft. The night fighters of 85 Group rely almost entirely on this aid for individual recognition by their ground controller, and it is unlikely, therefore, that an ordinary I.F.F. system in which the user is disinterested could be brought up to this level of operating efficiency. Over one period

/of....

of a week 68% of requests for "Canary" from ground stations met with a satisfactory response. After pointing out this low figure to the squadrons, a second week's check in December showed 81% of requests were satisfactorily met. Of the remainder, 8% produced no response, 8% were too weak to identify, and 3% were too strong to be satisfactory.

3. CONCLUSIONS

(a) The foregoing examples give some measure of the failure of the identification systems and of the difficulties experienced by personnel in this theatre through lack of adequate aids. The need for new methods is evident, and at this stage it is worth while considering the overall efficiency required of identification systems in order to give a reasonable chance of picking out a hostile aircraft. Under conditions of air superiority the requirement is to distinguish the minority of aircraft that are hostile. With present apparatus, this is an aircraft not showing I.F.F., that is we have a "negative" system. The required efficiency for a negative system varies with the degree of air superiority, and with the criterion taken for a "reasonable chance". A reasonable requirement is to be able to pick out a hostile at least 9 times out of 10 under conditions of air superiority up to 9 to 1. This can be met on a negative identification system only by 99% overall efficiency, whereas a 90% efficient positive system would give the same chance independently of the degree of air superiority.

(b) The experience of the campaign in N.W. Europe shows again that the requirements in identification have not been met. It seems useless to continue research, development, and production of equipment which will not meet these requirements: a new, and necessarily highly original, solution to the problem is called for.

L.P.C./F.L.S. July, 1945.