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FOREWORD

Due to the technical nature of the subject matter contained in this monograph, editing was limited to grammatical changes.

The translation of this text was performed by individuals not versed in the field of communications, and therefore technical terms used herein are not purported to be absolutely correct but are the closest interpretations of the Japanese characters.

26 May 1953

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Preface

Through Instructions No. 126 to the Japanese Government, 12 October 1945, subject: Institution for War Records Investigation, steps were initiated to exploit military historical records and official reports of the Japanese War Ministry and Japanese General Staff. Upon dissolution of the War Ministry and the Japanese General Staff, and the transfer of their former functions to the Demobilization Bureau, research and compilation continued and developed into a series of historical monographs.

The paucity of original orders, plans and unit journals, which are normally essential in the preparation of this type of record, most of which were lost or destroyed during field operations or bombing raids rendered the task of compilation most difficult; particularly distressing has been the complete lack of official strength reports, normal in AG or G3 records. However, while many of the important orders, plans and estimates have been reconstructed from memory and therefore are not textually identical with the originals, they are believed to be generally accurate and reliable.

Under the supervision of the Demobilization Bureau, the basic material contained in this monograph was compiled and written in Japanese by former officers, on duty in command and staff units within major units during the period of operations. Translation was effected through the facilities of Military Intelligence Service Group, G2, Headquarters, AFFE.

This Japanese Operational Monograph was prepared in English by the Japanese Research Division, Military History Section, Headquarters, Army Forces Far East and is based on the translation of the Japanese original.

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CHAPTER I

Organization and Development

Central Agency*

In the Navy General Staff of Imperial General Headquarters, the Communications Department, or what was also designated as the 4th Bureau, was the responsible organ for the preparation of plans and policies pertinent to all communications matters of the Navy. These plans and policies were implemented by the 4th Bureau after approval by the Navy General Staff. The Navy General Staff, in turn, submitted requests to the Navy Ministry for any necessary funds, materials and manpower to support the operational plans and policies as set forth by the 4th Bureau.

Within the 4th Bureau there were three sections (9th, 10th, and 11th). Details pertaining to communications plans, operational control, international communications, communications training, equipment and installations, control and censorship of communications and communications security were handled by the 9th Section. The 10th Section was responsible for code plans, code training, compilation, maintenance and revision of code books and crytographic tables, encoding and decoding and forwarding of radio messages

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*The term "Central Agency" actually does not refer to an established office as such but is merely the closest interpretation of what the Japanese Navy officials referred to as the highest authorities concerned with communications in the Navy General Staff and the Navy Ministry.

to and from the Navy General Staff and overall control of communications within the Navy. The 11th Section was responsible for research, plans, training and execution of matters regarding radio intelligence. This section also supervised communications censorship, control and security.

With reference to the function of radio intelligence under the 11th Section, its importance was greatly elevated from the time of the outbreak of the China Incident (1937) which had international repercussions. With the subsequent focus of foreign powers on the Orient, radio intelligence became an indispensable function, as increasing demands for information poured into the 11th Section.

It was not until the end of 1940 that the function of radio intelligence became a separate entity under the Communications Department, despite opposition voiced by the senior officers of the 4th Bureau. Radio intelligence or the Special Duty Group, as it was called, was established with the policy that it would chiefly be an enforcement agency with a status equivalent to the other bureaus of the Navy General Staff. A member of the 3d Bureau (Intelligence) and a member of the 4th Bureau (Communications) were assigned to this new group to assist in formulating plans by presenting the ideas of their respective bureaus in regard to intelligence and communications operations. The Special Duty Group was also responsible for the preparation of plans pertaining to the distribution of radio intelligence reports and preparation of an annual radio

intelligence program.

In the Navy Ministry, two bureaus and two departments were directly concerned with communications planning and policy, i.e., the Military Affairs Bureau, the Military Preparations Bureau, the Navy Ship and Ordnance Department and the Navy Aeronautical Department. Within each of these bureaus and departments there were sections primarily concerned with the technical aspects of communications among other general functions such as plans, budgets, policies and personnel requirements. The 1st Section of the Military Affairs Bureau and the 1st Section of the Military Preparations Bureau were concerned with communications plans, budgets, policies and personnel requirements.

The Navy Ship and Ordnance Department was concerned with the administration of planning, research, construction, testing, maintenance and supply of equipment (excluding aircraft); design, examination, construction, repair, research, testing and control of wire communications equipment; design and examination of installations of Navy construction and repair depots (excluding air installations). Furthermore, it controlled through the Navy ordnance inspectors, technical depots, Navy yards and the Navy Construction and Repair Department. Thus, in regard to the execution of war preparations, it was the direct supervisory agency.

The Navy Aeronautical Department generally handled design, maintenance and supply of air equipment design and examination of

ground installations pertaining to aviation and equipment for ships mobilization of plants and munitions essential to construction and repair of equipment and the training in aviation technique. The 2d Naval Technical Depot and all Navy air depots came under its authority regarding aviation technical matters.

Development of Communications Facilities

As a result of Japanese operations in China, efforts were made toward improving the Navy communications by modernizing communications equipment, increasing communications installations and intensive training of personnel. Moreover, stringent radio control became necessary because of the change in operational policy necessitated by the rapid development of aircraft and the progress of radio technique, particularly in the field of radio direction finders and radio intelligence techniques. Close cooperation with land-based air units deployed over vast areas had to be maintained and the improvement of communications installations to cover a wider range was essential. It was realized then that such accomplishments would necessitate the establishment of a single system of naval communications centered around land communications units. However, at that time Japan's efforts were concentrated on improving and expanding naval sea units, and little progress was realized in the improvment of land-based communications units.

The entire Navy communications system was centered at the Tokyo

Communications Unit. In 1937, additional construction was started and the project was completed in autumn of 1941. The work consisted of the installation of a Type-0 No 03 transmitter, a Type 97 No 01 high frequency transmitter, a Type-98 No 02 high frequency transmitter and a Type-99 No 2 high frequency transmitter. Furthermore, the umbrella-type antenna was discarded and an inverted L-type antenna was installed as well as a very-high frequency radio control mechanism.

The so-called Owada Receiving Station, which specialized in broadcast interception, was established as a detachment of the Tokyo Communications Unit. Interception was used with successful results during the China Incident, utilizing 23 large receivers, 200 small receivers and a total of 13 low, medium and high frequency radio direction finders. Subsequently, increasing demands for this service necessitated the expansion of the Owada facility and steps were taken to increase personnel and equipment to the extent where it could function as the coordinating unit covering radio intelligence for the Navy General Staff.

In obtaining intelligence data, it was most effective to set up intercept organizations as near to the target of interception as possible. In particular, since radio waves from the European areas pass the polar region, locations in northern Japan proved more satisfactory than Tokyo, insofar as reception was concerned. In those areas where specialized interception stations could not be established,

owing to the lack of appropriations, regular communications units were utilized in interception work by assignment of additional personnel and equipment. (Chart 1)

Initially the Navy had little idea of the value and use of a radio direction finding organization and the use of a radio direction finder to obtain strategic information was not considered. However, with the development of aircraft and radio intelligence technique, the acquisition of strategic information was demanded. The technical progress of radio direction finders made the acquisition of such information possible and facilities and personnel were expanded for that purpose. (Chart 2)

With the development of aircraft, the strategic value of the South Sea Islands increased. As a result of research and frequent maneuvers, the establishment of communications installation in this area was deemed necessary from the standpoint of strategy and security. Communications facilities at advanced bases such as Palau, Truk and Kwajalein and the relay base on Saipan were to be improved. Also, radio direction finding organizations and stations in these areas were to be improved and increased in number.

The Fourth Naval Armament Replenishment Plan of 1939 provided for the improvement of radio navigation installations at the air bases on Palau, Truk and Ponape, and the improvement of radio communications facilities on Palau and Truk. The plan also provided for the installation of radio direction finding stations at Ponape,

Chart 1

Communications Units Utilized for Interception

Interception Organization	Targets of Interception	Equipment	
Takao Comm Unit (Shinjo Det)	United States Britain Indian Ocean Area China Area	High freq large receiver Low freq receiver High freq receiver Special receiver Mark 2 Telephone Low freq RDF High freq RDF Model 2, medium freq RDF High freq trans 0.5 KW	6 2 2 20 1 1 2 1 1
Maizuru Comm Unit (Nakahojo Det)	Soviet Union	Special receiver High freq RDF Medium freq RDF Low freq RDF High freq trans 1 KW High freq trans 0.5 KW	9 2 2 1 1 1
Maizuru Comm Unit (Shibata Det)	Soviet Union	Special receiver High freq RDF Medium freq RDF Low freq RDF High freq trans 1 KW High freq trans 0.5 KW	7 2 2 1 1 1
Shumushu Comm Unit	United States Aleutian-Alaska Area	Special receiver Mark 2 Telephone	26 1
Kaibun Comm Unit	Soviet Union	Special receiver Low freq RDF Medium freq RDF High freq RDF High freq trans 1 KW High freq trans 0.5 KW	17 2 2 3 1 1
6th Comm Unit (Kwajalein)	United States Hawaii Area	Special receiver Low freq RDF Medium freq RDF High freq RDF High freq trans 1 KW High freq trans 0.5 KW	12 3 3 4 1 1

Note: RDF -- Radio Direction Finder

Radio Direction Finding Stations' Table of Equipment
(As of 1 Dec 44)

Communication Unit				1	Yokosuka			Owada
Equipment \ Detachment				2	Hatsuse	Shirakata	Hachijo-jima	
Radio Direction Finder	Low Freq	Type 87		3	3			
		Type 93 No 1		4		1	1	3
	Medium Freq	Type 89		5	3			1
		Portable		6		1	1	
		Type 21		7	1			2
	High Freq	Type 93		8				1
			Improved	9	3	1	1	6
		Type 3		10				2
TM-type	High Freq Portable		Improved 1	11				2
			Improved 2	12			1	
	Light		Improved 1	13	1		1	
			Improved 2	14		1		
No 2 Telephone				15	1			1
Receiver	Low Freq	Type 92		16				1
	High Freq	Type 97		17				4.19
		Type 92		18				2
	Special	Type 92	Improved 3	19	7			
			Improved 4	20	20	4	4	12
		Type 3		21				8
Transmitter	Low Freq	Type 92	No 3	22				
			No 4	23				
	High Freq	Type 95 No 3		24				
		Type 95 No 4		25	1			
		Type 95 No 5		26		1	1	1
	Special	Type 91 No 4		27				1
		Type 97 No 5		28				
Monitor		High Frequency, (Improved)		29	2.1	1	1	6
		Low Frequency, (Improved)		30	1	1	1	3
Generator				31	40KVAx1	15KVAx1	15KVAx2	60KVAx1 25KVAx1
Direct Current				32	50KWx2 15KWxa 7KWx1			5Kx2 7Kx2 20KWx2
Others				33	Model 5x10 Model 6x40			Model 1x12 Model 4x200

T/E of Radio Direction Finding Stations, as of 1 Dec 44 (cont'd)

Chart 2-b

1	Chichijima		Ominato				Shimushu
2	Ogiura	Iwojima	Sekine	Nemuro	Rosaku	Nosappu	
3			2				
4	3	1	1	1	1	1	
5	3	1		1	1	1	
6							
7	1		1	1			2
8	1		1	1		1	
9	3	1	4	2	1	2	3
10							
11							
12		1			1		
13							
14			1	1	1		
15		1	1			1	
16							
17							
18			1				
19			2			2	
20	2	4	7	10	4	11	15
21						2	
22							
23				1			
24							
25		1		1			
26							
27							
28							
29	2	1	2	3	1		3
30	1	1	1	2	1	1	1
31	6KVAx2	15KVAx2	3KWx1	6KVAx1 6KWx1	15KVAx1	15KVAx1	
32			5KWx1	10KWx1			
33							

T/E of Radio Direction Finding Stations, as of 1 Dec 44 (cont'd)

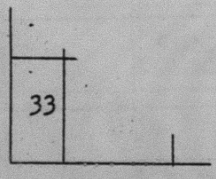
Chart 2-c

	Shimushu		Osaka	Maizuru		Kure	Sasebo
2	Musashi	Matsuwa	Shiono-misaki	Shibata	Nakahojo	Miyazaki	Namba
3							1
4	1	2	1	1	1	1	
5	1	2		1	1		
6			1			1	1
7			1	1	1	1	1
8	1						
9	1	2	1	2	2	2.1	3
10							
11						2	
12			1				
13			1				
14				1	1	1	1
15	1						1
16							1
17							2
18							1
19				7	7		9
20	6	6	4		2	7	3
21							
22							
23							
24		1					
25							
26				1	1		
27		1		1	1		
28							
29	1	2	2	3	3	2	4
30	1	2	1	2	2	1	3
31		60KVAx2	6KVAx2	25KVAx1	25KVAx1	6KVAx1	40KVAx1
32		5KWx2 20KWx2					15KWx2 5KWx2
33							

T/E of Radio Direction Finding Stations, as of 1 Dec 44 (cont'd)

Chart 2-d

	Sasebo			Rashin		Chinhae	
2	Hakata	Ee	Tanega-shima	Kaibun	Eiko	Ushijima	Rakuto
3							
4	1	1	1	2	1	1	2
5			1	2	1	1	2
6	1	1					
7							
8				1			
9	1	1	1	2	1	1	2
10							
11				1		1	1
12	1	1	1				
13						1	
14	1	1		1			
15							
16							
17							
18							
19				12			
20	4	4	4	5	4	4	6
21							
22							
23							
24				1			
25				1			
26							1
27							1
28					1	1	
29	1	1	1	2	1	1	2
30	1	1	1	1	1	1	1
31	15KVAx1	15KVAx1	15KVAx2	25KVAx1	15KVAx1	15KVAx2	25KVAx2
32				16KWx2			
33							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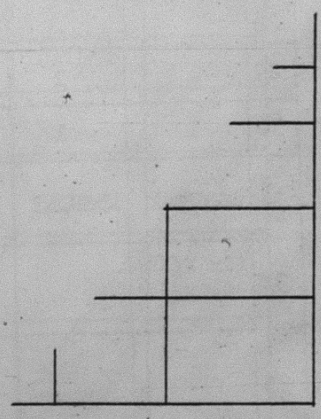


T/E of Radio Direction Finding Station, as of 1 Dec 44 (cont'd)

Chart 2-f

	10th Singapore	12th Rangoon		21st Soerabaya		24th Amboina	
2	3d Saipan	2d Rangoon	3d Andaman	2d Soerabaya	4th	2d Amboina	3d Kupang
3							
4			1	1	1	1	1
5							
6							
7	2	2	2	2		2	2
8					2	2	2
9	2	2	2	3			
10							
11							
12	1						
13		1					
14	1			1		1	1
15				1		1	2
16							
17							
18							
19							
20	5	18	14	5	7	6	11
21							
22			1				1
23							
24			2				
25			3				1
26	1			1		1	1
27							
28			1				
29	3	2	5	3	1	3	5
30	1		3	1	1	1	3
31	15KVAx2		6KVAx2 60KVAx2	25KVAx2		15KVAx2	15KVAx3 60KVAx1
32			7KWx2 30KWx2				
33							

T/E of Radio Direction Finding Stations, as of 1 Dec 44 (cont'd)

Chart 2-g

1	25th	31st Manila	32d Davao	Base Force	
				Okinawa	Port Arthur
2	Main Force	2d Manila	2d Davao	Koroku	Dojoshi
3				1	
4		1	1		1
5				1	1
6					
7	1			1	
8		3			
9	2		3	1	1
10					
11					
12			1		
13					
14		1	1		
15		1			
16					
17					
18					
19				2	4
20	10	15	25	18	
21					
22					
23					
24					
25					
26		1			
27					
28					
29	2	1.1	1	2	1
30	1	1.1	1	1	1
31	3KVAx1 25KVAx1	15KVAx1	6KVAx1 6KWx2	25KVAx1	3KWx1
32					3KWx1
33					

T/E of Radio Direction Finding Stations, as of 1 Dec 44 (cont'd)

Chart 2-h

	Base Force				
1	Bako	Hainan	10th	11th Indochina	22d Balikpapan
2	Tetsusembi	Tokyo	Miri Base	2d Saigon	
3	3				
4		2		1	
5	3			1	
6					
7					
8					
9	3	3	2	2	2
10					
11					
12				1	
13					
14				1	
15				1	1
16					
17					
18					
19					
20	2	6	5	7	12
21					
22					
23					
24		2			
25		2			
26			1		
27			1		
28					
29	1	2	1 (Type 99)	1	1
30	1	2	1 (Type 99)	1	1
31	3KWx3	60KVAx2	6KVAx1	6KVAx2	15KVAx1
32		5KWx2 30KWx2			
33		Model 4x120 Model 6x125			

T/E of Radio Direction Finding Stations, as of 1 Dec 44 (cont'd)

Chart 2-i

	Base Force	Garrison Units	
1	23d Makassar	Marcus Is.	Wake Is.
2	1st Makassar		
3			
4		2	
5		2	
6			
7		1	1
8		1	
9	2	2	2
10			
11		1	
12		2	
13			
14	1	1	
15	1	2	
16			
17			
18			
19			
20	5	22	12
21			
22			
23			
24		2	2
25		4	
26			
27			
28	1 (Type 2)		
29	1	6	3
30	1	5	2
31	15KVAx1	15KVAx2 60KVAx2	40KVAx2
32		7KWx2 30KWx2	
33		Model 4x120	

Woleai and Ulithi. The 1940 Naval Armament Replenishment Plan provided for additional improvement of radio navigation installations for the air bases on Palau and Truk, the improvement of radio communications facilities at Jaluit and the improvement of the Truk Radio Direction Finding Station. In addition, the 1941 Emergency Supplementary Naval Armament Replenishment Plan provided for the overall improvement of communications installations at important bases in the South Sea Islands. By the end of 1941, just before the outbreak of war, important temporary communications installations were improved considerably. However, there were very few bombproof installations and their improvement had to be carried out after the outbreak of the war (See Chart 3 for T/E of naval communications units).

To centralize control over the communications facilities, the 1st Combined Communications Unit was activated in May 1941. This new organization was comprised of the Tokyo and the Owada Communications Units and was placed under the command of Captain Kakimoto, Gonichiro.

To expedite the operations of the newly established Combined Communications Unit, the authority of the chief of the Naval General Staff to instruct and the authority of the C in C, Combined Fleet to direct were specified in Administrative Secret Order No 515, May 1941, which read:

The commanders of the Combined Communications Unit, the Naval Communications Unit and other specially established communications units will be given instructions by the chief of the Navy General Staff in regards to communications necessary for tactics and operations.

The commandants of the Naval Districts and Guard Districts will place the commanders of their subordinate communications units, insofar as it does not interfere with their other duties, under the C in C, Combined Fleet, with regard to communications, utilization of radio intelligence and radio direction findings of the Combined Fleet.

The communications units which had been newly organized in the Southwest Occupied Area after the completion of the First Phase Operations did not cooperate satisfactorily with the Combined Fleet, especially in the control of radio direction finding. Therefore, there was a strong desire for a central unit to direct and control effectively communications units in that area. In August 1943, the 3d Combined Communications Unit was activated and assigned to the Southwest Area Fleet and communications in this area became considerably improved.

When Saipan fell to the enemy in June 1944, the headquarters of the 1st Combined Communications Unit stationed there was annihilated. This unit had been engaged in radio intelligence, deviating somewhat from the original purpose for which it was established -- the supervision and coordination of naval operational communications in that area. It was realized that if the unit were to be reestablished and perform the duties for which it was originally intended, it would be necessary to find an energetic commander and staff to

Location of Communications Unit	Equipment / Type		Key to Unit Name	Transmitter				
				High Frequency				
				50 KW	15 KW	5 KW	2 KW	1 KW
Tokyo Comm Unit	Tokyo Main Body	A C	1					
	Funabashi Detachment	B	2	2	4	4	11	1
	Totsuka Det	B	3		12		8	3
	Kanigaya Det	C	4					
Yokosuka Comm Unit	Yokosuka Main Body	A C E	5					
	Mutsuai Det	B	6				2	6
	Hatsuse Det	C D E	7					1
	Kinugasa		8					2
	Hemmi		9					
Kure Comm Unit	Kure Main Body	A C	10					
	Yakeyama Det	B	11				2	4
	Miyazaki Det	D	12					
	Nakakurose Det	C E	13					
Sasebo Comm Unit	Sasebo Main Body	A C	14					1
	Hario Det	B	15			1	4	6
	Mamba Det	C D E	16					
	Hakata Det	D	17					
	Ei Det	D	18					
	Tanegashima Det	D	19					
Maizuru Comm Unit	Maizuru Main Body	A C E	20					
	Shiraku Det	C E	21					
	Uesugi Det	B	22				2	3
	Shibata Det	D	23					
	Nakahojo Det	D	24					

Transmitter

	High Frequency			Medium Frequency			Low Frequency				
Key to Unit Name	500 Watt	250 Watt	200 Watt	250 Watt	7 Watt	Telephone 50 Watt	30 KW	5 KW	2 KW	1 KW	500 Watt
1											
2				1		1	1	4	1		
3				2		1					
4					2	1					
5	4			1	1	3					2
6	6		1	1						3	2
7	2	3	1			1					
8	2	1		1		2				2	2
9	5	2		2							1
10	1		2	1		1					1
11	3			1		1			3		2
12			2								
13											
14			3	1		1					1
15	3	1		1		1		2	2		2
16	1					1					
17			1								
18			1								
19			1								
20	1		2	1		1					1
21											
22	2	2		1		1			3	3	1
23	1	1									
24	1	1									

T/E of Naval Communication Units
(cont'd)

Chart 3-c

Receiver						Others			
High Frequency				Low Frequency		Radio Direction Finder			Audio Frequency Amplifier
Key to Unit Name	Large	Small		Large	Small	High Freq	Med Freq	Low Freq	High Freq
		High Freq	All Wave						
1			51						
2			5						
3			6						
4	12								
5		3	52						
6			3						
7	1		37			3	1	3	
8			3						2
9									2
10		2	21		2				
11			2						
12			7			3	2	1	
13			16						
14		2	22		2				
15			2						
16	3		22	1		3	2	1	
17			4			1	1	1	
18			4			1	1	1	
19			4			1	1	1	
20			17		2				
21			13						
22			2						
23			7			2	2	1	
24			9			2	2	1	

T/E of Naval Communications Units (cont'd)

Chart 3-d

Location of Communications Unit	Equipment / Type		Key to Unit Name	Transmitter			
				High Frequency			
				15 KW	5 KW	2 KW	1 KW
Ominato Comm Unit	Ominato Main Body	A C E	1				
	Chikagawa Detachment		2	2	1	5	7
	Nosamu Det		3				
	Makubetsu Det		4				
	Sekine Det	D	5				
	Nemuro Det	D F	6				
	Wakkanai Det	A B C D	7				
	Henashi Det	D	8				
Chinkai Comm Unit	Chinkai Main Body	A C	9				
	Jonan Det	B	10			1	2
	Rakuto Det	D	11				
	Gyuto Det	D	12				
	Heikai Det	D	13				
Takao Comm Unit	Takao Main Body	A C	14				
	Hozan Det	B	15	1	1	2	9
	Shokozan Det	B	16			4	4
	Shinjo Det	D	17				
Osaka Comm Unit	Osaka Main Body	A C	18				
	Moriguchi Det	B	19				
	Shionomisaki Det	D	20				
Owada Comm Unit	Owada Main Body	A C D E	21			3	
	Ohira Det	C	22				
1st Communications Unit	Determined by C in C Combined Fleet	A B C D	23				
2d Communications Unit		A B C D	24				

Key to Unit Name	Transmitter								
	High Frequency			Medium Frequency		Low Frequency			
	500 Watt	250 Watt	200 Watt	250 Watt	Telephone 50 Watt	5 KW	2 KW	1 KW	500 Watt
1	1		2	1	1				
2	3			1	1	1	1	2	1
3					1				
4	1	1			1				
5					1				
6			1						
7	1				1				
8									
9	1				1				
10	4	1			1		2	2	1
11									
12									
13									
14		1							
15	5				1				
16									
17	1				1				
18					1				
19									2
20					2				
21			2		2				
22									
23									
24	1	1							1

T/E of Naval Communications Units (cont'd)

Chart 3-f

Key to Unit Name	Receiver					Others		
	High Frequency			Low Frequency		Radio Direction Finder		
	Large	Small		Large	Small	High Freq	Med Freq	Low Freq
		High Freq	All Wave					
1		1	62		2			
2			2					
3			13					
4		1	2					
5		1	9			5	1	3
6			10			1	2	3
7			21		2			
8			4			1	1	1
9			26					
10			2					
11								
12								
13								
14			29					
15		1	2		1			
16								
17	6	2	20		2	2	1	1
18			25					
19			2					
20			4			1	4	1
21	23	1	62	1		8	2	3
22								
23								
24			10			2		

Location of Communications Units		Equipment / Type	Key to Unit Name	Transmitter			
				High Frequency			
				15 KW	5 KW	2 KW	1 KW
3d Comm Unit	Koror, Palau Main Body	A B C	1				
	Peleliu 1st Det	D	2				
	Ailai 2d Det	B	3		2	2	5
4th Comm Unit	Dublon, Truk Main Body	A C	4				
	Chare*, Dublon 1st Det	B	5			1	7
	Sunday 2d Det	D	6				
	Ponape 3d Det	A B C	7				
	Uman 4th Det	B	8			2	4
	Moen 5th Det	B	9	4			
5th Comm Unit		A B C D	10				
8th Comm Unit	Rabaul Main Body	A C E	11				
	Rabaul 1st Det	B	12		1	2	6
	Vunakanau, Rabaul 2d Det	D	13				
Shumushu Comm Unit	Shumushu Main Body (Kataoka Transmitting Sta)	A B C	14			2	3
	Paramushiro Det	D E	15				
	Matsuwa Det	D	16				1
Chichijima Comm Unit	Chichijima Main Body	A C E	17				1
	Yoakeyama 1st Det	B	18				2
	Ogiura 2d Det	D	19				
10th Comm Unit	Singapore Main Body	A C E	20				
	Singapore 1st Det	B	21	7	1	3	8
	Singapore 2d Det	D	22				
	Sabang 3d Det	D	23				
	Penang 4th Det	D	24				

Key to Unit Name	Transmitter								
	High Frequency		Medium Frequency				Low Frequency		
	500 Watt	250 Watt	250 Watt	7 Watt	Telephone		5 KW	2 KW	1 KW
					150-Watt All Wave	50 Watt			
1						1			
2									
3	2	1				1	1	1	2
4						1			
5	4	5				1		1	1
6									
7									
8	1	2			2	1			1
9						1	1	1	
10									
11						1			
12	4	2			1	1			
13		1				1			
14	1	2	2			2			1
15						1			
16	1								
17						1			
18	4	2				1	1	1	
19									
20	1			2		2			
21	6				2		1	1	3
22									
23									
24									

T/E of Naval Communications Units (cont'd)

Chart 3-i

Key to Unit Name	Transmitter		Receiver				Others		
	Low Frequency		High Frequency			Low Freq	Radio Direction Finder		
	500 Watt	250 Watt	Large	Small		Small	High Freq	Med Freq	Low Freq
				High Freq	All Wave				
1			3	7	36	4			
2									
3	1				1				
4			2		36				
5									
6									
7									
8					2				
9					2				
10									
11					42				
12	1				2				
13					20		3	2	
14	1				31			2	3
15					6		1	1	2
16					6		2	2	2
17					39	1			
18	1	2			2				
19					2		3	3	4
20			2		44				
21	1								
22					15		2	2	
23									
24									

T/E of Naval Communications Units (cont'd)

Chart 3-j

Location of Communications Unit		Equipment / Type	Key to Unit Name	Transmitter			
				High Frequency			
				25 KW	15 KW	5 KW	2 KW
25th Communications Unit		A B C D	1				
32d Comm Unit	Davao Main Body	A C E	2				
	Davao 1st Det	C	3				
	Davao 2d Det	B	4				
	Davao 3d Det	B	5				
	Davao 4th Det	D	6				
12th Comm Unit	Main Body	A C	7				
	1st Det	B	8			2	
	2d Det		9				
21st Comm Unit	Soerabaja Main Body	A C E	10				
	Soerabaja 1st Det	B	11		1	1	6
	Soerabaja 2d Det	D	12				
	Malabar 3d Det	B	13				
	4th Det	D	14				
24th Comm Unit	Ambon Main Body	A C E	15				
	1st Det	B	16				
	2d Det	D	17				
31st Comm Unit	Manila Main Body	A C E	18				
	Manila 1st Det	B	19	1		1	2
	Manila 2d Det	D	20				
Rashin Comm Unit	Rashin Main Body	A C E	21				
	Rashin Meikodo Det	B	22				
	Kaibun Kaibun Det	D	23				
	Eiko Eiko Det	D	24				

Key to Unit Name	Transmitter									
	High Frequency			Medium Frequency				Low Frequency		
						Telephone				
	1 KW	500 Watt	250 Watt	250 Watt	7 Watt	150-Watt All Wave	50 Watt	KW	2 KW	500 Watt
1										
2										
3	3					2				
4	1	2				1	1			1
5										
6										
7										
8	6	2			2	1				
9										
10			1				1			
11	6		5	3	2	1			1	1
12			1				1			
13								400 100		
14										
15										
16	2	3	4			1	1			
17			1		1		1			
18		1					1			
19	5	3				3	1	300	1	1
20		1					1			
21							1			
22	1	3				1	1		1	1
23										
24										

Key to Unit Name	Receiver		Others		
	High Frequency		Radio Direction Finder		
	Large	Small All Wave	High Freq	Med Freq	Low Freq
1					
2		36			
3		28	3		1
4		2			
5					
6					
7		15			
8					
9		15	2	2	
10	2	34			
11		2			
12		18	3	2	1
13					
14					
15		23			
16		2			
17		6	2	2	1
18		49			
19		2			
20			3	1	1
21		20			
22		2			
23					
24					

Key to Type Column:

A. Taking command of communications and handling radio transmission and reception as telephone control.

B. Provided mainly with transmitting equipment.

C. Provided mainly with receiving equipment.

D. Provided mainly with radio direction finders.

E. Radio direction finder control.

lead it. At that time, there was a scarcity of suitable personnel and even the post of chief of 4th Bureau remained unfilled.

As communications in the area supervised by the 3d Combined Communications Unit had become, on the whole, satisfactory, the existence of this unit was not always necessary and it was felt that as long as some of the staff officers concerned were assigned to Headquarters, Southwest Area Fleet, the unit could be deactivated. It was decided therefore, to deactivate the 3d Combined Communications Unit and appoint the commander of this unit, Captain Onishi, Keiichi, to the post of chief of 4th Bureau and concurrently commander of the reestablished 1st Combined Communications Unit. To effect command liaison, it was decided to have a member of the 9th Section, 4th Bureau, serve as a staff member of the new unit and orders effecting this change were issued on 20 August 1944.

Policy for Control of Civil Communications Facilities

Although no positive policy had been adopted for guidance of communications facilities outside the naval service, the Navy had contended that there should be a consistent policy to assume control of shipping communications. The majority of private ships were equipped with low frequency transmitters, but only a few of the first-class ships subsidized by the Navy were equipped with high frequency transmitters. Most of the transmitters installed on merchant vessels had such varied frequencies that the Navy anticipated dif-

ficulty in escorting merchant vessels in wartime.

With the enactment of the Antiaircraft Defense Law in 1937, ocean-going fishing boats were required to report information pertaining to air defense. With the support and guidance of the Navy, the Communications Ministry (civil government agency) conducted training classes at fishing boat bases, but the fishing boat companies were not very enthused about the unification of communications facilities because of the expense involved. As such, a centralized control facility to control this new communications net did not materialize.

About 1940, the Navy overcame some of the difficulties and made progress in the control of civil ship communications by prescribing the limit of permitted deviation of frequency and making gradual improvements in transmitters. The first-class vessels subsidized by the Navy were directed to install high frequency sets, a means by which to control these vessels, especially ocean-going vessels, during wartime. When control of shipping affairs was transferred to the Navy, it was decided that merchant ships would be equipped, in accordance with its requirements, with radio sets to conduct simultaneous low and high frequency communications.

Because of the necessity to direct communications in escort operations, the need for surface traffic security, reports of submarine warnings and prevention of exposure of anticipated movements of important vessels, it was decided to dispatch Navy officers to

principal coastal radio stations to direct communications. In July 1942, Navy officers were dispatched to the coastal radio stations in Choshi, Tsunoshima, Shiomisaki, Nagasaki, Ochiishi and Keelung; and subsequently, officers were also dispatched to the four coastal radio stations at Shanghai, Tsingtao, Mokpo (Korea) and Naha (Okinawa).

In order to provide long-range communications in the event of war, the communications plans prepared annually provided for the wartime requisitioning of powerful transmitters owned by companies outside Navy control. However, concrete measures such as contracts with those companies were not taken.

By 1941, with the domestic and foreign state of affairs indicative of imminent war, it was feared that unless concrete preparations were expedited, it would become impossible for the Navy to requisition necessary equipment once the Army started requisitioning. Such being the case, negotiations were conducted with the Army and the Communications Board and an agreement was concluded regarding transmitters to be requisitioned by the Navy in wartime.

International Communications

Prior to the conclusion of the Japanese-German Military Alliance, the Japanese Navy had limited its activities in the field of international communications to support of the Communications Ministry in regards to technical matters and frequency assignments, and had not adopted an international communications policy. With the con-

clusion of this alliance, the Navy was required to adopt a policy to provide for direct communications between Tokyo and Berlin in order to establish closer liaison and exchange information between the Japanese and German Navies. Initially, the attitude of the Japanese Navy was that German authorities in Japan in communication with Germany and German vessels should use Japan's communications facilities and that direct communications would not be authorized. After further study, the Navy changed its attitude and a communications agreement was concluded which authorized the Japanese Embassy in Berlin and the German Embassy in Tokyo to communicate directly with their respective countries.

Japanese-German Communications Agreement

1. Direct communications between the Japanese Navy Ministry in Tokyo and the German Navy Ministry in Berlin:

   a. The Japanese Navy will use the Funabashi Transmitting Station of the Tokyo Communications Unit and the German Navy will use the Norddeich Naval Transmitting Station. A transmitter with approximately 20 kilowatts power will be used exclusively.

   b. Continuous liaison will be maintained and agreements will be made on frequencies in accordance with atmospheric and communications conditions.

   c. It will be made possible for the Japanese Embassy in Berlin and the German Embassy in Japan to communicate directly with their respective countries.

2. Transmittal of information to German vessels:

   a. The Japanese Navy will transmit information regarding enemy mines and submarines to German vessels and submarines in Japanese waters.

b. The Japanese Navy will transmit with the frequency used for Tokyo Broadcast No 2 in the same manner as shipping communications are being conducted.

3. Communications between German vessels and Japan through the Choshi Coastal Radio Station and the Naval Communications Unit at Singapore will be commenced immediately and communications with the Naval Communications Unit at Jogjakarta will commence when communications facilities there are completed.

4. Communications between Japanese submarines and German Navy radio stations will be through either the German Norddeich Radio Station or the submarine base radio station. Necessary information will be transmitted in the same way German shipping communications are conducted.

5. The Japanese naval representative in German-occupied areas and German naval representatives in Tokyo, Singapore, Jogjakarta and Penang may communicate directly with their respective countries and receive shipping communications.

When the agreement was put into effect in 1942, the Japanese Navy communicated with German submarines in accordance with the agreement, and in early 1944 the scope of communications stipulated in the agreement was expanded. The transmitting of radio messages by Japanese and German naval representatives in occupied areas through naval communications facilities was authorized; and as the German submarines began to use the Penang base in early 1944, the German radio station there was equipped with transmitters made at the Japanese Navy depot. German radio operations were authorized to communicate freely with German submarines, and it was agreed that the Japanese Navy retain ownership of the transmitters. Frequencies for communications between Tokyo and Norddeich were carefully studied for it was almost impossible to communicate in the daytime. However,

communications were conducted satisfactorily between 1800 and 0700 hours.

Although the Japanese-German communications agreement was secret, the Italian Navy soon learned of it and demanded that it become a party to the agreement. As the motive of Italy was regarded with suspicion, her demand was rejected. Subsequently, however, Italian vessels in Japanese waters were authorized to receive information on enemy mines and submarines. In 1943, call signs and other communications data were completely revised when Italy withdrew from the Axis Powers.

Combined Fleet Communications Regulations

All naval communications were to be conducted in accordance with the communications plan of the Navy General Staff and the Naval Communications Regulations prescribed by the Navy Ministry. Each fleet commander was to prescribe detailed regulations necessary for efficient communications within his fleet. However, the communications regulations formulated by the Combined Fleet were regarded as the best example of communications regulations for operational forces and therefore, communications regulations of the fleets not under the command of the Combined Fleet were, as a rule, patterned after the Combined Fleet Regulations.

In preparing a communications plan, forces temporarily activated normally used the plan of the Combined Fleet and simply modified the

details of the plan in accordance with the disposition of its force. Although the communications plans of the various fleets may have differed in some details, essentially all naval communications actually adhered to the Combined Fleet Radio Communications Regulations, which were as follows:

General

Article 1. Radio communications within the Combined Fleet will be conducted in accordance with the Naval Communications Regulations, the Army-Navy Communications Regulations and as specified in the following articles.

Article 2. Each fleet commander will be authorized to prescribe the necessary regulations in regard to communications within his fleet and will immediately report or notify the quarters concerned of his regulations.

Operational Communications

A. Communications within the fleet

Article 3. Communications within the fleet will be ordinarily conducted directly and freely by designated frequencies.

Article 4. The operational communications assignment will be as shown in Chart 4, and the frequency system will be as shown in Chart (omitted in original).

Article 5. Transmission with the simultaneous use of day and night frequencies will be the standard procedure. However, vessels with small communications capacity may choose one frequency which will definitely be received by the addressee.

Article 6. When the enemy is within 60 miles, the tactical communications assignment will be effected in lieu of the strategical communications assignment (specific order for the change will not be issued). Ships leaving the combat area will revert to the strategical communications assignment.

Article 7. When the fleet is cruising or is at anchor in a group, each ship will continue monitoring its designated frequency. However, ships with small communications capacity will be authorized to conduct joint monitoring.

Operational Communications Assignment

Classification & Abbreviation	Communications Net	High Frequency			Medium Frequency		Low Frequency		Very-high Frequency	
		Fleet FS	FS	Gen	FS	Gen	FS	Gen	FS	Gen
1st Strategy SE-TSU-HA No 1								X		
2d Strategy SE-TSU-HA No 2			X	X		X				
1st Daylight HI-TSU-HA No 1			X	X		X		X		X
2d Daylight HI-TSU-HA No 2		X	X	X	X	X	X	X	X	X
1st Night Action YA-TSU-HA No 1	Night Action Unit	X	X	X	X	X		X	X	
	Others		X			X		X		X
2d Night Action YA-TSU-HA No 2	1st Night Action Unit	X	X	X		X		X		
	2d Night Action Unit		X			X		X		
	Others					X				
3d Night Action YA-TSU-HA No 3	Night Action Unit	X		X						
	Others					X		X		

Note:

1. Special orders will be issued for the communications assignment. Otherwise radiomen will be assigned in accordance with the 1st Strategy Communications Assignment.
2. In case of unexpected encounter with the enemy, radiomen will be assigned without orders in accordance with the 1st Daylight Action Assignment.
3. As a rule the frequency system will be ordered simultaneously with the communications assignment using the abbreviations, "YA-TSU-HA No 1" and "TE-SO No 2," etc.
4. X denotes assigned frequency according to flagship and for general use.

Abbreviations:

FS ..... Flagship
Gen ..... General

Chart 4

Article 8. As the ships of a fleet enter port, the ships having entered the port are authorized to dispense with the low frequency wave after the arrival of the flagship of the division to which it belongs.

Article 9. When a ship dispenses with the low frequency wave of the fleet, it will monitor the medium frequency wave during the last quarter of every hour from 0600 to 2200 hours every day.

Article 10. Replies to calls from ships other than from its own division will be made by the division flagship.

Article 11. The standard speed of transmission will be 85 code digits per minute.

Article 12. A ship within visual communications range is authorized to withdraw its communications watch after notifying its division commander.

Article 13. The air communications assignment will be shown in Chart 5. (Incomplete)

Article 14. As a standard procedure, aircraft communications will be relayed by its carrier. When necessary, direct communications may be conducted by preparing necessary frequency.

Article 15. The submarine communications assignment will be as shown in Chart (not entered in original text).

Article 16. As a standard procedure, submarine communications will be relayed by its flagship. When necessary, direct communications may be conducted by utilizing the necessary frequency.

B. Communications Outside of the fleet

Article 17. Each fleet flagship (or ship representing the fleet) will join the nearest local communications net.

Article 18. When a ship cruises independently, it will be authorized to join the local communications net and conduct communications.

Article 19. Communications outside of the fleet will be conducted through the flagship.

C. Communications security

Air Communications Assignments (Incomplete)

Force	1st Air Comm Assignment	2d Air Comm Assignment	3d Air Comm Assignment	4th Air Comm Assignment
1st Fleet as nucleus strength	A	B	A	E
2d Fleet as nucleus strength			B	F
1st Air Fleet as nucleus strength			C	G
11th Air Fleet as nucleus strength			D	H

Chart 5

Article 20. Plain language communications will be authorized only when there is no alternative.

Article 21. The radio silence standard will be as follows:

(1) Very Strict Radio Silence (TE-SE-KA) will be conducted when utmost control is necessary. All radio transmission will be prohibited except emergency messages absolutely necessary for operations. The local supreme commander will control radio transmission.

(2) Strict Radio Silence (TE-KE-KA) will be conducted when strict control is necessary. All radio transmission will be prohibited except messages absolutely essential for operations. Commanders of all levels will control radio transmission of their unit.

(3) Radio Silence (TE-TSU-KA) will be conducted when ordinary strict control is necessary. All radio transmission will be prohibited except messages important for operations, safety precaution and rescue. Commanders of all levels may entrust control of radio transmission to the communications officers.

D. Radio jamming

Article 22. Commanders of all levels will be authorized to conduct radio jamming when deemed effective.

Article 23. Joint jamming will be conducted in accordance with frequency assignments.

Article 24. When it is detected that the friendly communications are being jammed by the enemy, measures will be taken as follows:

Method 1. Communications will be continued with the same frequency utilizing the intervals of the enemy jamming. This method will be used in general except in those cases covered by special orders.

Method 2.)
) (Contents omitted in original)
Method 8.)

Routine Communications

Article 25. The routine communications of the fleet will be conducted in accordance with the operational communications assignment.

Article 26. The use of radio communications will not be authorized for reporting results of gun and torpedo practice firing.

Article 27. Without requiring specific orders, medium frequency of the fleet will be monitored in the following cases:

(1) When passing through narrow channels

(2) When leaving or entering ports

(3) When conducting fleet maneuvers

(4) When visual communications are impossible due to poor visibility

Article 28. When the main part of the fleet is anchored at places other than a naval port or naval station, a communication liaison with the shore facilities will be established. Special orders will be issued each time in assigning the ship responsible for the establishment of a land communications post.

Communications Inspection

Article 29. The fleet flagship (or delegated ship) will inspect communications and prepare necessary records. Important matters will be reported immediately and other matters will be reported at the beginning of each month.

1941 Naval Wartime Communications Plan

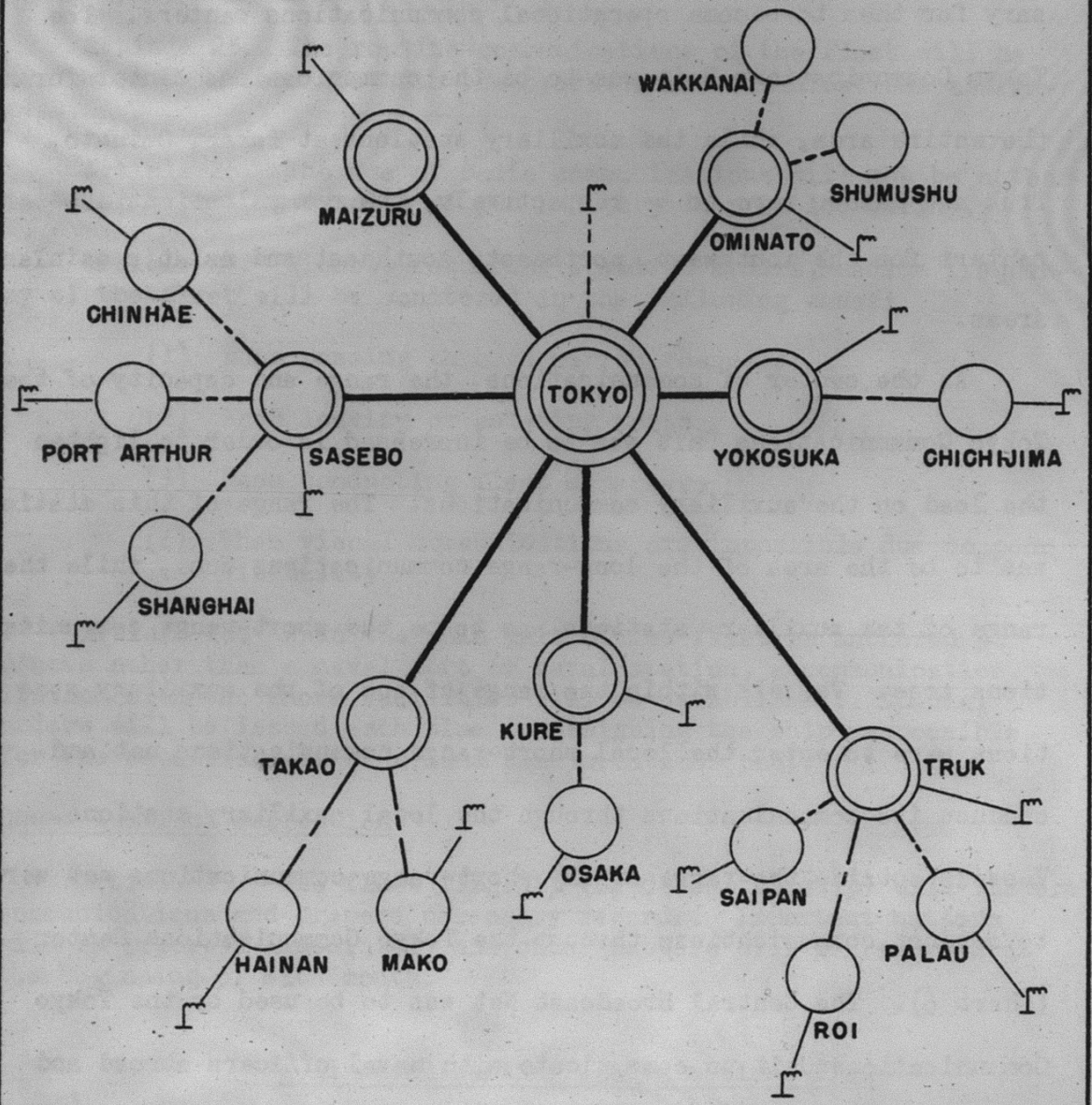
In 1941, instructions were issued converting existing peacetime communications plans to a wartime footing. The main object of this revision to wartime conditions called for converting, without undue change, existing communications facilities and practices into operational communications. The communications capacity of the main

advance operational bases were to be increased to the degree necessary for them to become operational communications centers. The Tokyo Communications Unit was to be the communications center for the entire area, while the auxiliary stations at Takao, Ominato, Truk and Sasebo were to be respectively, the communications sub-centers for the southwest, northeast, southeast and Asiatic mainland areas.

As the center of communications, the range and capacity of the Tokyo Communications Unit was to be increased in order to lighten the load on the auxiliary communications. The range of this station was to be the area of the long-range communications zone, while the range of the auxiliary stations was to be the short-range communications zone. Vessels within the range of one of the auxiliary stations were to enter the local short-range communications net and conduct its communications through the local auxiliary stations. Vessels outside the range of any short-range communications net were to conduct communications through the Tokyo Communications Center (Chart 6). The Central Broadcast Net was to be used by the Tokyo Communications Unit to communicate with naval officers abroad and with units in as well as outside the naval service. The Primary Radio Net was to be used for communications between secondary ship and land-based radio stations through the Tokyo Communications Unit. The Secondary Radio Net was to be used for communications between ship and land-based auxiliary radio stations through the secondary

CHART 6

RADIO COMMUNICATION NETS AND STATIONS



PRIMARY RADIO NET

SECONDARY RADIO NET

AUXILIARY RADIO NET

CENTRAL BROADCAST NET

PRIMARY RADIO STATION

SECONDARY COMMUNICATIONS SHIP OR STATION

AUXILIARY COMMUNICATIONS SHIP OR STATION

VESSEL

radio stations. The Auxiliary Radio Net was to be used for communications between ship and radio stations through the auxiliary radio station. The Force Radio Net was to be used for communications within the fleets or between ships and land stations or within Naval District and Naval Guard District units.

Each communications unit was the communications center of the area concerned and, as a rule, ships and stations assigned to each communications net (except those specially designated) communicated with proper parties through the central communications unit of the assigned communications net. All ship and land radio stations were attached to the Central Broadcast Net and when necessary, the fleet flagship or other ship or land radio station was to be attached to the Primary Radio Net to communicate directly with the Tokyo Communications Unit. In addition, ship and land radio stations were required to SOS on 500 KC frequency and for urgent dispatch on 215 KC frequency. In the event of an urgent dispatch, a ship or land radio station was authorized to call the desired station on the urgent dispatch frequency but was required, after contact had been made, to transmit on its proper frequency. The use of the urgent dispatch frequency was to be strictly controlled in order to maintain communications security against the enemy. Special attention was to be given to the utilization of wire communications to maintain communications security and to lighten the burden of radio traffic on Primary and Secondary Radio Nets. Transmissions by the

communications unit nearest to the fleet anchorage were to be remotely controlled by wire or else conducted by low-powered transmitters from flagships.

Communications with the Army were to be conducted in accordance with the Landing Operations Manual and the Army-Navy Radio Communications Agreement. Details regarding frequency and procedure were to be decided through consultation with all forces engaged in the operations to avoid radio interference.

Radio intelligence instructions designated Great Britain and the United States as the primary targets for radio intelligence while the secondary targets were the Soviet Union and China. The radio intelligence teams gathered information which was forwarded to the Central Radio Intelligence Group for decoding. Based on information received from these teams and through their own facilities, the Central Intelligence Group was responsible for the preparation and dissemination of the estimate of the situation.

The main target for radio direction finding was designated as the enemy forces located in the Pacific operational waters, and the secondary target as those in the Japan Sea, the China Sea and on the Asiatic mainland.

Revisions of the Communications Plan

When the theater of operation expanded considerably with the occupation of territories in the Southern Area and the increase of

forces in this area, there developed a great increase in communications traffic which taxed to the limit the capacity of the Tokyo Communications Unit. The situation reached the stage where it was impossible to conduct smooth and prompt communications through the existing method. In June 1943 therefore, revisions were made in the Navy Communications Regulations to strengthen wire communications and to strengthen radio control.

As the existing communications regulations concerned only radio communications and in view of the importance of wire communications, matters concerning wire communications were added to the regulations. Radio and wire communications were more closely coordinated to lighten the load on radio facilities as well as to increase efficiency. Communications between units having both wire and radio facilities were, as a rule, to be conducted by wire.

The existing long-range and short-range communications zones were abolished and transmission communications zones were established. They were classified into the central broadcast communications zone (entire area) and the local broadcast communications zone, and the frequency of all stations was fixed so that the transmission of any one station could cover the entire theater of operation. This called for the strengthening of the central broadcast communications net and the establishment of the local broadcast communications net.

Under the revised regulations, ships and stations assigned to each communications net could communicate with other units only

through the central communications unit of their assigned communications net. As a rule, all radio ships and stations were to be attached to the central broadcast net in addition to their local broadcast net. However, radio stations with small receiving capacity were not required to be attached to both communications nets but were assigned to only one communications net. A fixed communications net was established between units. Air communications zones and air communications nets were determined in order to unify the air transportation communications and maintain security of communications. In addition, a wire telegraph communications net and wire telephone communications net were established as well as a system for sending telegrams by telephone. When wire telephony was possible between ship and station, it was used as much as possible for unclassified or low classification messages.

As the war approached closer to the Homeland and air raids became intensified, the main operational strength of the Navy was centered on the land-based air forces. Along with the increase in forces and the acceleration of war preparations, the burden placed on communications increased heavily. Communications could not be conducted smoothly because of additional time required to handle more complicated codes and because of incapable personnel. As inefficient communications greatly affected operations, it became necessary to effect other fundamental changes in the communications plan. Therefore in December 1944, the fundamental policy was revised

and the preparation of facilities to cope with the changing war situation was also taken into consideration. Because the war situation was unfavorable, it was decided to gradually put the plan into practice before the completion of all preparations. The essentials of this revised policy were as follows:

1. The communications net will be separated into two nets -- the purely operational communications net and the administrative communications net.

2. The main air operation centers will be communications centers corresponding in size and capacity to the communications units.

3. In order to strengthen and increase the communications capacity of the communications units and main air operation centers, broadcast communications will be further strengthened, and as much of the regular fixed communications system as possible will be converted into the broadcast system.

4. Communications nets will be divided into the land communications net and ship communication net in order to facilitate the use of the ships and to strengthen cooperation of the communications unit with forces afloat.

Also included in the revision was the plan for establishing a weather net. The weather reports had been conducted mainly by wire under control of the Communications Board. However, with the intensification of enemy air raids and the expected decisive battle on the Homeland, it became necessary to convert wire communications into radio communications nets centered around the air bases.

The necessity for the immediate execution of this plan to cope with the war situation was recognized, but its materialization was delayed due to enemy disruption of communications and the delay in

the preparation of crystals. The plan, therefore, although gradually put into operation, had not been completed when the war ended.

CHAPTER II

Research in Wave Propagation

From about 1930, Vice Admiral Minohara, Tsutomu and Captain Ito, Yoji, both members of the Naval Technical Research Laboratory at the time, were engaged in research work in wave propagation and ionized layer. Experiments were made by the "interference method" which had originally been conducted by Dr. Appleton. In view of the fact that Dr. Appleton's experiment was conducted in 1926, it is worthy of mention that the research by the Japanese Navy began only four years later.

Although the early experiments were conducted by the "interference method," subsequent experiments were conducted by the "impulse method". This was the basis of radio communications used in the Pacific War. By this method, a transmitting station transmitted radio waves modulated by a very short impulse of about 10^{-4} second so that the approximate height of an ionized layer can be estimated by measuring the time difference between radio waves transmitted along ground surface and those reflected by air ionized layers in the upper atmosphere.

A transmitter of this type was installed at the Meguro Naval Technical Research Laboratory (Tokyo) and receivers were set up at Tachibana Mura Receiving Station and at Hiratsuka Receiving Station established in the compound of the Naval Powder Depot in Kanagawa

Prefecture. The results of experiments were recorded simultaneously at both receiving stations. Experiments were conducted with frequencies ranging from 2,000 to 2,999 kilocycles. Continuous measurements at fixed frequencies were conducted chiefly at 4,000 to 4,999 kilocycles. As a result, it was discovered that the ionized layer existed at heights of 90 to 110 kilometers in the daytime and about 200 kilometers at night. Subsequently, photographic strip records were made of the ionized layer at a fixed frequency (4,000 KC). It has been revealed by Dr. Appleton that the layers existing at heights of 90 to 110 kilometers in the daytime and at 200 kilometers at night were different. He called the former E-layer and the latter F-layer.

The measurement of the height of the ionized layer by the Navy was conducted by continuous observation of the various heights of the layers by fixed frequency. In November 1932, the relation of the layers with meteors was investigated. At the time of the solar eclipse on Losap Island in the South Sea Islands on 14 February 1934, research personnel were sent to investigate and to clarify the conditions of the ionized layer in the southern area. At the Hiratsuka Laboratory of the Naval Technical Research Laboratory, the strength of actual radio waves from every part of the world was measured and studies were made of the variations of wave strength during a day and the four seasons.

The measurement of the ionized layer up to that time had been limited to that of the height of the layers. In some cases, in-

vestigation of variations in radio waves was conducted occasionally by changing the frequencies. The measurement of density of the electrons (or penetration frequency) which determines the highest possible frequency, important for communications, was not made at all. On the other hand, in 1932, Mr. Namba, Shogo of the Electricity Research Laboratory of the Communications Ministry determined (similar to method by Eckersley) the alternation coefficient for radio waves passing through the ionized layer. He utilized the high frequency field intensity measurement records which were available as a result of cooperation between Great Britain and the United States and which were made public by Burrows. Mr. Namba estimated the ionosphere and announced the method as to how to calculate the high frequency field intensity for long distance communications.

The measurement of the height of the ionized layer as well as the penetration frequency was started in 1934. It was discovered by this experiment that when frequency is increased, radio waves which are originally reflected by E-layer penetrate this layer and are reflected by F-layer. It was also discovered that as the frequency is increased, the radio waves penetrate F-layer and pass beyond the ionosphere. In 1934, experiments for measuring the penetration frequency and the height of the ionized layer were chiefly conducted by the Naval Technical Research Laboratory. As a result, the highest practicable frequency in communications with Tokyo as a center was determinable for any hour of the day or season of the year.

The lowest practicable frequency according to the output of the transmitter was determined, as experimented by Eckersley, by the degree of attenuation of radio waves when they penetrate or are reflected by the E-layer. However, this question of attenuation presented many difficulties. From a theoretical point of view, there are different opinions even today in that numerous unknown coefficients are found in attenuation. Therefore, radio waves with various frequencies in actual communications should be utilized to measure the field intensity according to various ranges and seasons of the year and that attenuation factor be induced from the field intensity. However, such an experiment requires a large number of field intensity measuring sets and many years of observation and careful arrangement of data.

It was discovered that the highest practicable frequency (basis for making a communications plan) can be determined by measuring the ionized layer, regardless of the output of transmitters, and that the lowest practicable frequency can be calculated by the measurement of field intensity and by close observation of the ionized layer, especially E-layer. It was made clear that the basis for the selection of communications frequency lies in measuring the ionized layer and field intensity.

The ionized layer measuring equipment was gradually improved, largely through the efforts of Technician Shinkawa and Lieutenant (Technical) Yamamoto. For the observation of the solar eclipse in

Hokkaido on 19 June 1936, automatic equipment had been devised to record by photograph the penetration frequency by connecting a transmitter and a receiver to the layer measuring equipment and by changing frequencies. Thus, through research in the ionized layer, the necessary data was available for the communications plan. It was after 1934 that penetration frequency for the ionized layer could be measured. From 1934 to 1937, the following facts were made clear:

1. In the variations during a day and a year, the density of the electrons in E-layer varies with the sun's altitude and is approximately in proportion to $\sqrt{\cos x}$ wherein x represents the altitude of the sun. This coincides with the theory advanced by Chapman.

2. Besides regular reflections, there are irregular reflections called sporadic reflections in E-layer.

3. In the daytime, F-layer is divided into F1-layer and F2-layer. In winter, however, F1-layer does not appear. F2-layer appears only at night. The diurnal and annual variations in F1-layer are more irregular than E-layer, but are subject to variations approximately in proportion to $\sqrt{\cos x}$. However, the day-night variation in F2-layer disagrees considerably with Chapman's theory. In other words, the day-night variation is not symmetrical with noon as the dividing line. Penetration frequency becomes rapidly higher with the sunrise, and after sunset it gradually (especially in summer) becomes lower; it reaches the lowest at daybreak. Moreover, the day-night variation is considerably great, amounting from 10 to 20 per cent. In the seasonal variation, the lowest penetration frequency is observed twice--once in winter between December and January and again in June. The highest penetration frequency occurs in spring and fall. Considerable discrepancies with Chapman's theory exist on this point.

Results of Research, 1939-1940

In September 1939, an observatory was established on Palau

Island to conduct the observation of the ionized layer in the South Sea Islands area. By this observation, valuable data was obtained for communications in the equatorial area. The short and medium range high frequency propagation charts were prepared based on attenuation calculations in accordance with observation and measurement of field intensity and they were published December 1939 in Tokyo. This chart contained frequency, time and correlation of field intensity in every month of the year for ranges of 300, 500, 700, 1,000, 1,500, 2,000 and 2,500 kilometers, and served as a guide to communications in medium latitudes and during the period of maximum sunspots. The short and medium frequency wave propagation chart for the South Sea Islands area, based upon a one-year observation on Palau Island, was published and distributed by the Naval Technical Research Laboratory in September 1940.

Results of Research, 1941

As a result of research, data on penetration frequency (density of the electrons), the height of the ionized layer and field intensity was obtained. Research was made for day-night and seasonal variations and their relation with sunspots. The relationship of the density of the electorns with the sunspots is as follows:

1. Marked correlation between the day-night variation of the electrons and that of the sunspots cannot be observed.

2. There is a marked positive correlation between the mean monthly value of density of the electrons and that of the sunspots, and both make corresponding changes.

Therefore, practical radio frequency varies with the sunspot cycle. In other words, high frequency can be used during the maximum value of sunspots. Because high frequency is subject to less attenuation, it makes communications easier. Too high a frequency cannot be used for communications during the minimum value of sunspots when penetration frequency is low because it will penetrate the ionized layer. It was also discovered that communications become difficult on account of attenuation in this period.

The government organization of the Radio Physics Research Committee, which had been advocated by the Electronics Research Committee of the Scientific Research Council, was promulgated in April 1941. The elevation of the committee to the status of the Radio Physics Research Institute was, at the time, jointly supported by the Army, Navy and the Communications Ministry with the aim of research in wave propagation and the ionized layer.

Results of Research, 1942 - 1943

A wave propagation chart book was distributed in July 1942 by the Naval Technical Research Laboratory. In addition to the wave propagation charts for the equatorial and the medium latitude areas which had been published previously, it contained a wave propagation chart based on the data obtained at Shikuka, and a long-range propagation chart. Since these charts were based upon the data for maximum value of sunspots, many discrepancies were found in the actual communications during the minimum value of sunspots.

High frequency in the equatorial area was reported inadequate because of the minimum value of sunspots, sudden decrease in penetration frequency at daybreak and great attenuation in the equatorial area. Therefore, there arose an urgent need to use medium frequency at night and daybreak and for short distance communications. Such being the case, observations in the southern occupied areas became necessary. The Army planned to establish observatories at Singapore, Bandoeng, Manila and Rangoon; and the Navy at Paramushiro, Kwajalein, Makassar, Sabang and Rabaul. It was decided that the nucleus of these observatory staffs would consist of personnel from the Radio Physics Research Institute.

The Army began to establish its observatories from January 1943 in the order Singapore, Bandoeng, Rangoon and Manila, while the Navy commenced in July on Kwajalein, Paramushiro, Makassar, Rabaul and Penang. The observation party for Rabaul was lost enroute at sea. All members of the Kwajalein party were killed in action while preparing for observations after arrival. They were all costly sacrifices for wave propagation research. The observatories at Paramushiro, Makassar and Penang were established without difficulty and furnished valuable information.

Results of Research, 1945

As the conditions of the ionized layer in each area became clearer through data obtained from the southern area, the Naval Technical Research Laboratory distributed to the Navy a monthly bulletin

containing wave propagation information together with the forecast for the following month for use in communications.

With the progress of the war, research in wave propagation for aircraft became an urgent necessity. Only one frequency was used during one flight regardless of day or night. However, it was revealed that since the range of ground waves could be increased more in the case of aircraft owing to its high flying altitude than in the case of ground communications, the ground waves occupied half the radio waves used in transmitting from fighters operating at short range. This information, the result of calculating the ratio between the flying altitude and the range of ground waves on land and sea, was imparted to air units through the Yokosuka Air Group. Moreover, in consideration of the sky and ground waves with ranges up to 500 kilometers, a disc-type aviation wave propagation chart was devised and distributed to each air unit through the Yokosuka Air Group.

A practical high frequency chart was distributed as Wartime Research No 12, with Yokoyama, Eitaro of the Radio Physics Research Institute in charge. With time and range as the axis, and frequency as the parameter, this was a convenient and easy reference chart for beginners. However, there were gross errors pertaining to waves of 2, 3 and 4 megacycles, particularly in the attenuation in the daytime. Since the use of medium frequency on aircraft was stressed for operational radio waves at night and at daybreak, the books were distributed among the units concerned after corrections were made.

The following is summation of research on radio wave transmission directly connected with organization of the radio system:

1. Observatory in Tokyo, 1934. Condition: Sunspots at minimum.

In Tokyo, the vertical penetration frequency at F2-layer at noon was 6 to 6.8 megacycles in the spring and fall, and 5.5 to 6 megacycles in summer and winter. At midnight, it was 2.3 megacycles in December and January, and 4.8 megacycles in summer. Communications in high frequency became so difficult and the high frequency band so narrow that the following frequencies were adopted according to the distance of communications:

Day frequency ..... 5 to 13 megacycles
Night frequency ..... 2 to 6 megacycles

The number of sunspots made a sharp increase which indicated that the sun entered the period of intense solar effect. The penetration frequency at F2-layer at noon was 12 to 13.7 megacycles in spring and fall, and 7 to 8.7 megacycles in summer and winter. The frequency band was greatly expanded and communications became easier. Frequencies adopted:

Day frequency
Spring and fall ..... 9 to 25 megacycles
Summer and winter ..... 7 to 18 megacycles

Night frequency
Winter ..... 3 to 8 megacycles
Summer ..... 5 to 11 megacycles

No inconvenience was experienced in communications by the

high frequency band of more than about 4 megacycles. This precluded the need for using medium frequency. The output of more than one kilowatt increased the range of communications considerably. Therefore, in some cases, it was possible to use only one frequency through the day and night when the right frequency was selected.

2. Observatories at Tokyo, Palau and Shikuka

Sunspots gradually entered a period of decrease in number, with 1938 as the period of maximum frequency. Penetration frequency at the ionized layer also became greatly lowered. In Tokyo at noon, it dropped to 8 to 10 megacycles in spring, fall and winter, and 7 megacycles in summer. At midnight, it was 3 megacycles in winter and 6 megacycles in summer. In Palau at noon, it was 9 to 10 megacycles in spring and fall, and 8 to 9 megacycles in summer and winter. At midnight it was 8 to 9 megacycles in spring and fall, and 6 to 7 megacycles in summer and winter; but at daybreak, it showed a sharp decline to 3 megacycles. In Sakhalin at noon, it was 7 to 8.5 megacycles in spring, fall and winter, 5.5 to 7 megacycles in summer, while at midnight it was 3 megacycles in winter and 5.5 megacycles in summer. The conditions of communication became gradually worse with the decrease in the number of sunspots from about 1937. For night frequency, a frequency of about 3 megacycles became necessary for short distance communications. In the southern area, the density of electrons did not show much decrease from daytime until midnight, whereas it showed a sharp decrease at daybreak which made it very

difficult to choose an operational frequency at dawn.

Frequencies adopted:

Medium frequency
7 to 16 megacycles ..... in medium and low latitudes
5 to 13 megacycles ..... in high latitudes

3. Observatories at Tokyo, Palau, Toyohara, Paramushiro, Singapore, Rangoon, Bandoeng, Manila, Makassar and Penang.

Period: 1942 to 1945

Since sunspots were at the minimum value in 1943 and 1944, communications were very difficult. It often happened that at daybreak in the southern area, frequency had to be lowered as far as 1.5 megacycles. Therefore the use of medium frequency of 2 to 4 megacycles became necessary at night and daybreak. A close investigation had to be conducted into the time for change of day frequency to night frequency and vice versa. A very high frequency could not be used for day use as there was too much attenuation. The range of communications by one frequency was diminished and the planning for communications nets became extremely difficult.

Frequencies adopted:

Day frequency ..... 5 to 13 megacycles
Night frequency ..... 2 to 6 megacycles

CHAPTER III

Communications Security

Cryptographic Functions

As was briefly described in Chapter I, cryptography was administered by the 9th and 10th Sections of the Communications Department (4th Bureau, Navy General Staff). The 9th Section had one staff officer in charge who decided the general policy to be integrated in any communications plan of the Navy. The details for code planning, training, equipment, compilation, code books, code tables, encoding and decoding and other implementing functions were the responsibilities of the 10th Section.

Until 1943, the post of chief of the 10th Section was concurrently held by the chief of the Radio Communications Section of the Navy Ministry. In September 1943, a full-time section chief was assigned to the 10th Section and the chief of the Radio Communications Section was delegated the concurrent role of commander of the Tokyo Communications Unit. With this change, the function of encoding and decoding was transferred to the Tokyo Communications Unit as were most of the code personnel. The duties which were retained by the Radio Communications Section consisted of receiving and filling outgoing messages to and from the Navy Ministry, the Navy General Staff and other Navy offices in Tokyo, making copies and distributing incoming messages, security of messages and other matters concerning handling of coded matters.

In the naval districts and guard districts, crytographic materials were handled by the local communications unit stationed in that district. In the units, they were handled by the assistant communications officer or by a code officer independently assigned, but as the number of ciphered messages increased, additional commissioned and warrant officers were assigned.

The printing of cryptographic materials was carried out by the Printing Bureau of the Cabinet, but later when the Naval Code Book A and other publications were contemplated, the printing was undertaken by the printing office in the Navy Ministry. With subsequent increases in the various types and copies of cryptographic publications to be made, the printing services of the Naval Torpedo School and the Naval Communications School were called upon to perform the task.

During the Pacific War, most of the printing except military top secret matters was initiated by the Bunjudo Printing Office in Yokohama (Navy-controlled publishing company). In 1944, the 10th Section of the Navy General Staff was moved to that concern and code books of all description were printed there.

Code Printing Techniques

Combat experiences had shown that it was extremely difficult to dispose of code books immediately in emergencies. Thus various methods were sought to print code books which, when sunk, would be

obliterated in water such as: (a) Chemicals which dissolve the contents of a book when soaked in sea water, (b) water-soluble ink which fades away when exposed to sea water, and (c) water-soluble paper. Of these three methods, the chemicals mentioned in (a) had long been under study, but by this method alone, it was impossible to chemically treat all those which were being used. Therefore, careful study was made of (b) and (c). The research for water-soluble ink was made at the Technical Research Laboratory (by Senior Technician Kisa as the person in charge) but the study reached a stalemate because of the following problems:

1. If solvent action was too sensitive, there was danger of the writing fading from rain-water, splashes of sea-water or perspiration when the printed matter is being carried or used, and, if the action was too weak, there was danger of the writings failing to become invisible.
2. The chemical for treating printed or written matter had to be absolute so that it would be impossible for the enemy to use scientific means to cause reappearance thereof.
3. There was the difficulty of eliminating traces of type print.

The German water-soluble ink served as the incentive and water-soluble ink reportedly superior to the German counterpart was concocted. With the use of this ink and starch-coated paper, it was

planned that the regulations for its use should be printed first of all. After confirming its practicality, other matters such as the additive tables and the code books were to be printed.

The printing method merely entailed cleaning the type with benzine and then applying the water-soluble ink. No special printing machine was used and the matter to be printed was run off in the usual manner. When the printed matter was thoroughly soaked as a book, the permeation of sea-water through all parts took several hours. Whether the traces of the printing types remained depended largely upon the printing technique and there were some cases in which disappearance was not complete.

Encoding of Call Signs

For the utmost security, it was necessary to encode call signs and names of senders and addressees, particularly since it was vital that movements and locations of the naval forces be kept in strict secrecy. However, naval authorities felt hesitant about further complicating the encoding system as they were apprehensive of the costly delays to communications. On the other hand, it was believed that well-trained radiomen would be capable and the authorities started on the compilation of code books for utmost security. Actually, there was little hope of establishing an intricate system of encoding call signs and names of senders and addressees in view of the marked deterioration of radiomen's skill during the war.

A program to encode the call signs and the names of senders and addressees with the improved "ENIGMA" transcription machine* was planned, but got no further since clerical persons equal to the number of radiomen to dictate were required. In the Hawaiian operations, special code phrases were used by the Combined Fleet and no special measures had been taken by the Central Agency. However, in anticipation of commencement of operational action in November 1941 when the First Air Fleet anchored in Saeki, the "New Code Book for Air Communications, Vol II" and the "New Code Book for Tactical Operation (Part B)" were distributed to each ship of the Fleet to be used in the forthcoming operation.

The code was changed periodically but in case of security "accidents" to code books in the interim, top secret communications were handled by the application of the emergency regulations and use of other code books. Revision of code books was made by improvising on the code books currently in use. In case of "accidents" to the master code books, the emergency regulations were to be applied as a temporary expedient and new code books were distributed to replace the old ones. In case of "accident" to other than the master code books, the emergency regulations were telegraphed by means of other code books, depending upon the urgency and the extent

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*The "ENIGMA" was originally a German code machine which the Japanese improved and adapted to the "KANA" (Japanese alphabet). This machine transcribed, i.e., encoded from dictation.

of distribution. Units not accessible by telegraph were informed of the regulations through liaison by the nearest senior commanding officer, and the code books, after being revised, were distributed later to replace the old ones.

Communications Defense Countermeasure Committee

With the progress of communications technique, communications intelligence also made rapid progress through the expansion and strengthening of its agencies. As a result of the study of enemy communications, respective agencies often submitted recommendations on items requiring revision of security of friendly communications.

At the time of the northern French Indo-China operations in January 1941, the 2d Carrier Division (the Soryu, Hiryu and 23d Destroyer Division) was ordered to advance to southern Formosa. It sailed southward under radio silence but due to an unforeseen incident in the vicinity of Agincourt, Formosa, a considerable number of messages were transmitted. The British Navy at Hongkong learned of the Japanese movement apparently through interception of these messages. This was confirmed through Japanese interception of their communication which read: "The 2d Carrier Division is sailing south and it is certain that an aircraft carrier believed to be the Soryu reached northern Formosa, but nothing is known since then, and the rest of the force proceeded to Takao."

This incident served as a great impetus to security counter-

measures for communications. The results of studies showed there were considerable defects in the current call signs and that monitoring revealed the characteristic of each ship from its transmitting frequencies. It was therefore certain that the enemy, through monitoring, radio direction finding and call signs, was making an intensive study of Japanese communications.

Therefore, in order to establish countermeasures, a Communications Defense Countermeasure Committee was formed in December 1942. The members were as follows:

Chairman: 4th Bureau chief, Navy General Staff

Committee members:

9th Section chief (concurrently 10th Section chief)

Members of the 9th and 10th Sections

Naval Communications School instructors

Naval Technical Department members

Naval Air headquarters members

Yokosuka Air Group instructors

Members of Naval Affairs Bureau

Technical Research Laboratory members

The committee studied broad problems concerning communications, and in September 1943 submitted a report, the gist of which follows:

1. Revision of Communications Procedure:

With broadcast communications being the predominant means, the transmittal forms will be revised and adhered

to: strengthening of security, speed and reliability of handling, simplification in administration and discipline in communications.

2. The following code countermeasures are planned:

   a. Rationalization of code revision.

   b. Strengthening and increasing handling speed by mechanization.

   c. Prevention of "accidents" during transportation.

   d. Planning measures for localizing damage in case of "accidents."

3. Countermeasures for equipment:

   a. Investigation of transmitters incapable of radio direction finding.

   b. Elimination of the characteristics of radiation waves.

4. Induce more security measures in basic training at communications schools.

5. Establish efficient inspection agencies for communications.

These countermeasures were put into effect at once. Then revision of the communications rules was taken up, with the Communications School and the Yokosuka Air Group taking the initiative. In August 1944, a draft was prepared but further discussions and studies prolonged final decision until 1945 when it was ready for printing. However, there was no opportunity for its enforcement due to the adverse war situation at this time.

Countermeasures for Equipment

1. Development of a transmitter which could avoid detection

by radio direction finders: A device known as "NB" (medium frequency communications method which eludes radio direction finders to a great extent) had been completed at the end of 1944, and was installed on flagships in January 1945.

2. Elimination of the characteristics of radio waves.

a. Tone-changing device: In order to offset the characteristic of the tone of transmitters, a device was added by which the tone was varied intermittently.

b. Monitoring to determine correctness of signal was conducted on main warships. In particular, repairs were made on devices which transmitted notably peculiar radio waves.

The monitoring of friendly communications had heretofore been carried out by higher headquarters of each communications unit without resorting to any special research body. The necessity thereof had been keenly felt, but it did not materialize as there was great difficulty in providing suitable installations and personnel.

Essential Points of the Revised Communications Procedure

The Navy Communications Rules had been revised in 1937, and subsequent to that year, many revisions and additions had been entered. There still existed a need for security in tactical communications, particularly aircraft communications. The problem rested on the need for establishing a suitable transmittal form for messages and the need for communications discipline.

Outline of the revised Navy Communications Rules.

1. The name was changed to Navy Communications Regulations.

Radio, wire communications and radiotelephone were included therein.

2. Because of the peculiarities inherent in aircraft communications and the training of personnel, only matters concerning aircraft communications were extracted and compiled in the "Extracts from the Navy Communications Regulations (Aircraft Communications)."

3. The five types of message transmittal forms were as follows: basic, strategical (divided into general and security), tactical aircraft communications (air-basic, air-No 1 and air-No 2) and emergency.

a. The basic transmittal form

This was a transmission form used for direct communications or broadcast communications between bases and for short distances (generally 200 miles to avoid long-distance transmittal) in the routine and strategic communications.

b. Strategic general transmittal form

This was used mainly for broadcast communications between ships or stations in strategic moments. It was a transmittal form which had greater security for routine and strategic communications and could be used for general communications.

Calling: Common signs were used mainly.

Heading: (1) All prefixes were omitted; (2) the handling of all items, with the exception of those referred to in Code Indicator "KO" Manual or those having a broadcast number or those in numerical or letter code, were somewhat simplified.

Ending: The heading was to be repeated to prevent errors in broadcast call signs.

c. Strategic security transmittal form

This was applied in case greater security was required than in the strategic general transmittal form.

Heading: (1) Prefixes were the same as in (b); (2) addressee, for distribution list addressees, part or all of the conventional message text were made into code form and inserted at the end of the text (Call signs were the same as code signs).

d. Tactical transmittal form

This transmission form was to be used when voluminous, prompt and smooth handling was required. The main form of communications was broadcasting and direct communications could be effected when necessary.

Heading: (1) Only necessary matters were to be entered; (2) Senders address and distribution list addressees (these were not inserted in the text, unless special mention was required) were usually omitted.

Ending: Same as the basic transmittal form

e. Aircraft communications transmittal form

Because of the characteristics of aircraft communications, the tactical transmittal form was further simplified for sole use in aircraft communications and in facilitating training. The main form of communications was broadcasting, and direct communications could be effected when necessary. In order to strengthen the security of call signs of aircraft, ship and station communications, a different call and ending was used for this transmittal form, classifying them as air-basic transmission, air-1 or air-2 transmission.

f. Emergency transmittal form

This was the most simplified transmittal form used to transmit only the text and the ending (station callsigns were omitted), and was adopted in case of great urgency.

g. In case acknowledgement was required and direct communications were to be effected in various transmittal

forms, the acknowledgement request sign was transmitted at the conclusion of the "ending" to indicate the switch-over from broadcasting.

4. In case the indication of frequency in communications was required, abbreviated frequency code was used for security purpose.

5. The two relay methods were the ordinary relay method (usual relay method) and emergency relay method (a method of relay broadcast in which messages received were relayed as they were received in order to minimize delay). Relay instructions were prescribed for such instances wherein there was vagueness or doubt in the receiving of messages.

6. When jamming was perceived, transmission was required to be suspended at once.

7. Radiation of radio wave was so arranged that it could not, under any circumstances, be undertaken without the permission of the communications officer. At the same time, for the prompt handling of communications in case radio control was not in force (in strategic and other areas) for the radiation of radio wave, the communicator (radiotelephone operator) would obtain permission only on the following matters prescribed by the communications officer:

a. Correction of mistakes in transmission;
b. Reply to radio transmission (voice transmission);
c. Reply message in testing and transmitting call signs.

8. The service message was divided into the reply to transmission and service message. The reply to transmission was limited to an extremely small number (in case of aircraft transmission, it

was generally the same as that used in the past), the use of which was left to the operators, depending upon the situation. Except for the above, when the communications officer deemed it necessary, the Navy communications code books (the numerical and sign books, the security of which was better than the currently used procedure signals, and which were easy to use) were to be used for general communications. However, in the case of aircraft communications, the abbreviation "RI-YA-OTSU" was prescribed for those of special importance.

9. The operations liaison (liaison absolutely necessary for operations and security), testing (used exclusively for testing radio sets), and call-reply liaison (call and relay) were as newly prescribed and placed under the single heading "liaison".

Unification of the Code Regulations

The code books had their respective regulations concerning their use but the contents of these regulations were much the same. Therefore, the suggestion for unified regulations was made, but as multiformity of code was rather advantageous from the viewpoint of security, the suggestion was not carried out. However, it was decided that a unified code book should be provided for both the numerical code and letter code including the headings and indexes of the code method to be referred to.

The compilation of the code book "RO", which was to replace

the code book "D", was started in the latter part of June 1942 and completed in the latter part of July. This code book together with the code book "OTSU" which was still valid was immediately distributed to all the units of the Combined Fleet. The distribution within the Combined Fleet by means of destroyers and aircraft was completed by early September. The distribution to and enforcement by the China Area Fleet took an additional month or two. Since then, new code books were prepared successively and everything proceeded smoothly by the end of 1942.

In view of the fact that the distribution of code books had taken one and a half months even with the assistance of the Combined Fleet, there arose the demand for the urgent study of measures regarding further distribution due to the revision of code books.

Revision of Code Books

With the failure of the Midway operation, the main body of the air fleets was completely destroyed as well as some aircraft carriers. As a result of this situation, it was feared that some of the code books lost were seized by the enemy and necessitated changing all the code books (except those used for information). However, the staff of the Combined Fleet was of the opinion that if there were any code books lost, they would not cause an immediate danger. The Central Agency also held the same opinion and the only action taken was to apply the emergency regulations (using the old code books as

the master code) as a temporary expedient.

Subsequently, all the code books were revised in the order of their importance. The additive method (numerical code system) was adopted to a greater extent than before and the titles of code books were revised to disguise any suggestion of their contents. The existing code books were named by their contents and catalogued by the "JIKKAN" system (use of the ten Japanese calendar signs). When code books increased in number, Roman letters were added to the titles.

Code books had hitherto been revised every several years, and the regulations for their use as well as the additive tables were revised every 6 to 12 months. However, in view of the increase in communications, more frequent revisions were made according to the following standard:

1. Strategic code book and its regulations for use:
   Every six months or one year.

2. Additive table and its key table:
   Every one to six months according to the frequency of use.

3. Tactical code book:
   Once a month.

4. Call signs:
   The original was changed once a month; the change by a modification table was made every day or once a week.

Distribution System of Cryptographic Publications

The Navy Library and the Naval District Libraries respectively served as the cryptographic publications distributing organs for

the Central Agency and for each naval district.

The Navy Library was attached to the Secretariat of the Navy Minister and its chief librarian was charged with the custody and distribution of Navy publications. A chief librarian was assigned to each Naval District Library with the concurrent position of assistant to the staff officer in charge of the custody and preparation of publications.

Since there was no direct connection of command and supervision between the Navy Library and the Naval District Libraries, distribution could not be carried out smoothly, and the increase in the number of copies and frequent renewal of cryptographic publications necessitated a drastic reform of the distribution system.

In March 1942, the Navy Library became the 5th Section of the Naval Ship and Ordnance Department and the chief librarian of the Navy Library was concurrently assigned to the Naval Ship and Ordnance Department to be in a better position to command and control distribution.

Although this reform of the system greatly facilitated the transportation of cryptographic publications, the marked decline in the general appreciation for the maintenance of secrecy and the importance of the code and cipher caused the frequent loss of these publications. In addition, the whereabouts of many cryptographic publications became unknown during transit. Much time was taken for investigation to determine whether there were any cryptographic

publications carried by transport ships when they were sunk. In short, the merits and demerits of this system were about the same and only the Naval Ship and Ordnance Department staff who appreciated the importance of the cryptographic publications made positive efforts in making effective use of the new system.

The results were satisfactory in part, but the conspicuous drawbacks of the new system were that the personnel became lax in safeguarding secrets and that cryptographic publications were found to be missing for long periods of time.

Taking into consideration the capacities of the Navy Library and Naval District Libraries, the cryptographic publications were distributed to each department and the code book contents scheduled to be revised were made known to each department half a year before the revision. However, in consideration of the scope of distribution, this system was changed in 1940 and orders were issued by radiotelegraph because the old system involved complicated procedures due to frequent changes in schedules. It was decided to notify en bloc the schedule and change of schedules in monthly reports by the Telegraph Section.

In order to minimize security "accidents" to code books which had been put into use, it was decided after the Midway operation that only the current code book and that for the next phase of operations should be distributed and that the rest be kept in the libraries. Accordingly, in view of the necessity to distribute successively the

frequently revised code books in time for use, it was decided to issue detailed instructions concerning the distribution twice a month in addition to scheduled cancellation notices and other remarks in the Navy Official Report Appendix. These instructions were to be given exclusively to the headquarters and local distribution offices, and other departments were to be notified by their respective commanders.

With reference to the monthly report, a distribution division was instituted in the Telegraph Section to make a detailed investigation of the actual distribution of code books in addition to the compilation of the report in an effort to achieve maximum efficiency in handling code books and safeguarding secrecy. The code books, upon completion, were transferred to the Navy Library directly from the printing office under the supervision of the Bureau of Naval Affairs which immediately transferred them to each Naval District Library. Transmission was effected under the escort of librarians. The local distribution offices conducted mass transportation under the escort of their staff members, but as for distribution to minor offices, the recipients were summoned or the code books were forwarded by registered mail.

The return of code books from various units was made in the Homeland as soon as orders for cancellation were issued; from overseas areas, they were returned when ships were available; and code books in custody of ships were returned when the ships docked in

Homeland ports. Later however, due to frequent "accidents" during transportation and the shortage of transports, the officer in charge of code books was to burn them and then notify the Navy Minister in writing to that effect.

Enforcement of the Code Area System

As the war situation turned unfavorable, many forces were isolated at widely remote places. Accordingly, the distribution of cryptographic publications became very difficult and drastic measures were necessary for this distribution. Thus, it was decided to adopt the code area system (Chart 7).

The entire theater of operations was divided into 11 code areas, and of these, nine were grouped into three categories (W, Y and X in Chart 7) when unification was required from the operational viewpoint. The code books were differentiated as -- the code book used exclusively for communications within the area (non-related to other areas), and the code book used for communications between the headquarters of the area and the Central Agency. Japan Proper, the greater part of China and Formosa were excluded from the code areas and the old code system was observed.

The code book for the exclusive use within a code area was called Code System "HA", and Code Book "HA", the Regulations for Code "HA" and Key Table "HA" were used. As Code Book "HA" had not been compiled in time, Code Book "TEN" was used instead. The code

Area	Theater	Control Center	"I"	"RO"	"HA"
K	South China Hainan Island	Hq 2d China Expeditionary Fleet Hq Hainan Guard Dist	No 7 No 14	Special (Common to communications centers)	No 7
M	Malaya Sumatra North Borneo	Hq 10th Area Fleet (10th Comm Unit) Hq 1st Southern Expeditionary Fleet (10th Comm Unit)	No 1 No 13		No 1
S	French Indo-China Thailand	Hq 11th Base Force	No 4		No 4
J	Java S and E coasts of Borneo Celebes Lesser Sunda Islands	Hq 2d Southern Expeditionary Fleet (21st Comm Unit)	No 2		No 2
Y	Covering J, M and S areas	Hq 10th Area Fleet (10th Comm Unit)			No 13
X	Covering K, M and S areas	Hq 10th Area Fleet (10th Comm Unit)			No 14
B	Burma	Hq 13th Base Force (12th Comm Unit)	No 11		No 11
F	Philippines	Hq Southwest Area Fleet	No 10		No 10
G	Area north of Australia	Hq 25th Base Force (24th Comm Unit)	No 3		No 3
O	Bonin Islands Iwojima Marcus Island Wake Island Pagan	Hq Chichijima Base Force (Chichijima Comm Unit) Hq 27th Air Flotilla	No 5 No 15		No 5
N	Southeast area East Caroline-Marshall area	Hq Southeast Area Fleet (8th Comm Unit) Hq 4th Fleet (4th Comm Unit)	No 12 No 6		No 12
W	Covering N, O and P areas	Hq Southeast Area Fleet (8th Comm Unit)			No 6
P	West Caroline	Hq 30th Base Force (3d Comm Unit)	No 9		No 9
T	Formosa	Hq Takao Guard Dist (Takao Comm Unit)	No 8		No 8

Remarks:

1. "I" codes were for use between the center of a code area and the Central Agency or C in C Combined Fleet.
2. "RO" special codes, were for use between the following important sections: Central Agency; C in C Combined Fleet; commanders of various fleets; commander of 27th Air Flotilla; commanders of important base forces (those at Kurile Islands, Chichijima, Okinawa, Port Arthur, Rashin, Yangtze River, Amoy, Hongkong, Tshingtao and Mako); 9th, 10th, 11th, 12th, 13th, 15th, 21st, 22d, 23d, 25th, 30th, 32d, 33d Base Forces.
3. "HA" codes were for use between various sections within a code area.

book was common to all the code areas but the regulations for code and the key table were different.

The code book for use within the code area was distributed to every communications organ in the area and arrangements were made so that only the Central Agency and the Combined Fleet headquarters could communicate directly with the areas. The code book was distributed also to the naval districts and guard districts in Japan Proper and Korea to be used for interception. The code method was the numerical code by the additive panel.

The code book used for communications between each communications center was called Code System "I", utilizing Code Book "I", Regulations for Code "I", Key Table "I" and Additive Strip "I". The Code Book "I" had not been compiled in time so that Code Book "RO" was used instead.

In the beginning, it was planned that all the code books and tables should be different for each code area. Actually they were made different except the code book, which was used in common, but there was no code for use in the group areas, W,Y and Z. The Central Agency and the Combined Fleet headquarters possessed all the code books, while the naval districts and guard districts in Japan Proper and Korea possessed only the decoding books. The code method was approximately the same as Code "H", but to strengthen security, the additive "strips" which were attached to the additive panel were frequently changed.

When the distribution of code publications to District F became impossible, Area F used the special "RO" code which had been established for that area before the enforcement of the code area system as well as the code regulations and additive table* specially designated for that area.

The code area system was gradually carried out by areas where the revision of the codes "RO" and "TEN" was not feasible in case of security "accident", and in May 1945, the system was in force in almost all the code areas (excluding Area F). In Area F, the use of this system was not possible. Area B was dissolved because the Burma area was lost before the distribution. Area T (Formosa) was established after the enemy landing at Okinawa.

The Exchange of Code Books with the Army

By the end of 1944, it became necessary to unify codes in order to facilitate operations of the Army and the Navy, and as the first step, it was decided to interchange the currently used code books between the Navy and the Army for mutual utilization. The code books of the Army had a different code form, and the varieties of these books were so numerous that the Navy found it difficult to use. Moreover, administration became complicated because the notification

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*The additive table consisted of an irregular arrangement of a code group composed of five letters with numbers ranging from 0 to 9 each. The use of this code was limited to once for a unit.

on their usages was apt to be delayed; therefore, the Navy could hardly utilize them. On the other hand, the Army utilized naval code books very effectively in intercepting information for Army air intelligence. However, as air transportation to the Southern Area was disrupted and there was only the air communications mainly to the northern Asiatic continent, the code book for air transportation was used in the communications of the Japan Air Transportation Company.

Security "Accidents" and Countermeasures

Major security "accidents" concerning code and cipher and their countermeasures in the Pacific War were as follows:

Submarine I-1 at Guadalcanal Island:

While transporting provisions to Guadalcanal Island, the submarine was stranded on the coast of Kamimbo during combat with an enemy motor torpedo boat. It listed and exposed part of its hull above the water. The responsible persons evacuated some of the military top secret documents from the craft and buried them in the coastal sands of enemy territory where there was every fear of their being dug out plus the fact that water-soluble ink had been used for only a few of these documents. The loss comprised many code books for future use in addition to those in current use, totalling about 200,000 copies. This fact was reported about a month after the "accident" when the

crew involved returned to Rabaul. Although the Submarine Squadron Command issued orders to dig them out and destroy them immediately, one or two of the numerous places where the documents were buried could not be located. Moreover, as there were a considerable number of code books left in the submarine, aerial bombardment and torpedoing by submarines was carried out, but complete destruction was not confirmed.

Countermeasures:

1. Emergency measures were taken and new code books were used.
2. The additive table of the wartime code book was immediately revised and the encoding procedure was altered.
3. The original of the strategic code book was not changed.

"Accident" during transport to Tsingtao:

In 1943, when crytographic publications were being transported from Kure Naval Ship and Ordnance Department to Tsingtao Base Force, the box containing them was inadvertently opened. This was charged to the Naval Ship and Ordnance Department's failure to have a responsible officer cognizant of the importance of cryptographic publications.

Countermeasure:

1. Emergency measures were taken.

"Accident" on Biak Island:

When the enemy assaulted Biak Island in May 1944, the

garrison unit, anticipating danger, had the radio crew carry the code books to another communications room. The radio crew encountered enemy soldiers on the way and the code books were lost in the fighting. This "accident" was reported to the Central Agency about three weeks later because the responsible officer of the shore combat unit was negligent in reporting it earlier. Emergency measures were taken immediately. Since the A-GO Operation was just in the planning stage, overall emergency measures were taken. As a result of prompt and thorough investigation, it was found that only one or two codes were actually missing and nothing had happened to the important codes. However, as emergency measures were taken for many codes on the basis of the careless report, communications were slowed down considerably. In addition, as this "accident" happened immediately before the A-GO Operation, progress on this operation, was seriously affected.

Countermeasures:

1. Overall emergency measures were taken.
2. The encoding procedure was partially altered.
3. The original of the strategic code book was changed.

Jettisoning of code books from transport plane of the Fourth Fleet:

A transport plane of the Fourth Fleet flying from Truk to Rabaul in 1943 cast its cargo into the sea during flight because

of motor trouble. It became known that the cargo comprised some code books and there was fear that they might be adrift. For fear that the code books, being tightly packed, would remain adrift for a long period and as the place of "accident" was somewhat near the coast, countermeasures were taken immediately.

Countermeasure:

1. Emergency measures were taken.

"Accident" of code books washed from transport submarine:

A submarine was attacked from the air during debarkation of cargo destined for a unit stationed at Salamaua, New Guinea. The craft suddenly submerged and the cargo which was on deck was washed away. Among the cargo were some cryptographic publications.

Countermeasure:

1. Emergency measures were taken to some extent.

Freight-car door "accident":

When cryptographic publications were transported by freight train from the Yokosuka Naval District Library to the Ominato Naval Ship and Ordnance Department in 1943, it was discovered at the destination that the lock fastened to the freight-car door had been lost in transit. Whether it had fallen off or the door had been purposely opened could not be ascertained. Nothing was amiss with the packing.

Countermeasure:

1. No measures were taken.

Loss during railway transportation:

When cryptographic publications were sent under escort from the Chinhae Communications Unit to its detachment in 1944, they were lost due to negligence during transportation and were not recovered despite thorough search.

Countermeasure:

1. Emergency measures were taken by distributing duplicates of lost code book.

Besides these seven major code "accident" cases during the two years from 1 January 1943 to the end of 1944, there were a number of minor cases. Approximately 2,000,000 copies of cryptographic publications for current and future use were discarded due to these seven "accidents". For the safeguarding of military secrets, measures to minimize losses due to "accidents" were so earnestly desired that the "strip additive panel" device came to be adopted and put into practical use in part, though the war ended before its results were thoroughly studied.

Apart from the measures taken due to the "accidents" mentioned above, the "additive strip" was used together with the additive table as a measure to further increase security of code from the middle of 1944. In enforcing this system, the revision of the strategic code

book was effected by advancing the date for the regular revision.

The Japanese Navy could not obtain any actual proof whether the code was broken by the enemy, although it was presumed that some of the lost code books had fallen into enemy hands. Therefore, the conjecture was that, although secret communications might have been intercepted by the enemy, the important code books in current use could not be directly utilized by the enemy. However, the following factors were taken into consideration:

1. Since the Navy revised its important codes (at least the additive table) about every month, it was quite certain that the codes were not broken by the enemy inasmuch as numerous codes were used at not too frequent intervals.
2. It was presumed that if any messages were broken by the enemy, it was because outpost units used the old code book in re-transmitting radio messages when the new code book had not been distributed to them.
3. As the Army revised the letter substitution table for sending telegrams, the enemy could have broken the code by obtaining cross-checking data concerning matters identical both in the Army and the Navy.
4. Complete reliance was not placed in the diplomatic relations code.

At any rate, the Americans reported that the disaster to Admiral Yamamoto at Buin, Bougainville, was due to cryptanalysis.

However, this was impossible as his movement was never dispatched in the Navy code. Furthermore, from the success in the Kiska withdrawal operations and others, it was concluded that the main code book had not been broken.

List of Code Books

1. For strategic and administrative use:

   a. Naval Code Book (KO):

      Exclusively used for communications between important communication organs.

   b. Naval Code Book (SHIN):

      Used for communications concerning logistics but rarely used because the code personnel were accustomed to the use of Naval Code Book (D).

   c. Naval Code Book (D):

      A numeral code book which was widely and proficiently used for most communications.

2. For tactical use.

   a. Naval Code Book (OTSU):

      Used for tactical communications of surface forces; revised once or twice a year.

   b. Naval Code Book (BO):

      Used for local actions.

   c. Naval Code Book (F):

      Used for air communications; revised every two months.

   d. Naval Code Book (C):

      Used for air communications and other miscellaneous purposes.

e. Naval Code Book (H):

Used for air communications in the China area; a simple letter transcription method code which could be readily revised at any time.

f. Naval Code Book (KI):

Used for land combat in the China area. Widely used during the China Incident, but sparingly used after the outbreak of World War II. There was a tendency to use the Naval Code Book (OTSU) in place of this code book.

g. Code Book for the Army-Navy joint operation:

Its use was suspended due to a security "accident" by the Army.

h. The Combined Fleet Special Code (A).

A collection of code phrases.

3. For communications of intelligence reports.

a. Overseas Secret Telegraph Code Book:

Kept in reserve but was to be used for communications between attache's and the Central Agency.

b. Naval Code Book (J):

Used for communications between attache's stationed in Europe and America and the Central Agency.

c. Naval Code Book (HEI):

Used for intelligence communications in the China area.

d. "IC":

Used by intelligence agents.

"I C-A": This was distributed to officers stationed in Great Britain, France, Italy, Spain, Portugal, Turkey and Soviet Russia.

"I C-B": Distributed to the headquarters of the Second China Expeditionary Fleet, the officers stationed in Canton, and the headquarters of the Canton Base Force; headquarters of Mako Naval Guard District, headquarters of Takao Naval Guard District and headquarters of Hainan Naval Guard District.

"I C-C": Distributed to the officers stationed in North Korea, Khabarovsk, Manchuria and Korea; headquarters of Chinhae Naval Guard District.

"I C-D": Distributed to the officers stationed in America, Canada, Mexico, Brazil, Argentina and Chile.

"I C-E": Distributed to the officers stationed in Burma.

e. "The New Code Book":

Distributed to the officers stationed on the western coast of America.

4. Code books commonly used for communications with service branches outside the naval service.

a. Shipping Secret Communications Regulations:

Used in communications with merchant ships. These regulations provided for encoding call signs and names of the senders and addressees; and for the text the code from "Naval Code Book (S)" was applied.

b. Naval Code Book (S):

This book was distributed to merchant ships of more than 1,000 tons.

c. Code Book for Fishing Boats:

This was distributed to all vessels.

d. Naval Code Book (W):

Used for reporting all ships (foreign) entering and clearing ports. This book was distributed to principal naval headquarters and above, local resident officers, custom houses and Naval Harbor Master's Offices.

e. Standard Code Book for the Three Ministries:

Used by the Navy, Army and Foreign Ministries. It was distributed to the diplomatic officials stationed in East Asia and principal Navy and Army headquarters.

5. For miscellaneous uses.

a. Naval Communications Abbreviations:

Abbreviations for ranks and positions, the names of agencies and communications phrases.

b. Primary Signal Book:

This was also used in visual signals.

c. Special Abbreviations for the Combined Fleet:

The abbreviations used for tactical communications, for communications with temporarily established radio stations and for communications inspection.

d. Naval Call Sign Table:

This was distributed to all communications agencies.

e. Special Call Sign Table for the Combined Fleet:

Used for tactical communications of the Combined Fleet.

Disposal of Code Books After the End of the War

In the latter part of August, an order was issued to destroy by fire all the cryptographic publications except the following:

Code Book "RO" (3) and (4), their regulations for use

and additive tables; Code Book "TEN" No 1, its regulations for use and additive table; Code Book "HA", its regulations for use and its key table; the Code Book "I", its regulations for use and its key table; call signs and abbreviation signals in use.

It was planned to keep various kinds of code books at the offices of the Central Agency for some time but they were all destroyed due to an error by an officer of the Navy General Staff, and this created temporarily confusion in communications. On the last day of August, all documents were destroyed except Code Book "TEN" and related books and tables, and the call signs and abbreviation signals.

CHAPTER IV

Communications Preparations for War

The communications preparations before the outbreak of war were to have been planned according to the annual War Mobilization Program but since no preparations were made for equipment due to budgetary reasons, no full-scale program was undertaken until the fall of 1941 (Chart 8) (See Charts 9 and 10 for expansion of the Tokyo Communications Unit and standard TO/E for other communications units).

The establishment of the central communications installations for fleets, ground forces and air bases necessary in offensive operations and the completion of the wire communications nets of the Homeland were the main objectives in the communications preparations at the outbreak of war. Since the communications facilities of the naval vessels in the forward combat area had generally been completed (though not entirely adequate), there were no special problems to be considered.

After 1942, during offensive operations, the consolidation of the central communications facilities of the air bases and units in the occupied territory was emphasized. However, the production of fixed radio sets did not increase, so the operations were carried out mainly by means of mobile radio equipment (Chart 11).

Throughout World War II, the maintenance of overseas land com-

Prewar Preparations Plan for Communications Unit

Communication Unit	Summary of Preparations	Objective
Tokyo Communications Unit	1. Strengthen communications capacity. 2. Establish reserve sending and receiving stations.	Effect arrangement for the unit to serve as the central communications unit of the entire Navy.
Takao Communications Unit	Strengthen communications capacity	To serve as the central communications unit in the Southern Operations.
Ominato Communications Unit	Strengthen communications capacity	To serve as the central communications unit in the Northern Operations.
5th (Truk) Communications Unit	Strengthen communications capacity	To serve as the central communications unit in the Pacific Operations.
1st Communications Unit	Provided with: 15 mobile high frequency transmitters 15 receivers	To serve as the mobile communications unit during the French Indo-China and Malay Operations.
2d Communications Unit	Provided with: 20 mobile high frequency transmitters	To serve as the mobile communications unit during the Philippines and Dutch East Indies Operations.

Chart 9

Expansion of the Tokyo Communications Unit 1942-1944

	Project	Completed
Receiving Facilities	Installed underground receiving facilities with the compound for antiaircraft defense. Equipped with 40 receivers	Spring of 1943
	Installed reserve receiving stations at the Naval War College. Equipped with 40 receivers	Middle of 1942
	Reinforced receiving stations: Constructed two strongly built receiving station rooms. Equipped with 40 receivers	Middle of 1943
Transmitting Facilities	Installed Totsuka Transmitting Station No 2: Constructed 3 bombproof transmitting station rooms and installed 16 15-kilowatt transmitters.	Spring of 1944
	Reinforced the Transmitting rooms of the Funabashi Transmitting Station: Constructed 2 strongly built transmitting station rooms and installed 4 2 kilowatt transmitters.	Spring of 1944
	Installed control line between the Koyama Transmitting Station and the Tokyo Communications Unit; enabled use of 2 transmitters	Autumn of 1942
	Installed control line between the Usami Transmitting Station and the Tokyo Communications Unit; enabled use of the 100-kilowatt ultralong-wave transmitter	Autumn of 1942

Standard Table of Equipment for Communications Units, 1943

Classification	Applicable Unit	Station	Table of Equipment
A	Applicable to the Central Communications Unit of the Combined Fleet	Receiving Station	Receivers, large ..... 2 Receivers, small 40
		Transmitting Station	5-KW high frequency transmitters ..... 2 2-KW transmitters ..... 2 1-KW or less transmitters ..... 12 0.5-KW low frequency transmitters ..... 2 0.25-KW medium frequency transmitters 3
		Radio Direction Finder Station	Receivers ..... 20 High frequency radio direction finders ..... 3 Low frequency radio direction finders ..... 3 Medium frequency radio direction finders 3
B	Applicable to the Central Communications Unit of the Fleet	Receiving Station	Receivers, large ..... 2 Receiver, small .....
		Transmitting Station	2-KW high frequency transmitters ..... 2 1-KW or less transmitters ..... 8 0.5-KW low frequency transmitters ..... 2 0.25-KW medium frequency transmitters 3
		Radio Direction Finder Station	Receivers ..... 10 High frequency radio direction finders ..... 2 Medium frequency radio direction finders .... 2 Low frequency radio direction finders 2

Classification	Applicable Unit	Station	Table of Equipment
C	Applicable to the central radio station of the unit such as base forces, etc.	Receiving Station	Receivers, small 16
		Transmitting Station	1-KW or less high frequency transmitters .... 6 0.5-KW low frequency transmitters ..... 2 0.25-KW medium frequency transmitters 2
		Radio Direction Finder Station	Receivers ..... 6 High frequency radio direction finders ..... 2 Medium frequency radio direction finder ..... 1 Low frequency radio direction finder 1

Note:

1. When transmitters and receivers are lacking, mobile high frequency radio sets (250 watt) are to be provided, depending on the local situation.
2. All communication facilities are to be made bombproof.
3. Necessary power units and antenna array are to be arranged.

Chart 11

Mobile Communications Equipment Production Plan

Communications Equipment	Planned Monthly Production				
	From January 1942	From July 1942	From January 1943	From July 1943	From January 1944
High Frequency Mobile Radio Set	30	50	100	150	200
Air Base Radio Set No. 5	20	50	100	200	300
Portable Radio Set	100	200	300	400	500
Portable Very High Frequency Radio Set	100	150	200	250	300
Telephone Set	100	200	300	400	300

munications facilities was so poor that operations were always carried out with the facilities in an unsatisfactory condition. The main reasons for this being: (1) impossibility of mass production of communications equipment; (2) transportation difficulties due to American submarine attacks; (3) inefficient as well as lack of maintenance personnel.

Wire Communications Facilities

The establishment of wire communications nets was accelerated in 1941 as a measure in the preparations for war, and the Navy planned to obtain exclusive use of the wire nets controlled by the Communications Ministry. In the beginning of the war, the first consideration was the installation of the telegraph and telephone circuits connecting Tokyo, the naval districts and guard districts in Japan.

In anticipation of greater production of radios after 1943, plans were made to complete the air defense lookout communications and wire communications between air bases in the Homeland and make extensive use of the wire nets owned by the Communications Ministry. Every effort was made to complete the installation of portable telegraphs and telephones, but due to a shortage of materials and other factors, the work was not completed until about 1945.

As for wire facilities in occupied overseas areas, importance was particularly attached to installations at base air groups.

However, due to transportation difficulties and shortage of materials, no progress was made. When installation was completed, it was immediately destroyed by air raids, thus the work remained unfinished when the war came to an end. The base air groups which were specially designated in the installation plan were: Kanoya, Chitose, Bibai, Paramushiro, Takao, Clark (Philippines), Davao, Kendari, Singapore, Guam and Rabaul.

Communications of Carrier Task Force

In any operation, secrecy of fleet movement had been of absolute necessity. Fleets usually maneuvered in groups, but when dispersed for operations, the distance between each group, as a rule, did not exceed 100 miles. Thus, communications within a fleet were chiefly conducted by the visual method. However, radiotelephone communications by short-distance transmitting frequency was the usual means for radio communications. On the other hand, as total reliance could not be placed upon the radiotelephone, a double or a triple telephone system was generally adopted and the radiotelegraph system by low and high frequencies was also used as alternate and reserve communications means.

As task forces also had to maintain secrecy of movement in their operations, over-all coordination of land-based communications units in the operating area was required. A coordinated system between the task forces and land-based communication units was generally established before the outbreak of war. Moreover, the flag-

ship of a fleet (or the ship in charge of communications with outside units) required transmitters which would not be detected by enemy radio direction finders. Although such transmitters were completed in early 1944, they were not put to practical use until spring of 1944 when task forces actually engaged in operations.

Selection of Fleet Flagship

There were both advantages and disadvantages in using an aircraft carrier as the flagship of a task force, but the Japanese Navy used aircraft carriers as task force flagships throughout the war. From the standpoint of communications, it was more advantageous to use a battleship as a flagship because of its strong protective capacity against possible impairment to communications facilities. However, from the standpoint of directing the operation, the use of an aircraft carrier as a flagship was highly advantageous in that it enabled direct control over air squadrons, the main striking strength of the force, and also the commanding officer could directly control the commander of reconnaissance planes and gain firsthand knowledge of the enemy situation. Therefore, when Japan had flying squadrons equal or superior in fighting power and skill to that of the enemy at the start of war, an aircraft carrier had many advantages as a flagship.

With the progress of the war, the fighting power and skill of the Japanese air squadrons decreased steadily. As such, aircraft carriers became vulnerable to damages which frequently caused the

failure of command function at critical moments. Nevertheless, the fact remains that the aircraft carrier was used as a flagship to the very end of the war as the expedient means for combat command. Other means could have been easily taken had the radiotelephone within a task force been developed and improved to the same extent as the wiretelephone.

Communications Equipment for Ships

The number of vessels in the Japanese Navy at the time of the outbreak of the China Incident was approximately 330 (1,250,000 tons), the main strength of which consisted of the following: 10 battleships, 10 aircraft carriers, 35 cruisers, 136 destroyers, 80 submarines, 13 gunboats, 10 torpedo boats and 10 special duty ships. Vessels under construction were based upon the First Plan (four-year plan beginning in 1934), the Second Plan (five-year plan beginning in 1937) and the Third Plan (six-year plan beginning in 1939). (See Monographs 145, 149, 160, 169, 172 and 174).

Although there was some delay in the construction of these new ships, due mainly to the slow production of engines, no difficulty was encountered in the installation of radio equipment. However, from about 1940 when military preparedness began to be accelerated, the production of special radio equipment such as high frequency transmitters for submarines and other large-type high frequency transmitters tended to lag behind schedule.

Military preparations had been strongly stepped up from about 1940, and merchant ships and fishing boats were requisitioned one after another and converted into naval auxiliary vessels. Large-type merchant ships were converted to aircraft carriers and cruisers, and small fishing boats to minesweepers, subchasers and picket boats.

The installation of complete radio equipment on these converted vessels presented considerable difficulty as such equipment on these vessels was often inferior to the standards designated by the Navy. Replacements with new radio equipment were necessary beyond initial estimates, and, moreover, when they were installed, great difficulty was experienced in the problem of enlarging a radio room and of the adaptation of the power source which varied according to each ship.

From the beginning of 1941, a large number of converted vessels were rapidly completed, and these were fitted with either additional equipment or the old equipment replaced altogether. The Construction and Repair Depots undertook the task, which was done as rapidly as possible to minimize the docking period. When the war was in full swing, a new naval construction program was planned (Fourth Plan), which took into consideration the experiences gained in battle and emphasized the preparation of small vessels.

Through appropriations from the Munitions Preparation Expenditure, the preparation of transmitters and tubes for the expeditionary forces was completed. However, the types and amount of

equipment to be furnished were decided in accordance with the amount of stockpiled equipment and probable future developments.

From the beginning of 1940, TM-type high frequency portable radio sets had been ordered on a long-term basis for the monthly output of approximately 35 sets, the peak production in civilian industry. At the outbreak of the Pacific War, tubes valued at 60,000,000 yen had been purchased.

After commencement of hostilities, research was continued for ways and means to improve communications, a few of the objectives being:

1. To strengthen the radio room under the armored deck to maintain radio communications.
2. To make medium frequency communications possible.
3. To improve very-high frequency communications for greater security.
4. To improve the capacity for intercepting enemy communications.

To attain these objectives, the amount of radio equipment was increased according to a plan (Chart 12).

The situation of communications equipment for submarines from the fall of 1941 was as follows:

1. Only the high frequency transmitter was used and the low frequency radio tumbler mast was discarded.
2. The 17 KC very-low frequency receiving set (for underwater radio reception) was installed.
3. The installing of medium frequency transmitters was planned but ended in the experimental stage since the antenna array was not completed.

Plan for Increasing Radio Equipment on Naval Vessels

Type of Ship	Details
Capital Warship	1. Radio rooms to be provided in four places and the receiving and transmitting rooms under the armored deck to be made the main radio rooms. 2. Receivers for the interception of enemy communications to be increased: six receivers for the fleet flagship and four receivers for the division flagship. 3. Medium frequency transmitters to be increased: three for the fleet flagship, two for the division flagship and one for other vessels. 4. Installation of 25 W very-high frequency telephones: three for the fleet flagship, two for the division flagship and one for other vessels.
Destroyer	To be equipped with an additional medium frequency transmitter.
Defense Ship	To be equipped with an additional medium frequency telephone.

(For further details, see Chapter VII: Operational Communications of Submarines).

In the latter part of 1942, combat operations became very active and reports on damaged vessels began to come in from about the middle of May. Attention was focused on measures to minimize such damages and at the same time, serious consideration was given to a plan for improving communications on ships and simplifying equipment in order to minimize the amount of labor and materials required. As a result of combat experiences, various measures were taken into consideration such as redesigning the antenna to minimize obstruction and damage by gun fire or bombs, the change of location of radio rooms from the main deck and upper deck as a precaution against damage and the dispersion and care of communications equipment. Other measures instigated from the Munitions Preparation Expenditure, the simplification of command and communications facilities, the abolishment or curtailment of secondary radio batteries and the readjustment of other small equipment.

Development of Radar

Radar Research

When information was received that radar was being used in the European theater by both Great Britain and Germany, Japan became cognizant of the necessity of radar from the tactical standpoint. Thereafter every effort was made to advance radar research for military purposes.

In the initial stage of the war, technical research on radar and communications equipment pertaining to aviation was the responsibility of the Naval Air Technical Depot, while radar and communications equipment for ships and ground installations were handled by the Naval Technical Research Laboratory. However, chiefly because of the poor staff of radar research technicians available in the Naval Air Technical Depot, the research on aircraft radar equipment made little progress, despite the fact the Naval Technical Research Laboratory assisted in the research.

In view of the great effect radar had on operations, research on this type of equipment was accelerated by all departments concerned from the outbreak of the war. Various measures to improve production were studied and Navy Minister Admiral Shimada, presuming that the reason for the slow progress in the production and performance of radar equipment lay in the administrative systems of the Navy Ship and Ordnance Department and the Navy Aeronautical Department, decided to establish the Electronics Development Department as the central administrative agency, despite strong opposition.

The Military Affairs Bureau, the Navy General Staff, the Navy Aeronautical Department and the Navy Ship and Ordnance Department strongly opposed the establishment of the agency for the following reasons:

1. The establishment of an administrative agency would only complicate matters and would not expedite the development of radar equipment. The slow progress in radar equipment was attributable primarily to lack of research facilities.

2. Research and experimental manufacture of radar equipment and production would be impossible without the positive aid and the cooperation of the Navy yards and air depots. Furthermore, under the prevailing shortage of materials, it would be actually impossible for the Electronics Development Department, as an independent agency, to obtain the necessary materials.

Despite all the opposition, the Navy Minister ordered the establishment of the Electronics Development Department in March 1944. The new department took over matters concerning research and testing of radar, communications and sonic equipment which hitherto were assigned to the Navy Ship and Ordnance Department and the Navy Aeronautical Department. The department, organized into two bureaus (General Affairs and Technical), was responsible for research and testing of radar, communications and sonic equipment.

Although the creation of this administrative organization centralized the administrative control over the research and testing of radar equipment and facilities, the decentralized research facilities remained the bottleneck. In November 1944, a committee studied the problem and a new system was established whereby one organization would be concerned with research, testing, production and supply of materials for communications equipment. The Navy Electronics Development was dissolved and the 2d Navy Technical Depot was established on 15 February 1945, through the merger of communications facilities attached to the Central Agency concerned, the Naval Air Technical Depot, Naval Technical Research Laboratory and Yokosuka Navy Yard. The 2d Navy Technical Depot then became the responsible agency for

the research, testing production and materials for communications equipment.

Radar Production

From the commencement of hostilities until the spring of 1942, the promotion of construction and installation of radio equipment on vessels was the main task. It was in mid-May that radar No 1 Type 2 was installed on the battleship Ise for aircraft detection, and radar No 2 Type 2 was installed on the battleship Hyuga for surface craft detection. As a result of these first two experimental ventures which were relatively successful, the radar No 2 Type 1 was installed on aircraft carriers, cruisers and battleships. In March 1943, radar No 2 Type 2 was installed on Subchaser No 43 for surface craft detection, and on Submarine I-158 in April of the same year for submarine use (Chart 13). (Installation Standard of Radar for Ships, 1944, see Chart 14.)

Subsequently the demand for radar equipment placed a tremendous burden upon production. The emphasis on the transition to production of radar and the materials and labor facilities which had hitherto been laid upon general radio equipment required a large-scale study to be made. The Navy General Staff studied the potentialities of various industries to manufacture radar equipment and issued a general production schedule (Chart 15).

The production of radar for lookout posts commenced in the middle of 1942 and installation was carried out under the following plan: (Chart 16)

Chart 13

Installation Standard of Radar for Ships, 1942

Type of Vessel	Order of Installation	Type of Radar and Quantity	
		No 2 Type 1	No 2 Type 2
Battleship	3	1	2
Cruiser	2	1	2
Aircraft Carrier	1	2	
Submarine tender	2	1	
Destroyer (TSUKI-class)	2	1	
Destroyer	2		1
Submarine Chaser	1		1
Submarine	1		1

Chart 14

Installation Standard of Radar for Ships, 1944

Type of Warship	Order of Installation	Type of Radar and Quantity			
		No 2 Type 1	No 1 Type 3	No 3 Type 2	Radar Intercepter
Battleship	3	1	2	2	2
Cruiser	2	1	2	2	2
Aircraft Carrier	1	4		2	2
Aircraft (Small)	2	2	1		2
Submarine tender	2	1	1		2
Destroyer (TSUKI-class)	1	1	1		1
Destroyer	2		1	1	1
Submarine Chaser	1			1	1
Flagship submarine	1		1	1	1
Transport submarine	1		1		1
Submarine	1			1	1
Transport	3				1

Chart 15

Radar Production Schedule

Type	Jul-Dec 1942	Jan-Jun 1943	Jul-Dec 1943	Jan-Jun 1944	Jul-Dec 1944	Jan-Jun 1945
Radar for lookout posts	20	40	50	50	50	50
Portable Radar No 1 Type 3			50	100	150	150
Antiaircraft Radar for ship use	20	30	50	50	50	50
Anti-vessel Radar for ship use	20	30	50	100	150	150
Radar (Air No 6) for aircraft	300	500	800	1000	1000	1000
Radar for firing			20	20	20	20
Radar for searchlight directing				40	40	40
Radar intercept device			100	300	300	300

	From July 1942		From July 1943		Remarks
Type of Lookout Post	Monthly Installation Rate	Number of Radars at One Place	Monthly Installation Rate	Number of Radars at One Place	
E Class	10	2	15	2	Antiaircraft lookout station
F Class			10	1	Anti-vessel lookout station

Chart 16

From 1944, a great increase of radar lookout posts was planned due to the intensification of enemy air raids and the shrinking battlefront. The object of the plan was to perfect a warning system by radar nets throughout the Homeland, Formosa, the Philippines, Malaya, Java and the coast of Central and South China (Chart 17).

Search Radar Assignment

Location of Installation	Radar							Radio Equipment					Motor Generator				Description
	Anti-aircraft Search					Surface Search		Transmitter			Mobile High Freq Radio Set	Full-Wave Receiver	Diesel	Gasoline			
	No 11	No 11k	No 12	No 13	No 14	No 22	No 32	250-Watt Low Freq	250-Watt Med Freq	250-Watt High Freq			15 KVA	6 KVA	3 KVA	1 KVA	
Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Imaizaki	2		1								1		1	1			
Kagenoma	2		1								1		1	1			
Ishikawazaki	2										1		1	1			
Kakumabetsu	2										1		1	1			
Suribachi Bay	2										1		1	1			
Musashi Bay	2		1								1		1	1			
Sutegokoen	(2)																
Matsuwajima	2		2								1			2			
Shinshirujima	(2)										(1)		(1)	(1)			

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Kushizaki	(2)			2							1		(1)	(1)		2	
Rubetsu				1							1					2	
Teiitsu				2							1					2	
Tennei	2			2							1		2				
Kitashiretoko				2													
Nayoshi	2								1	1		1	2				
Nakashiretoko				2												2	
Nishinotoro							(1)				(1)			(1)			*
Soyamisaki				2			(1)							(1)			*
Nosammisaki	1			1							1			1			
Notorimisaki	(1)			2							1		(1)	1			
USA Airfield				2													
Oita Airfield				2													
Tomitaka	2			2							1		1				

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Miyazaki Airfield				2													
Toizaki	2	1			1		1				1		2				*
Kasanohara Airfield				2													
Hinosaki		2		1							1			2			
Ueki							(1)										*
Kanoyamachi				2													
Satamisaki				3			(1)							1		2	*
Kagoshimamachi				2													
Surigahama							(1)										*
Bonomisaki	1			2							1		1		2		
Tsurigakezaki	2			2							1		1				
Izumi				2													
Onnajima	1								1	1		1	2				
Osezaki	1			2					1	1		1	2				*

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ukushima	2			2					1	1		1	2				
Ikutajima							(1)				(1)						*
Tajimadake	1			2													
Mihoro Airfield			2														
Nemuro	1		1	1							1		1	(1)			
Nemuro Airfield				2													
Akeshi	1		1										1	1			
Erimomisaki	1		1								1		1				**
Chitose				2													
Keizanmisaki				2			(1)				1			2			* **
Shirakami							(1)				(1)			(1)			*
Kamoimisaki	(2)			2							1		(1)	(1)			
Shiriyazaki	1		1								1		1	1			**
Ominato	1		1										1				

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ryuhimisaki							(1)				(1)			(1)			*
Kodomari	1										1			1	1		
Samekaku	1		1						1	1		1	1				
Kinkazan		1	1	1			(1)		1	1		2		1			*
Matsushima Airfield				1													
Koriyama Airfield				2													
Shioyasaki	2		1	1			(1)		1	1		2	1	1			
Tsukuba Airfield				2													
Hyakurigahara Airfield				2													
Omura Airfield				2													
Wakamiya							(1)				(1)			(1)			*
Okinoshima							(1)				(1)			(1)			*
Futaoishima							(1)				(1)			(1)			*
Kaijima	1			2					1	1		1	2				

Chart 17-e

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Hinomisaki	1			2					1	1		1	1				
Togo	1			2					1	1		1	2				*
Miho Airfield				2													
Kyogazaki	2			2			(1)		1	1		1	1				*
Minazuki	1			2					1	1		1	1				*
Enkozaki							(1)				(1)			(1)			*
Kannonzaki						1	(1)				1			1			*
Kijibana						1	(1)										*
Danzaki	1			1													*
Niigata							(1)				(1)		(1)				*
Kamizaki							(1)				(1)		(1)				*
Gōnozaki							(1)				(1)		(1)				*
Kairyuto							(1)				(1)		(1)				*
Nagasu	(2)			(2)			(1)				(1)		(2)				*

Chart 17-1

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Makishima							(1)				(1)			(i)			*
Yatabe Airfield				2													
Konoike Airfield				2													
Inubosaki	2	1		1			(1)		1	1	1	2	2				*
Katori Airfield				1													
Taito	1	1								1	1	1					
Mohara Airfield				2													
Kisarazu Airfield				2													
Katsuura	2		1	1			(1)		1	1		2	40 KVA ...1				
Tateyama				2													
Fura		1	1	1		1		2	1			2	1				*
Kannonzaki							(1)							(1)			*
Sendazaki							(1)							(1)			*
Enoshima							(1)							(1)			*

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Atsugi				2													
Okusuyama	1			1													
Oshima				2			1				1	1		2	2	3	*
Niijima				2													
Miyakejima	1			2					1	1	1	1	2		2	3	
Mikurajima				2							1				2	2	
Hachijojima	1	2								1	1	1	2	2			
Chinkai				2													
Maifutsu-to							(1)				(1)			(1)			*
Shorijima							(1)				(1)			(1)			*
Kyobunto				2							1			1		2	
Koshu				2													
Eastern Part of Saishuto							(1)				(1)			(1)			*
Western Part of Saishuto							(1)				(1)			(1)			*

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Shorizanto				2							1			1		2	
Chozanshi				2							1					2	
Port Arthur				2							1					2	
Tanegashima				2							1				2		
Southern Part of Tanegashima				2							1			1		1	
Kushinoerabuto				2							1				1	1	
Kuchinoshima				2							1				1	1	
Takarajima				2							1				1	1	
Amamioshima				2							1				1	1	
Kikaigashima				1							1				1	1	
Kitadaitojima				2							1				1	1	
Minamidaito-jima				2							1				1	1	
Okidaitojima				2							1				1	1	
Aogashima				4							1	1			2	2	

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Torishima				4							1	1			1	1	
Ishimurozaki	1			2	1						1	1	2			4	
Fujioda Airfield				2													
Omaezaki	1		1	1						1		2	2				
Hamana				2							1	1		1		1	
Irako							(1)										*
Daiosaki	1	1	1	1			(1)		1	1		2	1				*
Nagoya Airfield				1													
Yamato Airfield				2													
Kashinozaki	2		1	1	1				1	1		1					
Shionomisaki				2		1					1	1 (High Freq)					*
Esugizaki				2							1						
Ichiezaki				2							1						
Hinomisaki							1				(1)			(1)			*

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Kata							(1)										*
Yura							(1)				1						*
Naruo Airfield				2													
Himeji Airfield				2													
Tokushima Airfield				2													
Miyokojima		2							1	1			1				
Ishigakijima		2							1	1			1				
Yonakunijima				2											1	1	
Hokasho				2													
Sanshokaku		1		2										1	1		
Suo		1		2										1	1		
Karenko		1		2										1	1		
Shinko				2											1	1	
Taito		2		2							1			2			

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Kotosho				2							1				1	1	
Garampi		1		2							1			1	1		
Toko		1		2							1			1	1		
Takao	2	1		2							1			1	1		
Taikozan	1	1		1							1		1	1			
Tainan				2							1						
Mako	1			4							2		1	1			
Kaiko				2							1				1	1	
Taichu	1			2							1			1	1		
Shinchiku	1	1		1							1		1	1			
Tansui		1		2							1			1	1		
Murotozaki	2		1	2						1		1					
Susaki							(1)				(1)			(1)			
Matsuyama Airfield				2													

Search Radar Assignment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Ashizurimisaki	2		1	2						1		1	1	1			
Okinoshima				2							1						
Iwakuni Airfield				2													
Fukashima				2			(1)				1				1		*
Tsuiki Airfield				2													
Uraota							1				1				1		*
Chichijima	1			4													
Hahajima				4													
Radar School	1		1	1					1	1		1					
Koizumi Plant				1												2	
Musashi Plant of Nakajima Co.				1												2	
Nagoya Plant of Mitsubishi Co.				1													
Meiji Airfield				2													
Chigasaki	No 6 ...1	No 62 ... 1	No 62 ... 1	1													

Search Radar Assinment (Cont'd)

Key to Equipment	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Fukikaku				2							1				1	1	

Remarks:

(1) "Description" Column:

* Indicates stations which were planned and set up as anti-surface craft lookout stations. However, some of them also served as antiaircraft lookout posts.

** Indicates posts which were destroyed by air raids.

(2) Number of Equipment:

The figure in parenthesis indicates the quantity of equipment which was not completed.

CHAPTER V

Naval Air Force Communications

Radio Equipment for Aircraft

In the preparations for war, radio equipment as well as other war materiel depended solely on production by the civilian industries. In 1940, the Navy took further measures to increase production by establishing the Numazu Ordnance Depot (specializing in manufacture of communications equipment). By 1941, large-scale equipping of aircraft was planned and the production of necessary radio equipment was set forth according to a production schedule issued by the Navy General Staff (Chart 18).

At the outbreak of war, the installation aspect of aircraft communications equipment was limited to installing equipment in any available space. The installation was carried out without careful consideration of the requirements in battle or the duties of the radio crew during flight. Therefore, efficiency of radio equipment could not be fully manifested.

In the installation of equipment on aircraft, the fitting of the radio was found to be most defective, and the radio crew had to operate it under very adverse conditions. Receiving was difficult or impossible because of the noise from the defective telegraph set or buzzers, and as a result, some of the important telegraph messages failed to be received. Moreover, it was extremely difficult

Aircraft Communications Equipment Production

Type	Planned Monthly Production				
	From Jan 1942	From Jul 1942	From Jan 1943	From Jul 1943	From Jan 1944
Aircraft Radio Set No. 1	400	500	1,000	1,500	2,000
Aircraft Radio Set No. 2	300	500	700	1,000	1,500
Aircraft Radio Set No. 3	200	300	500	600	1,000
Aircraft Radio Set No. 4	100	100	150	150	150
Very High Frequency Radio Telephone for communications within the Unit	100	100	150	150	150
Homing Direction Finder	500	1,000	1,500	2,000	2,500

to operate the telegraph set in a plane at a high altitude because the apparatus was poorly located and adjustment of the sets could not be made.

The installation work by aircraft manufacturing companies was also very unsatisfactory. In particular, careless supervision and poor testing frequently resulted in wrong wiring and defective high-voltage ground contact or bonding.

In many instances of defective wiring, the sets did not function after they were installed in the plane, and considerable time was required for repairs and maintenance. There was also a considerable number of aircraft on which the equipment was absolutely impossible to repair. Another defect was the noise caused by improper insulation and bonding of the ignition system; moreover in the installation there were frequent cases in which the mounting bases were of different size necessitating adjustments to be made.

There were various factors for the consistently defective installation of equipment. One factor which was quite flagrant was that the equipment itself was considered more important than the installation technique. Actually there were no research personnel specializing in the installation of equipment until 1944. Those who engaged in the planning and research in radio did not engage in the actual equipping of aircraft. They only considered the weight, volume and capacity of any equipment and were not familiar with the actual circumstances of those who operated it during flight.

Another factor was that the electrical engineers of aircraft manufacturing companies who engaged in the planning and experimental manufacture of airframes knew very little about radio equipment, much less its operatiohs. They merely did the work of a carpenter fitting something of a certain size into a certain size into a certain space, and had no idea as to how the equipment could be used effectively.

As for the companies themselves, they were forced to rush production of communications equipment and as a result, they deliberately scamped their work. Factory superintendents were so occupied with procuring materials that the testing of completed aircraft, their primary duty, was neglected.

Thus, as mentioned in the foregoing, there were many reasons for unsatisfactory equipment but the must fundamental one was that the installation work was neglected and that the personnel concerned were indifferent as to its effects upon the fighting power.

The standard radio equipment installed in various types of aircraft in December 1941 and August 1945 is shown in Chart 19.

A general classification of radio equipment for the land-based attack planes was as follows:

1. No 3 aircraft radio.
2. Fixed antenna for No 3 aircraft radio.
3. Trailing antenna for No 3 aircraft radio (75 m).
4. Radiotelephone for inter-unit communications.
5. Controller of radiotelephone for inter-unit communications.
6. Antenna of radiotelephone for inter-unit communications.
7. Loop antenna for radio direction finder.

Standard Radio Communications Equipment in Aircraft, December 1941

Equipment	Land Medium Bomber	Carrier Torpedo-Plane	Carrier Dive-Bomber	Land (carrier) Recon Plane	Three-Seater Sea Recon Plane	Two-Seater Sea Recon Plane	Sub-borne Recon Plane	Fighter	Flying Boat
Aircraft Radio Set No 4	X								X
Aircraft Radio Set No 3	X	X			X				X
Aircraft Radio Set No 2			X	X		X	X		
Aircraft Radiotelephone Set No 1								X	
Aircraft Radiotelephone No 4 for communications within the unit	X								X
Aircraft Radiotelephone No 3 for communications within the unit		X	X						
Radio Direction Finder for large aircraft use	X								X
Radio Direction Finder for small aircraft use		X	X	X	X	X		X	

Remarks: X denotes the standard equipment which should be installed in the respective aircraft. However, due to shortages, very few aircraft were fully equipped. Experimental radio equipment is not included in this chart.

Standard Radio Communications Equipment in Aircraft, August 1945

Equipment	Large Land Bomber	Medium Land Bomber	Light Land Bomber	Land Recon Plane	Carrier Torpedo-Plane	Carrier Dive-Bomber	Fighter	Night Fighter	Three-Seater Sea Rcn Plane	Two-Seater Sea Rcn Plane	Sea-Plane Bomber	Sub Recon Plane	Flying Boat	Patrol Plane
Aircraft Radio Set No 3	X	X	X	X	X	X		X	X	X	X	X	X	X
Aircraft Radiotelephone Set No 1							X							
Large aircraft Radiotelephone for communications within the unit	X	X	X										X	
Small aircraft Radiotelephone for communications within the unit					X	X			Patrol Plane Unit only X		X			X
Radio Direction Finder for large aircraft	X	X	X										X	
Radio Direction Finder for small aircraft				X	X	X	X	X	X	X	X			X
Radar	X	X	X		X			Special X	X				X	X
Radar Intercept Receiver	X	X											X	
Magnetic Detector									Patrol Plane Unit only X					X

Chart 19-b

8. Auxiliary antenna for radio direction finder.
9. Radar.
10. Side antenna for radar.
11. Front antenna for radar.
12. Radar intercept receiver.
13. Antenna for radar intercept receiver.

The radio equipment for other types of aircraft was generally the same as the above.

The radiotelephone was necessary for fighter planes to carry out effective aerial combat and interception operations, but because of its limited range, the pilots became disinclined to use it to the fullest extent. This tendency was probably attributable to the pilot's indifference toward radio and partly to imperfection of the equipment itself, but the basic reason for the poor fighter plane communications was that there were very few officers enthusiastic enough to overcome the drawback and make the best use of existing equipment.

With the appearance of Type 3, No 1 aircraft radio set, radiotelephone capacity increased as it was simpler to manipulate, but maintenance thereof was neglected. Moreover, most of the units had poor communications due to the lack of attention to the screening of electromagnetic elements.

There was originally in existence the Type 96, No 4 aircraft radio set which could be operated by remote control and it was installed in large and medium planes. Then the Type 2, No 4 radio set was experimentally manufactured for remote control purpose but its mass production was shelved because it was deemed impracticable.

However, since the Type 96, No 4 aircraft radio set could not be operated on medium frequency, the Type 2, No 3 aircraft radio set was installed in land-based attack planes. This necessitated the radio operator's seat to be placed far behind the pilot, making intercommunications difficult.

In small planes, too, with the increase in the amount of equipment carried such as radar and other equipment, the space for radio sets became smaller, thereby increasing even more the necessity for remote control. Remote control for the radiotelephone of fighter planes was adapted for the Type 3, No 1 aircraft radiotelephone with good results, and the application of remote control to radiotelegraph was finally revived in the last Type No 3 experimental aircraft radio set, modified in 1944. This however, was not put into practical use by the operational forces.

Base Air Force Communications

At the beginning of the war, the base air force was organized as a unit of the Combined Fleet; consequently, each unit with its own independent communications system was included in the communications system of the Combined Fleet. Later, with the progress of operations, the base air force became the main striking strength of naval operations, and to cope with this situation, communications facilities of the base air force were gradually increased. However, the capacity of the cooperating land-based communications units was far too limited to satisfy the requirements of the air forces from

the standpoint of both personnel and equipment (See Chart 20 for authorized strength of the base air force communications department).

The base air force's independent communications system encompassed two communication nets, namely, the air force communications which was considered an operational communications net, and the administrative communications net. At the time, it was felt that uninterrupted communications could have been maintained through maximum utilization of communications units if the following measures had been taken: boost the capacity of communications units, thereby strengthening broadcasting communications of communications units; adopt mechanical control for regular unit-to-unit communications; and increase their capacity in handling communications.

Operational air communications centers which were projected to be strengthened were Kisarazu, Yamato, Kanoya, Shokozan (Takao), Clark Field, Tinian, Truk, Rabaul and Seletar (Singapore). With the progress of the war, those in Formosa and Japan were enlarged and became flexible organizations with auxiliary centers as reserve installations. As enemy air activity grew in intensity, dispersal in depth of groups of bases and the dispersal of installations in each base was required, and at the same time, a new arrangement of radiotelephone networks to connect dispersed installations became necessary. However, there was no equipment available to meet the foregoing requirement, and moreover, at this stage of the war, the war

Authorized Strength of Base Air Force Communications Department

Personnel Classification (See Key on Chart 20-d)			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Communications Officer			1		1									1					
Divisional Officer					0-1										1	1			
Assistant Communications Officer					1									1					
Warrant Officers and Above	Radio Dept	Materiel Assistant to the Communications Officer	2	1	1							1	1						
		Radio Officer	1			1	1	1	1	1				1	1	1	1		
		General Duty Officer	1											1					
	Code Dept	Code Officer	1																
		Officer and Reserve Officer	1												2	1			
		Special Duty Officer and Warrant Officer		1											2	1	1		
		Assistant Code Officer	1	1										1					

Authorized Strength of Base Air Force
Communications Department (cont'd)

Personnel Classification			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Radio and Code Dept	Special Communications Personnel (Inter-plane Communications)		6	3	3	3	3	3	3	3	3	1	1		3	3			
	Advanced Radiomen	Communications Personnel	6	6	3	3	3	3	3	3	3	3	3		13	8	6	4	
		General Equipment Personnel													3	3	2	0	
	Ordinary Radiomen		2	2											50	34	19	13	4
	Code Personnel		15	5		3	3	3	3	3	3	2	2		35	15	10	10	2
	Wire Telephone Personnel														30	18	12	12	3
	Administration Personnel (non-specialist)				1										21	15	6	6	1

Authorized Strength of Base Air Force
Communications Department (cont'd)

Personnel Classification			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
Radar Equipment Maintenance Dept and Wire Telephone Maintenance Dept	Warrant Officers and Above	Officer in Charge of Maintenance Section			1									1					
		Maintenance Section Officers			2	1	1*	1*	1*		2*	1	1	1					
	Radiomen	Advanced Course Maintenance Enlisted Trainees			1	4	4	2	2	2	2	4	2	1	2	2	2	2	
		Ordinary Course Maintenance Enlisted Trainees			1	4	4	2	2	2	2	4	2	1	8	8	8	8	
	Radar Personnel	Advanced Course Maintenance Enlisted Trainees				4	2	2		2	2	2			2	2	2	2	
		Ordinary Course Maintenance Enlisted Trainees				6	2	2		2	2	2			6	6	6	6	
	Wire Telephone Maintenance Personnel														10	5	3	3	

KEY

A Air Fleet Headquarters
B Air Squadron Headquarters

"KO" Air Force (Air)

C Headquarters
D Bombers
E Fighters, light bombers and medium attack planes
F Reconnaissance planes
G Flying boats
H Reconnaissance seaplanes
I Transport planes
J Fighters and interceptors
K Night fighters

"OTSU" Air Force (Ground)

L Headquarters
M Base A
N Base B
O Base C
P Base D
Q Base E

NOTES

1. The authorized strength for "KO" Air Force is to be determined on the basis of its air units.

2. Types and number of assigned bases will be the basis for determining the authorized strength for "OTSU" Air Force.

3. The various bases will be used as follows:
   Base A: By Air Fleet Headquarters
   Base B: By Air Squadron Headquarters
   Base C: For permanent stationing or as a mobile base for attack units or reconnaissance air units.
   Base D: For permanent stationing or as a mobile base for fighter units.
   Base E: To be used as a shelter base.

4. The main strength of radar maintenance personnel will be assigned to "KO" Air Force.

5. Advanced course radio enlisted trainees (air equipment) will be temporarily assigned as advanced course maintenance enlisted trainees.

6. Personnel for the column "Warrant officers and above" will be assigned from inter-plane communications.

7. Figures with asterisks indicate specialists for radar maintenance.

industry of Japan was so overburdened that there was no means nor time to manufacture new equipment. There was no alternative but for the air bases to use low-power sets which were originally to be installed on ships.

Base Communications Equipment

The standard for communications equipment supply to occupied bases and mobile land-based air forces was determined after the outbreak of hostilities (Chart 21).

The base construction policy had undergone great changes since the start of the Inner South Seas Operations. The changes meant that bases were maintained as a group of bases and that base installations were dispersed and converted into bombproof installations. As a result, all communications equipment was moved into the bombproof installations. The standard for communications equipment supply was reestablished in consideration of the speedy execution of this type of large scale conversion work and of the need for increasing medium-frequency transmissions.

Standard for Naval Air Base Communications Installations and Equipment (established in September 1944) entailed dividing the air base installations into the following four categories: (Chart 22).

Standard Communications Equipment for Mobile Land-Based Air Force

Communications Equipment		Permament Base	Mobile Base
Transmitter	Low and Medium Frequency	1	1
	High Frequency	4	2
Receiver		8	8
Radio Direction Finder		1	1
Mobile High-Frequency (or 'AGS' type)		2	4
Power Source		60 Kilovolt Ampere High Frequency 40 x 1 60 Kilovolt Ampere High Frequency 3 x 1	
Description	This standard shows per base communication equipment supply; actually, from half to several times the number of per base communication equipment listed herein were supplied in proportion to the strength and mission of the base force.		

Classification	Transmitter			Receiver
	High Freq	Med Freq	Low Freq	
(A) Air Fleet Hq	6	2	2	20 (later changed to 30)
(B) Air Flotilla Hq	5 (some with medium-frequency transmission)		1	10
(C) Air Gp at large base	5 (some with medium-frequency transmission)		1	7 (later changed to 9)
(D) Air Gp at small base	3 (some with medium-frequency transmission)			5

Chart 22

1. Major Air Base Communications Equipment Maintained in 1937 (Chart 23).

2. Major Air Base Communications Equipment Maintained from 1938 to 1940 (Chart 24).

3. Major Air Base Communications Equipment Maintained from 1941 to 1943 (Chart 25).

4. Major Air Base Communications Equipment Maintained in Japan at Termination of War (Chart 26).

Communications of Air Squadrons

General Situation

The concept of the air squadron communications system and its application, taking into consideration the battle experiences of the

Major Air Base Communications Equipment Maintained in 1937

No	Name of Base	Transmitter							Receiver	Emergency Power Source	Description
		Low Frequency		Medium Freq	High Frequency						
		1 KW	0.5 KW	250 W	2 KW	1 KW	0.5 KW	250 W			
1	Kazan										At first provided with no communications equipment. Maintained as a transport plane base
2	Ominato (Mizukami)	1					2		8	40 X 1	
3	Tsukuba		1				2		8	100 X 1	Maintained as a training plane base
4	Hyakurigahara		1				1		4	100 X 1	Same as above
5	Kasumigaura	1	2		1	2	2		18	350X1 100X1 60 X1	Same as above
6	Kashima		1				2		8		Same as above
7	Kisarazu	2	2		1	2	3		24	250X1 100X1	Maintained as a central base for land medium bombers
8	Tateyama	1	2		1	2	2		18	100X3	Maintained as a combat aircraft base
9	Yokohama	1	2		1	2	2		18	40 X 2	Maintained as a central base for large flying boats
10	Yokosuka No 1	2	1	1	1	3	3		24	250X1 100X1	Maintained as a training plane base
11	Oi	1	2			2	2		18	100X2 250X1	Same as above
12	Suzuka No 1	1	2		1	2	2		24	250X1 100X1	Same as above

Major Air Base Communications Equipment Maintained in 1937 (Cont'd)

No	Name of Base	Transmitter							Receiver	Emergency Power Source	Description
		Low Frequency		Medium Freq	High Frequency						
		1 KW	0.5 KW	250 W	2 KW	1 KW	0.5 KW	250 W			
13	Maizuru		1			1	2		8		Maintained as a combat aircraft base
14	Kure		1			1	2		8	250X1 60X1	Same as above
15	Saeki	1	1		1	2	2		18	100X2	Same as above
16	Sasebo	1			1	2	2	1	18	100X2	Same as above
17	Omura	2				1	3	1	18	100X2	Same as above
18	Kanoya	2			1	3	3		24	100 X 2	Maintained as a central base for land medium bombers
19	Chinhae		1			1	2		8	100 X 2	Maintained as a combat aircraft base
20	Takao	2			1	5	6		32	100 X 3	Maintained as a central base for land medium bombers
21	Saipan	1	1		1	2	2		18	250 X 2	Same as above
22	Koroku		1				2		8	100 X 3	Maintained as a staging base

Note: The information contained herein is based mostly on memory since records were scattered and lost. In some cases, the amount of communications equipment is based on the originally formulated plan; transmitters of 250-watt or less, except those recalled from memory, are not included in this table. A considerable number of medium-wave transmitters besides those listed herein were installed after the middle phase of the war. Generally, a considerable amount of communications equipment was removed while in use or moved to some other area in keeping with the progress of operations.

Major Air Base Communications Equipment Maintained from 1938 to 1940

No	Name of Base	Transmitter									Receiver	Emergency Power Source (KVA)	Remarks
		Low Frequency		Medium Frequency		High Frequency							
		1 KW	0.5KW	250W	100W	5 KW	2 KW	1 KW	0.5KW	250 W or less			
25	Shisuka	1						2	2		13	250 x 1 200 x 1	The communications equipment listed herein was installed after the transmitting-receiving station and night landing equipment.
26	Matsuwa	1						2	1		10	100 x 2	
27	Tennei	1						3	2		10	100 x 2 200 x 1	
28	Mihoro No 1	1	1			1	1	5	2		24	250 x 2 100 x 2	Maintained as a central bases for medium bombers
29	Nemuro								1		7		Maintained as an emergency landing base
30	Chitose No 1	1	2			1	1	4	5		32	250 x 2	Maintained as the Hokkaido Area Central Base Equipped with radio landing device
2	Ominato	1	1				1	1	2		18	100 x 2 40 x 1	Reinforced
31	Misawa	1	1				1	3	3		18	100 x 2	Maintained as a medium bomber base
32	Matsushima		1			1	1	3	3		18	100 x 2	
5	Kasumigaura	3	2					2	7		60	350 x 1 100 x 1 60 x 1	Expanded as a training plane base

Chart 24-a

Major Air Base Communications Equipment
Maintained from 1938 to 1940 (Cont'd)

No	Name of Base	1 KW	0.5KW	250W	100W	5 KW	2 KW	1 KW	0.5KW	250 W or less	Receiver	E P S (KVA)	Remarks
33	Tsuchiura												Used jointly with the Kasumigaura Base by primary training planes
34	Mohara	1 (2KW) 1					2	3	3		18	250 x 2	Maintained as a medium bomber base
7	Kisarazu	3	2				4	7	4		60	250 x 2 100 x 2	Maintained as a central base for medium bombers
8	Tateyama	1	3				1	4	4	1	24	100 x 3	Expanded as an amphibious base
35	Hachijojima		1					1	2	2	9	60 x 2	
9	Yokohama	1	2			1	1	2	2	1	24	100 x 2 40 x 2	Reinforced as a central base for large flying boats
10	Yokosuka No 1	2	1	1	2		1	5	6		42	250 x 2 100 x 2	Reinforced as a training plane base
36	Toyohashi	1	1			1	2	3	2	1	32	300 x 1 100 x 2	Maintained as a central base for medium bombers
37	Meiji	1						2	2		8	100 x 2	Maintained as a fighter plane base
38	Mineyama		1					2			8	60 x 1	Same as above
39	Otsu							1			6	250 x 1	Maintained as a training plane base
40	Miho	1	1			1	1	3	3		18	250 x 2	Maintained as medium bomber base (The communications equipment was later removed)
41	Iwakuni	1	1					3	4		32	100 x 2	Maintained as a training plane base
42	Tokushima	1	1				1	2	1		18	100 x 2	Maintained as a combat aircraft base

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Chart 24-a

Major Air Base Communications Equipment
Maintained from 1938 to 1940 (Cont'd)

No	Name of Base	1 KW	0.5KW	250W	100W	5 KW	2 KW	1 KW	0.5 KW	250 W or less	Re-ceiver	E P S (KVA)	Remarks
43	Komatsujima	1	1					3	2		18	100 x 2	Maintained as a combat aircraft base.
44	Kochi	2	3				1	3	5		18	100 x 1 250 x 1	
45	Sukumo		1						1		6		Maintained as an emergency landing base
46	Tsuiki	1	1					3	2		18	250 x 1 100 x 1	Maintained as a combat aircraft base
47	Usa	2						4	3		24	250 x 1 100 x 1	Maintained as a combat aircraft base as well as a training plane base
48	Oita	1	1					2	2		24	250 x 1 100 x 1	
49	Tomitaka	1						3	2		18	250 x 1 100 x 1	Maintained as a combat aircraft base
50	Hakata	2	1					4	3		24	250 x 1 100 x 1	Maintained as a training plane base
51	Izumi	1	1				1	3			18	100 x 2	Most of the communications equipment was removed after the base was established as a medium bomber base
52	Kagoshima	1						2	2		18	250 x 1 100 x 1	Maintained as a combat aircraft base
53	Kasanohara		1					1	2		18	50 x 1 15 x 1	

Major Air Base Communications Equipment
Maintained from 1938 to 1940 (Cont'd)

No	Name of Base	1 KW	0.5KW	250W	100W	5 KW	2 KW	1 KW	0.5KW	250 W or less	Receiver	E P S (KVA)	Remarks
18	Kanoya	3				1	3	6	13		42	100 x 3	Reinforced as a central operational base
54	Kikai									6	8		Temporarily established as an emergency landing base
55	Koniya									3	6		
22	Koroku		1					1	1		8	100 x 2	Later underwent many changes with progress of operations
56	Minamidaito									6	4	60 x 2	Temporarily established as an emergency landing base
57	Ishigaki No1									6	4		Same as above
58	Chichijima		1					1	2		8	100 x 2	Maintained as a small aircraft base
59	Saishu-to		2					3	2		18	100 x 2	Maintained as a staging base; the communications equipment was later removed
60	Genzan		2				1	3	3		24	250 x 1 100 x 1	Maintained as a medium bomber base
61	Taihoku		1 (1)					2	2(1)	(2)	8 (4)		Civilian installations were reinforced to use the airport as a medium bomber base
62	Shinchiku	1	1				1	3	3		24	250 x 2	Maintained as a medium bomber base
63	Taichu		1					1	1		8	100 x 2	The communications equipment was later removed
64	Tainan		2				1	2	2		18	100 x 2	Maintained as a fighter base

Major Air Base Communications Equipment Maintained from 1938 to 1940 (Cont'd)

No	Name of Base	1 KW	0.5KW	250W	100W	5 KW	2 KW	1 KW	0.5KW	250 W or less	Re-ceiver	E P S (KVA)	Remarks
20	Takao	2	2			1	2	5	8	6	72	250 x 1 100 x 2	Reinforced as a central operational base
65	Toko	1	1				1	3	3		18	250 x 1 100 x 1	Maintained as a large flying boat base
66	Mako												Installations of the communications unit were utilized
67	Tinian	1	1			1	1	3	2		24	250 x 1	Maintained as a medium bomber base
68	Truk	1	2			1	2	3	2		32	100 x 3	Overall amphibious installations
69	Pagan												Emergency landing field
70	Woleai									3	6		
71	Jaluit	1	1			1	1	2	2		18	250 x 2	Maintained as a medium bomber base
72	Wotje	1	1			1	1	2	2		18	250 x 2	
75	Shanghai		2				2	2	4		32	100 x 2	Total communications equipment for several Shanghai area bases are listed herein. Maintained as an operational base.

Major Air Base Communications Equipment Maintained from 1938 to 1940 (Cont'd)

No	Name of Base	1 KW	0.5KW	250W	100W	5 KW	2 KW	1 KW	0.5KW	250 W or less	Re-ceiver	E P S (KVA)	Remarks
73	Tsingtao		1						1		8		The communications equipment was originally earmarked for supply to the Chiangkou Base
76	Nanking		1					1	1		8	100 x 2	Maintained as a base
77	Kiukiang							1	1		8	100 x 2	
80	Hankow	1					1	2	2		18	150 x 2	
83	Santsaotao	1	1				1	2	2		18	150 x 2 100 x 1	
81	Amoy									1	6		
74	Chiangkou									1	8		
78	Anking		1					1	1		8	150 x 2	
79	Nanchang	1	1				1	2	2		18	100 x 2	
82			1					1	1	1	18	100 x 2	
84	Haikow		1							1	8		
85	Samah	1	1				1	2	2		18	250 x 1 100 x 1	

Major Air Base Communications Equipment Maintained from 1941 to 1943

No	Name of Base	Transmitter										Receiver	Emergency Power Source (KVA)	Electrical Device for Night Landing	Remarks
		Low Freq		Med Freq		High Frequency					Others				
		1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	100 W					
101	Shumushu No 1	2	1		2	1	2	2				26	60 x 1	1	Maintained as an operational base
102	Shumushu No 2				1							13		1	Same as above
103	Paramushiro No 1	1			1		2	2				26		1	Same as above
104	Paramushiro No 2		1					2				10		1	Same as above
105	Minoro No 2	1		1	2		1	1				18	100 x 2	1	Same as above
106	Akeshi									2		7		1	Maintained as an emergency landing base
107	Chitose No 2	3	2		4	1 (5 KW ..1)	4	5				88	250 x 2	1	Reinforced as a central base
30	Chitose No 1														
108	Yatabe									2		3		1	Maintained as a training plane base
109	Konoike	1					3	2		7		8	100 x 2	1	Maintained as a combat aircraft base

Major Air Base Communications Equipment
Maintained from 1941 to 1943 (Cont'd)

No	Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	100 W	Others	Receiver	EPS (KVA)	EDNL	Remarks
110	Kátori	2	1		2	2	4	2		4		18	100x2 250x1	1	Maintained as a central base
111	Tokyo									2		2		1	Maintained as a training plane base
112	Yokosuka No 2	2	1	1	3	1	4	5		6		42	250x2 100x2	1	Maintained as a training plane base
10	Yokosuka No 1														Reinforced as a training plane base and as an operational base
113	Atsugi	1	1		1		2	4		5		20	250x1 100x1	1	Maintained as a combat aircraft base
114	Sagamino									1				1	Maintained as a training plane base
115	Nagoya	1			1		2	1				9	100x2	1	Maintained as a combat aircraft base
116	Yamato		1		1				1	1		4	250x1	1	Same as above
117	Komatsu	1		1	2	1	2	2		2	10		100x2	1	Same as above
118	Kushimoto		1				1	1		1	7		8x1	1	Same as above
119	Takuma	2	1		3	1	2	2		3	16		250x1 100x1	1	Same as above
120	Saijo	1		1	2	1	2	2	1	1	14			1	Maintained as a fighter base
121	Matsuyama	1	1	1	3	1	2	2			10		100x2	1	Maintained as a combat aircraft base

Major Air Base Communications Equipment
Maintained from 1941 to 1943 (Cont'd)

No	Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	100 W	Others	Receiver	E P S (KVA)	E D N L	Remarks
122	Miyazaki	1		1	2	2	1	1			6		100 x 2	1	Maintained as a combat aircraft base (Most of the communications equipment was later removed)
123	Isahaya									5	3		100 x 1	1	Maintained as a primary training plane base
124	Kokubu			1				1		5	6		100 x 1	1	Maintained as a training plane base and later as a combat aircraft base
125	Ibusuki				2	1	3	2		1	15			1	Maintained as a combat aircraft base
126	Tanegashima				2		2	2		1	12		250 x 1 100 x 2	1	Maintained as a combat aircraft base (The communications equipment was later removed)
127	Nawa		1		2	2				6	18		100 x 2	1	Reinforced as a combat aircraft base
128	Karenko										Although the plan was formulated previously for providing the bases with communications equipment, the local Naval Construction and Repair Section apparently did not install communications equipment; nothing is known definitely due to lack of records.				
129	Taito														
130	Ulithi		1		1					3	6		60 x 1		Maintained as a staging base
131	Palau	1	1	1	2	2	2			5	18		150 x 2	1	Maintained as an amphibious base
132	Mortlock		1		1					3	6				Maintained as an emergency landing field
133	Ponape		1			1	2			2	8		100 x 2	1	Maintained as a combat aircraft base
134	Eniwetok		1		1	2	2			5	18		150 x 2	1	

Major Air Base Communications Equipment
Maintained from 1941 to 1943 (Cont'd)

No	Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	100 W	Others	Receiver	E P S (KVA)	E D N L	Remarks
135	Kusaie		1		1					3	6				Maintained as a staging base
136	Rongelap		1		1	2	2			5	18		150 x 2	1	Maintained as a combat aircraft base
137	Maloelap		1		1	2	2			5	18		150 x 2	1	Same as above
138	Majuro		1		1	2	2			5	18		150 x 2	1	Same as above
139	Mili	1			1	1	2	2		5		18	100 x 2 250 x 2	1	Same as above
140	Makin	1			1		1			3		18	150 x 2	1	Same as above
141	Tarawa	1			1		1	1		3		8	100 x 1	1	Same as above
142	Toulon	Communication equipment for five permanent bases was dispersed and maintained by the local commanders. Details are unknown.													
143	Nhatrang														
144	Camranh														
145	Thu Dau Mot														
146	Saigon														
147	St. Jacques														
148	Soctrang														

Chart 25-d

Major Air Base Communications Equipment
Maintained from 1941 to 1943 (Cont'd)

No	Name of Base	1 KW	0.5 KW	250 W	100 W	2. KW	1 KW	0.5 KW	250 W	100 W	Others	Receiver	E P S (KVA)	E D N L	Remarks
149	Port Blair		1					1	3	3		6			Details unknown
150	Car Nicobar		1				1		3	3		6			
151	Sabang	Communication equipment for 15 permanent bases and 10 mobile bases was dispersed and maintained by the local commanders.													
152	Koetaradja														
153	Penang														
154	Seletar														
155	Bataan														
156	Jakarta														
157	Jogjakarta														
158	Madang														
159	Soerabaja														
160	Labuan														
161	Bandjermasin														

Major Air Base Communications Equipment
Maintained from 1941 to 1943 (Cont'd)

No	Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	100 W	Others	Receiver	E P S (KVA)	E D N L	Remarks
162	Balikpapan	Communication equipment for 15 permanent bases and 10 mobile bases was dispersed and maintained by the local commanders.													
163	Makassar														
164	Kendari														
165	Menado														
166	Ternate														
167	Kaoe														
168	Amboina														
169	Waingapoe														
170	Koepang														
171	Delhi														
172	Soron														
173	Manokwari														
174	Kavieng														
175	Rabaul														

Major Air Base Communications Equipment
Maintained from 1941 to 1943 (Cont'd)

No	Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	100 W	Others	Receiver	E P S (KVA)	E D N L	Remarks
176	Buka		Communication equipment for 15 permanent bases and 10 mobile bases was dispersed and maintained by the local commanders.												
177	Buin														
178	Wake														
179	Heitaku		1		2	1	2	2				8	100 x 2	1	Maintained as an operational base
180	Reisui		1		2	1	1	1				8	100 x 2	1	
181	Pusan		1		2	1	1	2				12	100 x 2	1	

Major Air Base Communications Equipment Maintained in Japan at Termination of War

Name of Base	Transmitter									Receiver	Remarks (The figure in parenthesis indicates the quantity of equipment which was not completed)
	Low Frequency		Medium Frequency		High Frequency						
	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W		
Shisuka (Shikuka)	1			1 (1)		2	2 (1)			13	Hardly used
Odomari	1		1				2 (1)	1	2	7	The communications equipment was shipped but apparently was not installed
Shumushu No 1	2	1		2 (2)	1	2	2 (2)			26	Bombproof construction was completed
Shumushu No 2				(1) (1)						17	The transmitting station was to be used jointly with Shumushu Base No 1
Paramushiro No 1	1			1 (1)		2	2 (1)			26	The communications equipment in the Chishima area was removed and shipped to Hokkaido
Paramushiro No 2		1					2 (2)			10	
Matsuwa	1					2	1 (1)			10	
Tennei	1					3	2 (2)			10	
Mihoro No 1	1	1		2 (2)	1 (5KW) 1	5	2 (1)			18	The ground bombproof construction was converted into the underground type
Mihoro No 2	1		1	2 (2)		1	1 (1)		2 (1)	10	Bombproof construction completed

Major Air Base Communications Equipment Maintained in Japan at Termination of War (cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W	Re-ceiver	Remarks
Mihoro No 3	1		1				2	1	1 (1)	7	Bombproof construction completed
Shibetsu No 1	1	1	1			1	2	2	2	14	Same as above
Shibetsu No 2	1	1	1			1	2	2		14	Same as above
Nemuro							1		1	7	The same construction as the Mihoro Base No 2 was planned, but actually a smaller base was constructed
Chitose No 1											Converted to underground bombproof construction with headquarters installations
Chitose No 2	3	2		4 (4)	1(5 KW) 1	4	5		9 (4)	88	
Chitose No 3											
Kabayama	1					1	2	2		10	Construction work discontinued
Ominato	1		1	2 (1)			2 (2)		1 (1)	14	Maintained also as an agency for the communications units
Masawazawa	1	1			2	3	2 (1)			22	
Matsushima		1			1 (5 KW) 2	3	2 (1)		1	10	Conversion to bombproof construction completed

Major Air Base Communications Equipment Maintained in Japan at Termination of War (cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W	Re-ceiver	Remarks
Koriyama				1 (1)					4 (4)	11	Conversion to bombproof construction completed
Koriyama No 3	1		1			1	2	2		13	The planned construction of a "RENZAN"-type bomber base was under way
Tsukuba		1		1 (1)			1		7 (4)	8	Bombproof construction was completed
Hyakurigahara		2		1 (1)		2	2		6 (3)	16	Same as above
Kasumigaura	3	2	2	3 (3)		2	7		8 (4)	38	Bombproof construction with headquarters installations completed
Yatabe				1 (1)			2 (2)		2 (2)	12	Bombproof construction completed
Kashima	1	2				2	2		4	10	Same as above
Konoike	1					3	2		7 (3)	8	Same as above
Katori	2	1		2 (2)	2	4	2 (1)		4	14	Same as above
Ohara	1(2KW) 1			2 (2)	2	3	2 (2)			13	Same as above
Misarazu	3	1			4	7 (2)	2 (2)		6 (3)	41	Bombproof construction with headquarters installations completed; the receiving station moved again

Major Air Base Communications Equipment Maintained in Japan at Termination of War (cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W	Re-ceiver	Remarks
Tateyama	1	3	2		1	4	2 (2)	1		20	
Hachijo	1	1	1			1	2 (2)	2	6	21	Provided with communication equipment which was not included in the plan; bombproof construction completed
Tokyo									2	2	
Yokohama	1	1	1		1	2				9	Hardly used. Part of the communications equipment transferred to the Igaueno base
Yokosuka No 1	2	1	1	3 (3)	1	4 (1)	5 (1)		6	25	Bombproof construction completed
Yokosuka No 2	1			1 (2)			1		2	5	Construction work under way
Atsugi	1	1		1		2	4 (2)		5 (5)	20	Bombproof construction completed
Fujisawa								1	3 (1)	8	Same as above
Fujieda	1					2	3 (1)			12	Same as above
Oi	2		1	2		3	4		2	12	The communications equipment for training was removed and transferred to the Yamato Base and others
Toyohashi	1	1		2 (2)	1(5KW) 2	3	2	1	1 (1)	13	Bombproof construction completed

Major Air Base Communications Equipment Maintained in Japan at Termination of War (cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0,5 KW	250 W	150 W	Re-ceiver	Remarks
Okazaki						1			1	4	Bombproof construction completed
Meiji	1		1 (1)	3 (3)		2 (2)	2 (2)			13	Bombproof construction completed; headquarters installations were being established
Nagoya	1			1 (1)		2	1 (1)			9	Bombproof construction completed
Kowa		1		1 (1)				1	1	4	Same as above
Suzuka No 1	1	3		1 (1)		4	5 (1)			9	Bombproof construction completed; the training equipment was rearranged to be used at other locations
Suzuka No 2	2		1			4 (1)			3 (1)	12	Bombproof construction was completed
Igaueno	1		1			2	2		3 (2)	16	Construction work under way; headquarters installations under construction
Jimmachi				2 (2)		1	1		3 (1)	8	A request was received for the construction of headquarters installations, but no decision had been made
Komatsu	1		1	2 (2)	1	2	2 (2)		2 (1)	10	Bombproof construction completed
Otsu							1		1 (1)	5	Same as above
Yamato	2					6 (4)	8		2	30	Headquarters installations were prepared and completed

Major Air Base Communications Equipment Maintained in Japan at Termination of War (cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W	Re-ceiver	Remarks
Maizuru	2	1				1	3			16	Bombproof construction completed
Mineyama		1					1 (1)			6	Same as above
Fukuchiyama				1 (1)			1	2	6 (5)	11	Construction work under way
Miho	1		1	1 (1)	1(5KW) 1	2	2			18	Same as above
Kushimoto		1				1	1		1	7	Bombproof construction completed
Naruo	1		1	2 (2)		4			4 (3)	12	Bombproof construction completed; conducted part of the antiaircraft defense communications of the Osaka Security Unit
Itami										5	Bombproof construction completed
Himeji		1	1	2 (2)		2 (1)	1		4 (3)	13	Same as above
Kurashiki									4 (3)	6	Same as above
Fukuyama	1		1				1		4	9	Same as above
Kure	1	1	1	2 (2)		3	2 (1)		2 (2)	24	Bombproof construction completed; planned as the reserve for the Kure Communications Unit

Major Air Base Communications Equipment Maintained in Japan at Termination of War (Cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W	Re-ceiver	Remarks
Iwakuni	1	1	1	3 (3)		3	4		1 (1)	29	Bombproof construction completed
Tokushima	1	1			1	2	1		3 (2)	15	Bombproof construction completed; training installations partially moved elsewhere
Tokushima No 2									3	4	Construction work under way
Komatsujima	1	1	1	2 (2)		3	2			10	Being converted to bombproof construction
Takuma	2	1		3 (3)	1	2	2		3 (1)	16	Completed
Kannonji	1		1	2 (2)	1	2	2		1 (1)	14	Completed
Saijo	1		1	2 (2)		2	1 (1)			8	
Matsuyama	1	1	1	3 (3)	1	2	2 (2)			20	
Taisha	1						1 (1)		3 (3)	9	A request was received for the construction of headquarters installations, but the construction was not effected
Nanao									2 (1)	2	
Kochi	2	3	1	2 (2)	1	3	5 (2)			15	Completed

Major Air Base Communications Equipment Maintained in Japan at Termination of War (cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W	Re-ceiver	Remarks
Sukumo		1					1			3	
Tsuiki	1	1	1	3 (3)		3	2 (2)		2 (2)	12	Bombproof construction completed
Usa	2		1	3 (3)		4	3 (1)		2 (2)	20	Same as above
Oita	1	1	1	1 (1)		2	2		11 (4)	40	Bombproof construction completed; headquarters installations established
Saeki	1	1	1	3 (3)	1	3	2 (2)			16	Bombproof construction completed
Tomitaka	1		1	2 (2)		3	2 (1)		1 (1)	10	Same as above
Miyazaki	1								1 (1)	6	Same as above
Hakata	2	1	1	1 (1)		4	3 (1)		9	22	Bombproof construction completed; headquarters installations established
Fukuoka									2	11	Bombproof construction completed
Sasebo	1		1	2 (2)	1	3	2 (1)		3	14	Bombproof construction completed; can be used as auxiliary to the Sasebo Communications Unit
Omura	2					1	6		4	10	Bombproof construction completed

Chart 26-h

Major Air Base Communications Equipment Maintained in Japan at Termination of War (cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W	Re-ceiver	Remarks
Isahaya									5	3	Bombproof construction completed
Tomie							1 (1)	1	2	10	Same as above
Amakusa							1		2	9	Same as above
Izumi	1		1	1 (1)			1		3 (3)	6	Same as above
Kokubu			1				1		1 (1)		Same as above
Kokubu No 2			1	1 (1)			2 (1)		6 (2)	7	Same as above
Kagoshima	1		1	3 (3)		2	2 (1)		1 (1)	14	Same as above
Iwakawa			1	1 (1)			2 (1)		2 (1)	7	Same as above
Shibushi			1	1 (1)		2	2 (2)		1	12	Same as above
Kushira	1			2 (2)		1	1 (1)			101	Same as above
Kasanohara				1			1 (1)		2 (1)	7	Same as above

Major Air Base Communications Equipment Maintained in Japan at Termination of War (cont'd)

Name of Base	1 KW	0.5 KW	250 W	100 W	2 KW	1 KW	0.5 KW	250 W	150 W	Re-ceiver	Remarks
Kanoya	3		4	2 (2)	1(5KW) 3	6	13 (4)		5	36	Bombproof construction completed; headquarters installations established
Ibusuki	1			2	1	3	2 (1)		1 (1)	15	Bombproof construction completed
Tanegashima	1			2		2	2 (1)		1 (1)	12	Same as above
Kikaigashima									6 (3)	7	Same as above
Koniya									3 (1)	5	Same as above
Minamidaito-jima									6 (5)	10	Same as above
Miyakojima									6 (5)	10	Same as above
Ishigakijima									6 (4)	8	Same as above
Ishigakijima No 2									3 (1)	6	Same as above
Koroku	1	1				2	3		3 (2)	15	Same as above
Okinawakita	1	1	1			2	4		4 (4)	20	Bombproof construction completed; headquarters installations established

China Incident, was more or less stabilized before the outbreak of the Pacific War. There was no noticeable improvement in aircraft equipment after the outbreak of war, but instead there was a definite trend in which the quality as well as quantity dropped as the supply of materials became scarce. Moreover, the skill of flight radiomen dropped in proportion to the increase in casualties and consequently, the air communications system had to be simplified according to the capabilities of the available personnel.

Intensive training in telegraphic communications with fighter planes had been carried out prior to the outbreak of war. The use of the radiotelephone in communications with fighters was the most advantageous and suitable method. However, since it was necessary for the fighters to coordinate with the attack unit and for security reasons, there was no alternative but to utilize telegraphic communications to cover the 200-mile range. This placed a considerable burden upon the flight personnel of fighter planes in operations, but they successfully overcame these difficulties and showed satisfactory skill in operational actions, at least during the early phase of the war.

Frequency System

Frequencies used by the forces committed to an operation were classified into three types, that is, A, B and C, according to the usages (Chart 27) (See Charts 28 and 29 for Frequency Assignment Standard and Organization of Communications Net respectively).

Frequency Classification

Classification	Usages
Type-A air communications frequency	This will be used for communications of important operational matters and matters concerning the entire fleet.
Type-B air communications frequency	1. Operational communications concerning the flotilla (or unit corresponding to the above in strength). 2. Communications in case each flotilla attacks a different target.
Type-C air communications frequency	1. Communications between air flotillas and the base or aircraft carriers. 2. Communications for securing homing flight.

Frequency Assignment Standard

Unit	Type A High Frequency	Type B High Frequency	Type C High Frequency	Type A Low Frequency	Type B Low Frequency	Type C Low Frequency	Very-high Frequency
Search Force Attack Unit	Regular 1 Auxiliary 2	Regular 1 Auxiliary 1	Regular 1 Auxiliary 1	Regular 1 Auxiliary 1	Regular 1	Regular 1	Regular 1
Patrol Force	Regular 1 or Auxiliary 1	Regular 1	Regular 1 Auxiliary 1	Regular 1	Regular 1	Regular 1	
Air Control Unit	Regular 1	Regular 1					
Antisubmarine Direct Escort Unit			Regular 1				
Combat Air Patrol			Regular 1				
Interception Patrol Force			Regular 1				
Notes	1. The Type C low frequency will be used in homing direction finding. 2. The Type A high frequency for fighter plane (attack unit) use may also be used by the plane of the attack unit commander.						

Chart 28

Organization of Communications Net

Classification	Communicating Ship, Station or Aircraft	Frequency	Radio Control Ship or Aircraft	Communications Procedure
General Aviation Communications	Plane unit (attack, search, reconnaissance, patrol and tracking) and aircraft carrier	(High) or (Medium), or (Low) depending on the situation	Aircraft carrier	Free and direct exchange of communications or controlled communications as occasions demand.
Communications between Flying Squadrons and Others	Between plane unit and ship, aircraft carrier, radio station and aircraft of other units	(High) or (Medium)	Aircraft carrier	Aircraft carrier will be the relay ship and no direct exchange of communications will be made.
Communications within Attack Unit	Between planes	(Very-high)	Unit communications plane	Free and direct exchange of communications
Air Control Unit Communications	Between fighter planes; guide plane, unit commander's plane	(High) (Telephone)	Unit communications plane	Free and direct exchange of communications; communications between aircraft carrier and fighter planes will be relayed, as a rule, by guide plane.

Chart 29-a

Organization of Communications Net
(cont'd)

Classification	Communicating Ship, Station or Aircraft	Frequency	Radio Control Ship or Aircraft	Communications Procedure
Combat Air Patrol Communications	Between fighter plane and ship escorted by fighter plane	(High)(Telephone)	Ship escorted by fighter plane	Free and direct exchange of communications
Antisubmarine Direct Escort Communications	Between antisubmarine escort plane and ship escorted by antisubmarine escort plane	(High)(Telephone) (Very-high wave) (Telephone)	Ship escorted by antisubmarine escort plane	Same as above
Communications between Plane and Submarine	Between plane and submarine	(High) or (Medium)		Communications by time (as per agreement)
Radio Direction Finding Communications (Low frequency Radio Direction Finding)	Between plane and aircraft carrier	Exchange of communications (High) Radio direction finding (Low)	Aircraft carrier	Controlled communications
Radio Direction Finding Communications (High Frequency Radio Direction Finding) Radio Homing (Aircraft Radio Direction Finding)	Between plane and aircraft carrier Between plane and aircraft carrier	Both exchange of communications and radio direction finding (High), (Medium) or (Low)	Aircraft carrier Aircraft carrier	Same as above One-way communications

Radio Equipment

1. The standard radio equipment for various types of aircraft is shown in Chart 30, and spare equipment equivalent to 30 per cent of each item was supplied to each air squadron.

2. Changes in radio equipment

a. First Phase Operations

The types of aircraft radio equipment in late 1941 were as shown in Chart 31. Every item of equipment was produced in rapid succession and every type of aircraft was, in general, properly equipped. The breakdown of equipment was quite rare and flight radiomen were skillful enough to repair and maintain the equipment. Consequently, in the battles of various areas in the early phase of the war, there were rarely any occurrences of poor liaison or difficulty of communications due to breakdowns of equipment to hinder combat efficiency. Moreover, one radio maintenance man was assigned to each air squadron and he successfully discharged duties in cooperation with the flight radiomen. Meanwhile, the Central Agency decided to carry out manufacture of experimental new equipment (Chart 32) to improve quality and to effect standardization and mass production of equipment in order to meet the growing demands of the expanded operational zone and improved aircraft performance.

b. Second Phase operations

The First Phase operations had progressed very satisfactorily and the operations zone was greatly expanded. In parti-

Standard Radio Equipment for Various Types of Aircraft (Excluding Radar)

Type of Aircraft	For Communications with Units Outside the Air Force	For Communication within the Air Force	Radio Direction Finder
Large-size planes	N3-type (R3) 2 sets	U4-type 1 set	1
Medium-size planes	N3-type (R3) (2) 1 set	U4-type 1 set	1
Two or three-seater planes	N3-type (R3, N2) 1 set	U3-type 1 set	1
Single-seater fighter	NI-type 1 set		1
Remarks	Guide plane of fighter plane unit had an additional NI-type set.		

Communications Equipment in Actual Use at Start of War

Equipment	Type of Aircraft Carrying Communication Equipment	Frequency in Kilocycles	Power in Watts	Weight in Kg	Radio Range Plane to Ground (Miles)	Remarks
Type-96 Aircraft Radiotelephone Set No 1, Improved Model No 1	Single seater	4,200-5,500	15	18	50	This is an improved model of Aircraft Radiotelephone Set No 1, using the aircraft generator instead of dry cell battery.
Type-96 Aircraft Radio Set No 2	Two-seater	High... 5,000-10,000 Low... 300 - 500	100	45	600	Possible to change three transmission frequencies in a single motion; devised mainly for observation communications use; for radiotelegraph and radiotelephone communications use:
Type-96 Aircraft Radio Set No 3	Three-seater Multiseater	High... 5,000-10,000 Low... 300 - 500	150	52	700	
Type-96 Aircraft Radio Set No 4	Multiseater	High.... 5,000-10,000 Low... 300 - 500 (Receiving)	300	76	1,200	Low frequencies are used only in receiving; transmitter is remote-control type.
Type-1 Aircraft Radiotelephone No 3 for communications within the unit	Two or three-seater	30 - 50 Megacycles	10	18	Plane-to-plane, 5 miles	Both transmitter and receiver are crystal controlled; capable of transmitting musical sound.

Communications Equipment in Actual Use at Start of War
(cont'd)

Equipment	Type of Aircraft Carrying Communication Equipment	Frequency in Kilocycles	Power in Watts	Weight in Kg	Radio Range Plane to Ground (Miles)	Remarks
Type-98 Aircraft Radiotelephone No 4 for communications within the unit	Multiseater	30 - 50 Megacycles	40	35	Plane-to-plane, 20 Miles	Same as above.
Type-1 Aircraft Radio Direction Finder and Homing Device No 3	Light Aircraft	170-1,200		28	60	Modelled after the American radio direction finder.
Type-0 Aircraft Radio Direction Finder and Homing Device No 4	Large-type and medium-type aircraft	165-1,000		58	200	Improved model of the German TELEFUNKEN radio direction finder.
Notes	1. Both crystal-controlled and automatic transmissions can be conducted (except radiotelephone communications within the unit). 2. Only automatic reception is conducted (same as above). 3. 75-meter trailing antenna is used in all low frequency transmissions.					

Experimental Communications Equipment at Start of War

Equipment	User	Frequency in Kilocycle	Power in Watt	Weight in Kg	Remarks
Type 3 Aircraft Radiotelephone Set No 1	Fighter Plane	5,000-10,000	100	30	Improved model of the Type 96 Aircraft Radiotelephone Set No 1
Type 1 Aircraft Radio Set No 3	Three-Seater Aircraft	High 5,000-20,000 Low 300 - 500	300	70	Superior aircraft radio set with characteristics of both the Type 96 Aircraft Radio Sets No 2 and No 3.
Type 3 Aircraft Radio set No 5	Air Base	2,500-20,000	300x3	150	Mobile radio set for exclusive use of air bases.
Type 96 Aircraft Radio Set No 2, Improved Model No 1	Two-Seater Aircraft	High 5,000-10,000 Low 300 - 500	100	45	Standard vacuum tubes used.
Type 96 Aircraft Radio Set No 4, Improved Model No 1	Multi-Seater Aircraft	5,000-15,000	300	76	Frequency bands magnified.
Type 1 Aircraft Radiotelephone No 3, for communications within the unit. Improved Model	Two or Three-Seater Aircraft	30 - 50 Megacycle	15	13.5	Standard vacuum tubes used.
Notes	Types of vacuum tubes were decreased as much as possible and the vacuum tubes made interchangeable. Namely: Transmitting Tubes: Master Oscillator Tube, FZ-064A, Amplifier Tube, & FE-325A. Receiving Tube: FM-2A05A				

cular, when the Solomons area became the main theater of operations, radio frequency unexpectedly became an important problem as data was lacking on the frequency range in this area. In night communications, high frequency was ineffective and this greatly hindered operations. Although it was known that high frequency is less effective at night than daytime, this was not considered a matter of great importance in Japan. However, for air operations in the southern areas in which night flying was frequently conducted, the frequencies of 5,000-10,000 kilocycles ordinarily used in the past turned out to be extremely ineffective. In many cases, a search plane's report on the sighting of the enemy failed to reach its destination and frequently hindered the execution of operations. Therefore, research and experiments were started immediately on the utilization of the medium frequency band.

Towards the end of 1942, the medium frequency band (2,500-5,000 KC) was first added to the Type-96 No 3 aircraft radio set and sent to the forces in operations (excluding fighter planes). As a temporary measure, part of the trailing antenna for low frequency was used for this modified set. As the adjustment of this medium frequency attachment was more complicated than that of the high frequency and as its handling was not thoroughly understood, the peak performance in medium frequency was not realized.

With the Guadalcanal campaign as a turning point, the Japanese realized that war production was too slow to meet the counteroffen-

sives of the enemy. Therefore, standardization of the materials and products and simplification of design was attempted in order to facilitate mass production.

Principal improvements realized from the manufacture of experimental equipment were as follows:

1. Experimental manufacture of the Type-43 experimental equipment (equipment experimentally manufactured in the fiscal year 1943) for various types of aircraft.

2. Elimination of covers to various radio sets for protection from dust and water.

3. Decrease in number of relays in various radio sets.

4. Restricting the use of neon tubes by using Argon tubes.

5. Use of iron and wood as substitutes for aluminium and copper.

The above were tested and successively put into practice after 1943 (Chart 33).

c. The beginning of the Third Phase operations (February 1943 - October 1944).

As a result of the widespread war covering the entire Pacific Ocean, the greater part of the highly-trained, skilled flight personnel was lost and they were replaced by those who had undergone mass-training in a shortened period. Therefore, interior communications technique as well as poor handling and maintenance of equipment became apparent. Furthermore, carelessly manufactured equipment was supplied to the front line forces without being tested. Consequently,

Summary of the 1943 - Experimental Equipment (Excluding Radar)

Equipment	Use	Frequency in Kilocycles	Power in Watts	Weight Kg	Range Nautical miles	Remarks
Type-43, No 1, Aircraft Radiotelephone Set	Fighter planes	5,000-10,000	100	30	500	Construction and operation simplified; tone quality improved.
No 3, Experimental Aircraft Radio Set, modified 1943	Various types of aircraft except fighter planes	2,500-10,000 300 - 500	300	45	1,500	Remote control and common use for various types of aircraft possible. Manufacturing process of Type-2, No 3 Aircraft Radio Set simplified.
No 5, Experimental Aircraft Radio Set, modified 1943	Bases	100-20,000 (All wave)	300	?	1,500	Six tuning units used in plug-in method; plywood used.
Experimental Radio Homing Direction Finder, modified 1943.	Various types of aircraft	300 - 500	-	35	200	Two kinds of loop antenna used for large and small planes.
No 8, Experimental Aircraft Radio Set, modified 1943	Parachute forces	2,500-10,000	60	20	300	
Experimental Interphone, modified 1943.	Three-seater planes	-	-	7.5	-	When completed, to be installed in other types of aircraft.

every unit was plagued with frequent breakdowns of equipment and complaints were received from a number of units that the failure of messages reaching the destination and improper functioning of communications equipment hindered the execution of operations. The practical and experimental equipment manufactured in this period is shown in Chart 34.

d. The latter period of the Third Phase operations (November 1944 - August 1945).

In order to meet the rapidly mounting enemy counter-offensives, the role of operational communications became increasingly important. The most urgent problems were the need for strict supervision over the increasing output of carelessly manufactured equipment and the need for immediate use of experimental equipment. By March 1945, such equipment had undergone some improvement and was ready for practical use (Chart 35).

When enemy air attacks by B-29's increased in intensity, the plants manufacturing vacuum tubes and other various parts of equipment were successively destroyed. In addition, due to the drop in productive capacity resulting from the dispersal of plants, the manufacture of equipment was insufficient to meet the requirements of front line forces. Later, in anticipation of the Homeland operation in which all-out suicide attacks were to be carried out, the need for simplified communications equipment for special attack planes was envisaged and efforts were directed to the experimental

Radio Communications Equipment in Actual Use
(Jan 43 - Oct 44)

Equipment	Equipped on	Frequency in Kilocycles	Power in Watts	Weight in Kg	Transmitting Range Miles	Remarks
Type-3 Aircraft Radiotelephone Set No 1, Improved Model No 1	Fighter planes	5,000-10,000	100	20	To plane, 100 To ground, 300	Standardized Type-18 Experimental Aircraft Radiotelephone Set No 1.
Type-96 Aircraft Radio Set No 2, Improved Model No 2.	Two-seater planes	2,500-10,000 300 - 500	100	46	600	Further developed Improved Model No 1 with additional medium frequency band, however receiver went out of order frequently.
Type-96 Aircraft Radio Set No 3, Improved Model No 1.	Three-seater planes	2,500-10,000 300 - 500	150	52	700	Improved with additional medium frequency band.
Type-2 Aircraft Radio Set No 3, Improved Model No 1	Three-seater & Multi-seater planes	2,500-20,000 300 - 500	300	74	1,500	Weight and capacity increased with additional medium frequency band.
Type-1 Aircraft Radiotelephone No 3 for communications within the unit.	Two or three-seater planes	30 - 50 Megacycle	15	18.5	To plane, 10	Went out of order frequently due to faulty wiring in plane.
Type-98 Aircraft Radiotelephone No 4 for communications within the unit	Multi-seater planes	30 - 50 Megacycle	40	35	To plane, 10	Many defective vacuum tubes.
Homing Device	Same as that in initial phase of war.					Hardly used by the units towards latter phase of the war.

Improved Models of Radio Communications Equipment in Actual Use

Equipment	Equipped on	Frequency Kilocycles	Power Watts	Weight Kg	Transmitting Range Miles	Remarks
Type-3 Aircraft Radiotelephone Set No 1, Improved Model No 2	Fighter planes	5,000-10,000	100	30	To plane, 100 To ground, 300	Equipped with auxiliary controller for send-receive switching.
Type-3 Aircraft Radiotelephone Set No 1, Improved Model No 3	Fighter planes	5,000-10,000	100	32	To plane, 100 To ground, 300	All receiving-tubes changed with "SORA"-type.
Type-19 Experimental Aircraft Radio Set No 3	Two or three-seater planes	2,500-10,000 300 - 500	300	50	1,500	Improved experimental model of the Type-18 Experimental Aircraft Radio Set No 3; rebuilt because of numerous defects.
Type-19 Experimental Aircraft Radio Set No 4	Multi-seater aircraft	2,500-10,000 300 - 500	300	55	1,500	Remote control transmitter, improved model of the transmitter of the Type-19 Experimental Aircraft Radio Set No 3.
Type-19 Experimental Aircraft Radio Set No 9	Life raft	4,528	About 6	About 5	100	Hand-operated transmitter designed for telegraphing emergency landing; no receiver.
Type-19 Experimental Aircraft Radio Transmitter No 10	Transmitter parachuted over enemy fleet	950	About 60	About 60	?	Special radio wave radiation transmitter parachuted to determine the radio direction of enemy fleet.
Type-18 Experimental Aircraft Radiotelephone for communications within the unit	Three-seater aircraft			7.5		Provided with "SORA"-type vacuum tubes replacing those of the Type-18 Experimental Radiotelephone for communications within the unit.

Experimental Radio Equipment

Equipment	Equipped on	Frequency in Kilocycles	Power in Watts	Weight in Kg	Range plane to ground	Remarks
Type 96, No 4 Aircraft Radio Set, Improved Model No 3	Multi-seater planes	2,500-10,000 300- 500	300	80	High freq 1,500 Low freq 300	Modification with low frequency bands attached to the improved models, No 1 and No 2
Experimental Aircraft Radio Set, No 1 Modified 1944.	Fighter planes	4,000- 8,000	100	30	Telephone 350	Modification of frequency bands; Modification of Type 3, Aircraft Radio Set No 1 for mass production.
Receiver for Shusui-Type planes	Shusui-type planes	5,000-10,000		9	100	Receiver removed from Type 3, Aircraft Radio Set No 1
Radio Set for suicide planes	Special attack planes	4,000- 8,000		More than 20	100	Short-range communications stressed.
Experimental radio-telephone for intra-unit communication, modified 1945.	Two-seater planes; three-seater planes	30,000-50,000	15	22	40	Acron tubes used; strength and clarity greatly improved.

Note: Of those listed above, only the Type 96, No 4 Aircraft Radio Set was in practical use.

manufacture of small-type radio sets for these planes.

The improvement and experimental manufacture of principal equipment was carried out during the period just prior to the end of war. On the other hand, manufacture of much of the other equipment had to be suspended due to lack of vital parts:

1. Suspension of manufacture of Type-96, No 2, aircraft radio set, improved model No 2.

2. Suspension of manufacture of Type-96, No 3, aircraft radio set, improved model No 1.

3. Suspension of manufacture of Type-2, No 3, aircraft radio set, improved model No 1.

4. Improvement of Type-96, No 4, aircraft radio set, improved models No 1 and No 2 (adding low and high frequency bands to the equipment turned in for replacement).

5. Suspension of experimental manufacture and test of the No 10, experimental aircraft radio transmitter, modified 1944 (because its practical value was questionable).

6. Experimental manufacture of No 1 experimental aircraft radiotelephone, modified 1944 (improvement and modification of Type-3, No 1, aircraft radiotelephone for mass production).

7. Acceleration of mass production of No 3 experimental aircraft radio set, modified 1944.

8. Experimental manufacture of radio set for special attack planes (small-size sets less than 20 kg in weight).

9. Experimental manufacture and test of the receivers exclusively for the Shusui (interceptor plane).

10. Experimental manufacture and test of experimental radiotelephone for inter-unit communications, modified 1945 (measures taken to increase the power of inter-unit telephone communications).

11. Acceleration of experiments on experimental aircraft radio homing direction finder, modified 1944.

Communications Procedure

Since the establishment of the Naval Radio Communications Regulations in 1937, all the naval communications were carried out in accordance with these regulations. At that time, these regulations were considered satisfactory in carrying out the general communications and were disseminated to all units to effect uninterrupted communications. The contents of these regulations were divided into two classes--general communications and special communications procedures.

The general communications procedure entailed communications between two or more ships or stations under ordinary conditions. Such communications were considered complete after receiving acknowledgment from the ship or station at the other end.

The special communications procedure entailed the following: (1) Unilateral broadcasting in that acknowledgment was not required from the radio receiving ship or station; (2) indirect communications

by intercepting telegraph messages from a third party instead of directly from the receiving ship or station; (3) collation of messages received; (4) ship or station controlled communications instead of permitting free and direct communications; (5) transmission on a certain frequency or that designated by the radio ship or station can be either curtailed or changed; (6) transmission of emergency signal in case of distress; (7) time synchronization; (8) and a means to calibrate to standard frequency.

These communications regulations were also applied to aircraft communications. However, as they were originally established for use by ships and local radio stations, they caused some barriers when strictly applied to aircraft communications and steps were taken to permit a more flexible application of the regulations.

Aircraft communications were different from other general ship or land communications on various points, particularly in regards to the following factors:

1. There were many instances requiring emergency communications.

2. Large number of aircraft used one common frequency. This was in contrast to ship-to-ship or ship-to-station communications.

3. Radio equipment used in aircraft was not as reliable as that used for ground communications.

4. Compared with general communications, there were more tactical communications which required simple procedures.

5. The range of communications changed suddenly and greatly in

a short period.

6. There were rarely any relay communications to be conducted.

7. Where there were no skilled radio operators, communications had to be conducted to verify if equipment was functioning. This had to be done even at crucial periods when strict radio silence was mandatory.

8. Codes used in headings were required to be brief as possible or omitted.

When special communications procedures were initially formulated as required for aircraft communications, they were not standardized by the Central Agency and their implementation was left up to each unit as it saw fit. Some of the disadvantages which became apparent were:

1. Special communications procedures could not be applied to the communications other than that of the unit concerned.

2. Whenever a unit operated in concert with other units, prearrangement was necessary.

3. When the communications of other units were intercepted, the headings of the monitored messages could not be identified in many cases.

4. It was necessary for aircraft radiomen and ground radiomen to learn quickly the special communications procedures of the new unit whenever they were transferred.

From about the end of 1943, heavy demands were placed on the Central Agency to establish a standard communications regulations

suited to the actual circumstances required in aircraft communications. Consequently the establishment of the new communications regulations for aircraft became the responsibility of the Communications Counter-Planning Committee which was comprised of authorities from the 9th Section of the Naval General Staff, the Naval Communications School and the Yokosuka Naval Air Group.

The new communications procedures were centered on the broadcast communications system. There were actually five classifications of communications procedures and one of these was for aircraft communications. The principal changes effected in the new communications regulations for aircraft communications were completed in January 1945 and were as follows:

1. The aircraft communications were simplified by distributing an extract of the communications regulations to aircraft communications personnel. By this means, they were fully able to conduct communications in spite of their unfamiliarity with other complicated ground communications procedures.

2. A standard reply signal was designated for plane units.

3. Call signals for communications control stations were made uniform.

4. The merits of the special communications procedures of various units were adopted. Communications dispatch forms were standardized to facilitate usage.

Communications Plan for Homeland Air Defense Operation

The air defense of the Homeland was undertaken by the Army, and the Navy was in charge of the air defense of the Naval districts and naval guard districts. Consequently, each naval district or guard district functioned as a central organ for the air defense operations, and the communications structure was planned and maintained along this line in accordance with the air defense program of each naval district and guard district.

As the war progressed and the Homeland was subjected to incessant bombings by B-29's, a partial change was made of the air defense structure, but no change was made in general principles. The Army expressed earnest desire to effect Army-Navy unification of intelligence agencies, especially the unified command of search radars. However, the Navy was opposed to the Army proposal because of the difficulty in unification of communications and for fear of serious setback to communications capacity. By compromise, an agreement was made to merely maintain closer contact with each other and this was observed until the war ended.

The communications plan for the Homeland air defense operation was as follows:

Policy

1. The establishment of the new communications system will conform to the objectives of the Homeland antiaircraft defense operations. Judging from the disposition of the main enemy air bases in the south (Iwo Jima and Marianas), and in the light of

the enemy air raid tactics upon the Homeland in the past, a rough estimate can be made as to the directions from which the enemy will attack.

2. The air raid information and warning system will be newly established to cope with the potential directions of the enemy air attacks in order to locate their approach and spread the warning to the necessary organs as early as possible. The command communications system should also be adequately equipped to expedite communications with the interceptor planes for interception operations.

Plan

1. An air defense intelligence center will be placed in each naval district and guard district, and auxiliary centers will be established within the command center of the interceptor fighters according tc the area of the assigned defense sector and the disposition of the interceptor fighter units.

2. The intelligence center and the interception command center will be combined.

3. Both wire and radio communications will be used, and radio broadcasting in plain language will be carried out to the fullest extent.

4. Telephone communications will be established between adjacent radar stations for mutual use of intelligence gathered by the Army and the Navy.

5. The intelligence report procedures of the Army and the Navy lookout posts will be unified, while the information notification procedure will be revised to facilitate use of information reports by the various quarters.

Intelligence and Air Defense Command Centers

The principal centers will be: Ominato, Yokosuka, Yamato, Maizuru, Kure, Sasebo and Kanoya.

The auxiliary centers will be: Chitose, Kisarazu, Meiji, Osaka (for intelligence only), Matsuyama and Oita.

Lookout Communications Net

Policy:

In establishing a communications system for lookout posts,

the main assault directions of the enemy air attack force upon the mainland will be taken into consideration and presumed to be as follows: Attack from the Marianas bases; attack from the Philippines and Okinawa; attack from the bases in China; and attack from the bases in the Aleutians.

Preparations:

In view of the installations and current assignments of air defense tasks, an intelligence center will be established in the headquarters of each naval district and guard district. Kanoya and Yamato will be added; the former will be the center of southern Kyushu and the latter will be the center of the area consisting chiefly of the Kinki District.

A principal center will organize one intelligence system by placing under its control lookout posts deployed within an approximate 120-mile range.

Organization:

As a rule, the operational communications net will be separated from the administrative communications net. In the operational communications net, the report communications net must be completely separate from the command communications; and although the common use of one communications net for report and administrative purposes may be permitted depending upon the installation, the communications net for command must always be separate for exclusive use.

Wire communications, as a general rule, will be established to connect lookout posts with the centers to which they belong and with adjacent air bases.

Communications Nets: (See Chart 36)

Transmission of Air Defense Intelligence

The object will be to notify promptly each department of any information collected and collated at the intelligence center in order to enable each department to make prompt and effective use of the information for operational purposes or its own defense.

The transmission of information will be effected by radio or wiretelephone broadcasting and the chief of the department will make possible the direct use of these information reports.

Lookout Communications Nets

Communications Net	Details
Report Communications Net	1. The communications of mutual stations is ideal, but due to the lack of communications facilities and personnel and the difficulty of assigning frequencies in the center, two or three separate lookout stations within approximately the same distance from the center will be included in the same frequency as a standard, and each organization will establish three or four different report nets. 2. This communications net will be used exclusively for reports from lookout stations in which the broadcast method will be used. 3. In case of lack of facilities, this communications net will be used for daily administrative communications, depending on the situation.
Communications Net for Controlling Lookout Activities	1. This net will be subdivided into two or three communications nets according to the specified areas. (anticipated directions of enemy invasion). 2. As a rule, telephone broadcasting will be carried out, but the report communications net will be employed to control remote stations which are difficult to reach by telephone broadcasting. 3. This net will be used exclusively for controlling lookout activities. 4. The simultaneous command issuing apparatus will be attached to wire communications.
Daily Administrative Communications Net	1. As a rule, all lookout agencies stationed in the district under administrative assignment will be included in one communications net, but, especially, in case a different frequency is required because of the distance, two communications nets will be provided. 2. As a rule, this will be provided independently of other communications nets, but it will be employed as the report net, depending on the situation.

The method of indicating the target is prescribed as follows: The target will be indicated by the bearing and distance from the principal center. (Example): Target number, bearing and distance (in degrees and kilometers); altitude, course.

Medium frequency will be employed in telephone broadcasting in order to permit radio receiving sets to be repaired or completed for use. To supplement the lack of communications capacity resulting from the above measure, the auxiliary center and the low frequency telegraph broadcasting will also be used.

Communications nets:

Communications Net	Details
Telephone net for broadcasting air defense intelligence	1. Medium frequency radiotelephone broadcasting will be carried out. 2. The air defense center will monitor the intelligence broadcasts of adjacent sectors and include the necessary data in its own broadcasts.
Communications net for broadcasting air defense intelligence	1. The existing communications net for the air defense intelligence broadcast will be used. 2. Frequencies of adjacent sectors will differ to facilitate the mutual interception of information broadcasting.

Chart 37

Organization of command communications nets.

Communications Net	Details
Communications net for commanding air defense operations	1. This will be used exclusively for the transmission of operational orders to the interceptor fighter units. 2. Broadcasting method will be used generally, but ordinary communications procedure will also be adopted depending on the situation.
Wiretelephone communications net	As a wire communications net, only a telephone net is adopted and used chiefly, but it will also be used for wire telegraphy, depending on the situation.
Telephone net for commanding air defense operations	1. This net will be used exclusively for the transmission of operational orders to the interceptor fighter units. 2. One-way telephone communications will generally be carried out, but the exchange of talk is possible, depending on the situation.

Chart 38

Ground Control of Interceptor Fighters

A new communications net for intelligence broadcasting will be established with the view to facilitate the actions of a small number of interceptor fighters. The intelligence center of each sector will broadcast the information necessary for interception operations and the fighter planes operating in the sector will maneuver in accordance with the information monitored.

A special command-communications net other than the one mentioned in the preceding paragraph will be established for command with unit and for ground control of interceptor fighter planes.

Communications net:

Communications Net	Details
Communications net for broadcasting intelligence	1. This will be used exclusively for the transmission of intelligence to fighter planes in flight or waiting in readiness, but can also be used for ground control, depending on the situation. 2. As a rule, telephone broadcasting by Type-A high frequency will be adopted. 3. Classification of frequencies will correspond to that of the disposition of units and the assigned districts.
Command telephone net	1. This net will be used exclusively for ground control of the fighter plane units and for intra-unit command by the fighter plane unit commander. 2. Type-B and C high frequencies will be adopted.

Chart 39

Summary of Installation Work

In November 1944, when large-scale enemy air attacks upon the Homeland became imminent, it was decided to implement the plan for completing the communications system for the Homeland Air Defense Operation. The preparations were started immediately after the formulation of the plan, and, by May 1945, the work was nearly completed.

Later as air attacks by B-29's grew in intensity and attacks were launched from higher altitude (above clouds), there was a pressing need for hastening the establishment of a radar net and fighter homing device. Meanwhile, warning was used at air bases, because there was practically no reserve of the new equipment and partly because the air defense of the Homeland was originally assigned to the Army.

Communications Between the Army and Navy

From the outbreak of war, joint operations of the Army and Navy Air Groups were frequently carried out, but communications were always conducted by prearrangement and were never operated by direct mutual communications between plane units because of the different systems used.

The Army used mainly the numerical code for aircraft communications and the Navy used Japanese characters. Therefore, despite the fact that direct communications between the services would have been very expedient, nothing was done about standardizing the systems.

The Army and the Navy established communications regulations for joint operations after consultations in Tokyo (in 1943), but as these regulations were found to be inapplicable to the actual conditions of operational forces, they were not enforced. When the war situation became adverse, direct joint operations between the Army and the Navy became vitally necessary. This was particularly evident

when elements of the Army Air Force (98th Air Regiment and 7th Air Regiment) were placed under the command of a naval force (762d Naval Air Group) for training in torpedo bombing. Therefore, the Naval Communications Regulations were taught to the Army personnel, and in about four months they reached the point where operations could be carried out somewhat satisfactorily. Thereafter, the necessity for direct communications between the Army and the Navy became even greater, but the war situation worsened day by day and precluded any efforts towards establishing standard regulations.

Radio Navigation

In accordance with the demands from the standpoint of security and operations, research and improvement of the radio direction finder and the guide apparatus had been carried out even before the outbreak of war. After the outbreak of war, the United States invented many effective navigational devices such as the radar, the high frequency directional beam transmitting set and the long-range radio aid to navigation. These contributed much to their capability in air navigation, whereas Japan made little progress from the time of the outbreak of war until its termination.

As far as Japan's capability in radio navigation was concerned, the planes could not fly through even slightly inclement weather. When on a mission, they missed the enemy which should have been sighted, or lost a tactical opportunity for attack and allowed the

enemy to take the initiative. From about the end of 1943, forced landings became very frequent because they could not return to their carriers or bases due to the incapability of the navigator. Actually, if the radio equipment which was supplied at that time had been fully utilized, a number of the forced landings would have been generally avoided. However, with the low caliber of flight and communications personnel, nothing could be done to prevent losses as radio navigation was hardly comprehensible. Moreover, since the equipment in itself was very inferior as compared to American equipment, the Japanese operational forces had no confidence in the equipment.

Utilization of the Radio Direction Finder

The utilization of the high frequency radio direction finder on ships was impossible owing to the polarization and turbulence phenomena. Thus, high frequency radio direction finders were established only as fixed equipment at land bases, and ships were equipped exclusively with low frequency direction finders. Some of the ground high frequency radio direction finders were used mainly for the interception of enemy radio communications, but very few were utilized for navigation. Low frequency radio direction finders were actually used only by carriers and naval vessels carrying seaplanes. These ships reported only the direction of a plane, and although the reporting of a plotted position by cross-bearing method was specified in various communications regulations, it was not actually carried out because the cross-bearing coordination by radio direction finder

stations was difficult to execute. Generally, the base air forces did not use direction finders for the following reasons:

1. The flight personnel preferred simple ground navigation and avoided use of radio aid navigation because it was not necessary when the visibility was good.
2. Low frequency radiation was much too complicated to be conducted on aircraft.
3. Communications authorities were generally indifferent toward this problem.

The carrier forces often conducted training in radio navigation by direction finding from ships and utilized it in actual battles. This method was deemed particularly necessary for aircraft in returning to the carrier. The drawback was that it was necessary to trail the antenna about 70 meters from the plane in order to radiate low frequency, and this slowed down the plane considerably. Moreover, with the improvement of aircraft and the increase of aircraft speed, a trailing antenna often broke during high speed. Therefore, the use of high frequency equipment for ordinary communications as direction finding from ships was advocated and this was first installed on the task force aircraft carrier Taiho in March 1944. The results were very favorable as this equipment kept the mean margin of error within five degrees, although compared with the automatic radio direction finder, it was still unsatisfactory.

At the outbreak of war almost all combat aircraft had radio

direction finders, the range of which was approximately 150 to 200 miles for large aircraft and approximately 50 to 100 miles for the small aircraft.

With the huge expansion of air strength, the number of aircraft which were to be equipped with radio direction finders increased greatly. However, since this equipment required precise adjustments at the time of manufacture and vacuum tubes of excellent quality, production could not meet the demand. Moreover, as production was boosted, defective equipment was supplied successively to the operational forces due to failure to inspect the finished products. Consequently, confidence in the equipment was gradually lost. In particular, since the pilots of small land-based aircraft felt that radio direction finders were useless and only increased the weight of aircraft, the radio direction finders were stored away in warehouses.

The carrier task force had radio direction finders to the very end because of the necessity for aircraft homing, but there were many radio direction finders which could not be used because of poor functional capacity.

There was a gradual increase in accidents in which planes were listed missing due to poor navigation. The Central Agency, therefore, encouraged the use of the homing device, and at the same time established a plan to facilitate navigation by installing powerful low frequency transmitters at well known capes and bases to radiate

induction waves regularly as necessary.

Radio Beacon

Before the war, there had been a considerable number of radio beacon stations under the jurisdiction of the Transportation and Communications Ministry, and they were utilized for civil aviation and by some of the military aircraft. However, after the outbreak of the war, nearly all the radio beacon radiating devices were removed and these stations were used merely as short wave radio stations.

From the time the decisive battle on the mainland was advocated due to the critical war situation, the importance of the beacon was emphasized again in order to prevent navigation accidents which would occur because of the deterioration in skill of flight personnel. The officials of the Navy, the Army and the Transportation and Communications Ministry met and advocated the restoration and utilization of existing equipment, but because of the protracted disuse, its restoration could not be effected as anticipated. Also, experiments were carried out on a portable medium frequency beacon but it proved impractical. Thus the beacon was not used during the war.

CHAPTER VI

Communications in Escort Operations

General Situation

The communications in the operations for protecting surface traffic varied with the change of system for escort operations. For purpose of analysis, the conduct of communications can be divided into two periods: the period in which each naval district executed the operations for protecting traffic at the outbreak of the war; and the period in which unified operations for protecting surface traffic was executed by the establishment of the General Escort Command (15 Nov 43).

At the beginning of the war, the naval districts and guard districts took charge of the protection of surface traffic within their respective sea areas. Consequently, the communications for the operation of protecting a convoy or an individual ship which sailed through two or more sea areas necessitated the use of as many communications nets.

After the establishment of the General Escort Command, this situation was improved. Later however, with the increase in shipping losses due to enemy submarines, coordinated operations of the air groups were carried out and a great improvement resulted chiefly in the aircraft communications system. Moreover, as the minelaying operation by the enemy B-29's became intensified, additional lookout posts were newly established to watch for the laying of mines, and

this added a new burden to the General Escort Command's communications.

The Communications Plan of the General Escort Command

The communications of forces under the General Escort Command were conducted in accordance with the Naval Communication Regulations, Combined Fleet Communications Regulations, the communications regulations of the General Escort Command, the communications regulations of various escort units, shipping communications regulations and the Convoy Movement and Communications Regulations. The foregoing regulations were supplemented with the following instructions:

The communications of the surface escort units and traffic protecting organs which are located in the same sector will be executed jointly, except under unavoidable circumstances.

1. Ship communications

   a. The communications net will be divided into three categories: escort unit communications net, broadcast net, and the specially established communications net in the Japan Sea area (Chart 40).

   b. Monitoring by units and ships will be prescribed as shown in Chart 41.

   c. The ship or station which is the central communications unit in each communications net will promptly broadcast necessary communications to the escort unit by the broadcast net (Consecutive numbers will be given to each message). The above communications ship or station will also monitor the wave of the broadcast net of the neighboring unit and endeavor to transmit immediately the messages concerned.

   d. Escort units and transport vessels will always exercise radio silence during their movement except when special

Escort Unit Communications Net Chart 40-a

Communications Net	Central Station	Stations of Communications Net	Frequency Used			
			Low freq	Med freq	High freq	Very-High Freq
Ominato Escort Unit Communications Net	Ominato Communications Unit	Ominato Surface Escort Unit Wakkanai Communications Unit 903d Air Group Hq.				41,350 (TE-TA1)
1st Escort Unit Communications Net	Maizuru Communications Unit	1st Escort Unit 901st Air Group Hq. Rashin Base Force Hq.				
Seventh Fleet Escort Unit Communications Net	Seventh Fleet Hq. (Moji)	Seventh Fleet Escort Unit Chinhae Communications Unit				

Chart 40-b

Surface Escort Unit Broadcast Communications Net

Communications Net	Abbreviation	Broadcasting Station	Broadcast Time	Frequency
Ominato Surface Escort Unit Broadcasting Net		Ominato Communications Unit	Regular	
1st Surface Escort Unit Broadcasting Net		Maizuru Communications Unit	Regular	
Seventh Fleet Escort Unit Broadcasting Net		Seventh Fleet Hq. (Moji)	Regular	
Remarks	Broadcasting stations or ships will always monitor communications of the broadcasting net of adjacent sea areas.			

Japan Sea Area Special Communications Net

Communications Net	Central Station	Stations of Communications Net	Frequency
Japan Sea Area Special Communications Net	Maizuru Communications Unit	Tokyo Communications Unit, Wakkanai, Ominato, Niigata, Rashin, Chinhae, Moji.	

Monitoring by Surface Escort Unit or Ship

Chart 41

Comm Net	Fleet-level Flagship (Communications Unit)	Division-level Flagship	Single Ship or Unit	Single Vessel, or Escort	Office of Resident Naval Officer
Escort Unit Frequency	X	X	X	X	Z
Escort Unit Broadcasting Net	X	Y	Y	Y	Y
Tokyo Broadcasting Net No 1	Y	Y			
Aircraft Frequency	Y	Y	Y	Z	
Air Base Comm Net	Z				
Japan Sea Special Comm Net	X	Z			
Submarine Information, (Weather)	Y	Y	Y	Y	Y
500 Kilocycles	Y	Y	X	X	Y
Adjacent Broadcasting Net	Y				

Key

X..... Exchange of communications

Y..... Monitoring

Z..... Monitoring, depending on the situation

orders are issued.

e. The communications of a convoy with the units outside the convoy will be the responsibility of the ship carrying the commanding officer, except as noted in paragraph f.

f. All the ships in the convoy will normally monitor through the 500 kilocycles net and will broadcast to the proper party by the same channel and by the frequency disignated by the escort unit when it positively sights the enemy or when attacked by enemy submarines.

g. For communications within the convoy, each vessel will use the frequency prescribed by the Convoy Movement and Communications Regulations and also the 41,350 kilocycles band unless special orders are issued. While antisubmarine patrol planes are escorting in the air, special precaution must be taken regarding this frequency.

h. Communications between escort vessels and transports within a convoy will be conducted by the visual communications method. Such communications will be completed by sundown except in unavoidable cases. Night communications will be avoided.

i. As for communications of ships at anchor in the harbor, the direct radiation of waves by vessels will be avoided except under special orders, and the ships will dispatch communications through the nearest land-based communication unit or by wire.

2. Air communications

a. The communications net will be classified as the air base communications net and the aircraft communications net, and will be designated as in Chart 42.

b. Monitoring by the groups will be designated as in Chart 43.

c. When an aircraft sights the enemy, it will broadcast the sighting immediately, and the central air base will broadcast this report by the same frequency and also on the frequency of the surface escort unit.

d. While an aircraft is in flight, it will maintain strict

Air Base Net Chart 42

Communications Net	Abbre-viation	Central Base	Bases of Air Base Net
901st Air Group 1st Base Net		Maizuru Air Base	Noshiro, Nanao, Komatsu, Mineyama, Miho, Tamatsukuri, Chinhae Air Group, 903d Air Group
901st Air Group 2d Base Net		Chinhae Air Base	Rashin, Genzan, Oura, Hakata, Pusan, Yosu
903d Air Group Base Net		Ominato Air Group	Akeshi, Noshiro, Otaru, Wakkanai, Bihoro, Chitose, Odomari

Frequency for Escort Plan

Air Group	Abbre-viation	Frequency		
		Low	High	Very-high
901st Air Group				41,350 (TE-TA 1)
903d Air Group				
958th Air Group				

Monitoring by Aircraft Chart 43

Communications Net	(KO) A - Base	(OTSU) B - Base	(HEI) C - Base
Air Base Communications Net	X	X	X
Aircraft Frequency	X	X	X
Tokyo Broadcasting Net No 1	Y		
Escort Unit Broadcasting Net	Y	Y	
Excort Unit Frequency	X	Z	
500 Kilocycles	Y	Y	
Submarine Information, (Weather)	Y	Y	Y
Air Defense Communications	Z	Z	Z

Note: 1. A-Base (where the C in C is located)

2. B-Base (where a base commander is located)

3. C-Base (where a squadron commander is located on a mission)

Key: X ... Exchange of communications.

Y ... Monitoring.

Z ... Monitoring, depending on the situation.

radio silence, except for the transmission of enemy contact reports, emergency dispatches and other important information. Special precautions must be taken regarding the radiation of waves.

e. When an aircraft engaged in antisubmarine patrol sights a friendly convoy, the plane will report the name, position, course, speed and the time the convoy is sighted to the base. The base will relay the message to the adjacent air base scheduled to take over the patrol and at the same time report to the local surface escort unit. In this instance, wave radiation above the convoy must be avoided as much as possible.

f. While an aircraft is patrolling above a convoy, it will monitor on 41,350 kilocycles (radiotelephone frequency which is used within the convoy), and will try to maintain close contact with the convoy. If the aircraft locates an enemy submarine, it will immediately report to the convoy by the abbreviations specially prescribed in the communications regulations of the General Escort Command, and by the signals prescribed in the Convoy Movement Regulations and Communications Regulations.

3. Communications of ship protecting facilities

a. Communications between a naval district or a guard district and the office of the Resident Naval Officer will be carried out by wire, but the radio communications net prescribed by the commandant of the naval district or the guard district will be used additionally in an effort to report accurately and quickly.

b. Besides the above, the officer of the Resident Naval Officer will endeavor to receive directly antisubmarine information, weather reports and monitor the broadcast net for the sea area under the charge of the local naval district or guard district.

c. The Resident Naval Officer will closely analyze air defense information, establish close contact with the air defense intelligence headquarters and harbor guard unit stationed in his jurisdictional area, and endeavor thereby to obtain promptly reports on enemy air raids and minelaying. He will send such reports immediately to the ships at anchor in the harbor under his jurisdiction.

e. The commandants of naval districts, guard districts and the C in C of the Seventh Fleet will establish anti-mine lookout communications nets in their respective sea areas.

4. Intelligence communications

a. The General Escort Command will broadcast antisubmarine information prescribed in the shipping communications regulations.

b. The General Escort Command will broadcast battle situation reports (serially numbered) to the forces under the General Escort Command whenever antisubmarine reports are broadcast. The reports will also be broadcast to ships which are directly concerned, using the call sign directed to all ships (including the forces under the General Escort Command).

c. The commandants of naval districts, guard districts and the C in C of the Seventh Fleet will broadcast anti-mine reports for their respective sea areas. Also, the General Escort Command will broadcast a comprehensive anti-mine report (based on the above anti-mine reports), to all vessels (including the forces under the General Escort Command) whenever the anti-mine reports are broadcast.

d. The force under the General Escort Command will always pay attention to air defense information and endeavor to receive it directly in order to be on the alert against enemy air attack.

5. Interception of enemy communications

a. The General Escort Command will maintain close contact with the Special Duty Section (radio intelligence) of the Navy General Staff and other organs concerned and promptly notify the necessary quarters the battle situation reports or warnings.

b. All naval districts, guard districts and the First Escort Fleet headquarters will order the intercepting and radio direction finder organs under their command to concentrate on enemy communications to determine enemy locations and movements and promptly notify the authorities concerned of any enemy activity.

c. The commandants of all naval districts, guard districts

and C in C, First Escort Fleet may conduct jamming and radio deception against enemy communications if necessary.

d. In accordance with the order of the commanding officer, the enemy communications interception section attached to each escort convoy will endeavor to intercept on the frequency of enemy submarines and enemy patrol planes maneuvering in the vicinity.

6. Code books and cipher tables

a. Besides the present code books and cipher tables, the abbreviations and signals prescribed in the communications regulations of the General Escort Command will be used.

b. For communications from surface escort units to transports, special attention must be paid to the code books and call sign list in possession of the other party.

Communications of the General Escort Command

Before the General Escort Command was established, the Japanese Navy was without a standard system for its surface escort and anti-submarine operations. Instead, these operations were carried out under separate systems by the commander of each unit responsible for escort. This made it difficult to maintain mutual liaison and the convoy escort forces operating in their respective sea areas under such conditions experienced great difficulty. Moreover, as these escort forces were organized with various types of escort craft assembled each time for each convoy trip, no unified conception of the communications system existed among them. The equipment used by these vessels was generally worn out and the communications personnel were

of low caliber. Under such conditions, it was impossible to carry out operational communications smoothly, skillfully and rapidly.

After the General Escort Command was established, the gradual unification of the system and reorganization of the facilities and personnel were planned. However, the importance of safeguarding transport routes by surface escort was not generally recognized and by the time its necessity was realized, it was too late to take any effective measures.

Ship Communications

Since communications between the various escort units were not carried out smoothly at the time the General Escort Command was established, convoy escort proved weak at the boundary of sea areas where escort transfers took place (an escort unit operated up to the limits of a designated sea area only, whereby another unit took over for the next area). Therefore, the through-escort system was adopted wherever possible and the communications systens were revised and unified. The frequencies for the communications over the routes from Yokosuka to Ominato, Osaka and Saipan respectively were unified with those of the Yokosuka Surface Escort Force, and the frequencies for the route between the Kyushu area and Formosa were unified with those of the Surface Escort Force of the Sasebo Naval District.

Communications units in the South China Sea monitored the frequency of the 1st Surface Escort Unit and conducted scheduled communications. As for the communications of the 1st Surface Escort

Unit (with its center at the Takao Communications Unit) which was in charge of the through-escort on the special route between Majo and Singapore, the following communications units rendered assistance to the escort forces in order to offset the limited capacity of the Escort Unit (by monitoring on the frequency of the 1st Surface Escort Unit and conducting scheduled communications): Sasebo Communications Unit, 11th Communications Unit (Saigon), 30th Communications Unit (Manila) and 10th Communications Unit (Singapore).

After the American forces landed at Lingayen Gulf in the Philippines in early January 1945, the special route between Moji and Singapore, for which the First Escort Fleet (1st Surface Escort Unit was deactivated 10 December 1944) activity and traffic became difficult over the transport route in the South China Sea. Therefore in February 1945, the First Escort Fleet headquarters moved to Moji where it became the communications relay point for the transport routes to north and central China areas.

As escort ships were often required to use low and high frequencies simultaneously, it was repeatedly requested that each escort ship be equipped with one transmitter solely for low frequency and another one for high frequency instead of one transmitter then in use for both low and high frequency. Requests were also made for the high frequency capacity to be increased to that of high frequency No 4 transmitter to meet the needs of the expanded operating sea areas. However, none of these requests were ever brought to realization.

The communications personnel were also few in number. Each coast defense ship engaged in extensive operations under the 1st Surface Escort headquarters had only six radiomen (including maintenance) and one code clerk, while the old-type destroyers each had only four radiomen for every five receiving sets. Since it was extremely difficult to carry out extensive escort communications under these conditions, a request was made to increase the personnel at least to the extent where three receiving sets could be in operation continuously. As a result, a temporary increase of the radio crew by two persons and the code personnel by one was authorized for each coast defense ship and destroyer.

Up to autumn of 1944, escort vessels had not been organized into the escort divisions and destroyer divisions. The escort units had been comprised of various types of vessels which had but few opportunities for training and had no unified plan or system. As it was difficult for such escort units to carry out inter-unit communications (with telephones such as Type-90 very-high frequency telephones and No 2 telephones), it was decided to use the handy crystal-controlled aircraft radiotelephones designed for communications within the unit. Thus, all vessels except for a very limited number of converted vessels were equipped with these telephones and contact with aircraft was improved by standardizing the frequencies (41,350 KC) for communications within the escort forces so as to be applicable to