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SECTION I

PURPOSE OF PAMPHLET

The purpose of this pamphlet is to provide a brief-non-technical description of the Control Net System SCS-2, which is commonly referred to as a semi-fixed VHF interceptor pursuit control system SCS-2. Sufficient information is included to enable the reader to understand the principles of operation and to form a picture of the system and of the components of which it consists. The information provided will also enable the reader to visualize the layout of the various components of the system at a particular site.

It should be understood that an article of this length and purpose cannot begin to discuss the many tactical, technical, and operational factors which are involved in the location, employment, and operation of these complex systems. If additional or more detailed information is required reference should be made to the material listed in Section XII.

SECTION II

WHAT THE CONTROL NET SYSTEM SCS-2 IS AND DOES

The Control Net System SCS-2 provides a means of simultaneously controlling from one to four interceptor pursuit squadrons from the time they leave the air field, make contact with the enemy, and return to the same or a different air field. This is accomplished by means of a rather elaborate arrangement of two-way wire line and radio communication between the planes and the ground, and with means for continuously plotting the location of the interceptor pursuit squadrons.

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If an interception is to be made the information on enemy planes which appears as a track on the Aircraft Warning Service information center operations board (See Section XIII, Diagram No. 3, Part A) is transferred to an intercept board. A squadron (the term Squadron as used in this pamphlet applies to a full squadron or any portion thereof) is assigned to make the interception. The assignment is based upon the availability of planes as indicated by the status board which shows at all times the availability of all pursuit planes under the control of the pursuit officer. Once the squadron has been assigned and has left the airfield the control is taken over by an intercept control officer who overlooks the intercept board.

Voice communication is automatically established with the squadron leader through a ground transmitter and receiver channel. Three radio direction finder (D/F) station begin to take bearings on the squadron as soon as it leaves the airfield. The bearings are plotted on the direction finder plotting board to obtain a "fix" or position of the squadron. (See Section XIII, Diagram No. 1.). This position is then plotted on the intercept board. A continuous flow of information on the enemy planes from the information center operations board and on the interceptor pursuit from the direction finder plotting board provides separate tracks of the enemy and interceptor pursuit squadron on the intercept board. With this information the intercept control officer is able to estimate the position at which the interception can be made. The bearing from the position of the interceptor pursuit

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squadron to this point is obtained from the intercept board and is transmitted to the squadron leader who adjusts his course to the bearing given. The intercept control officer continues to give additional bearings to the squadron leader as required. He also furnishes him with information on the number of enemy planes, type, altitude, etc. as information on the enemy planes is received from the information center.

When the squadron leader sights the enemy he so reports and takes over control. After the interception he again reports to the intercept control officer who gives him the bearing necessary to return the squadron to the airfield. The squadron can also be brought back to the airfield by means of a "homing" direction finder station at the field.

It should be noted that the squadrons may either take off or land from fields several miles distant from the field at which the control system is located. The control system may be at or near the information center, or may be at any location covered by the operations board in the information center.

SECTION III

ASSIGNMENT OF FREQUENCIES

The normal assignment of frequencies provides for sixteen separate frequencies, or channels, between the ground and airborne transmitters and receivers. The frequencies are so assigned that three air groups of three squadrons each can operate in the area normally assigned to the groups without interference between channels. Because of the "line of sight" characteristics of the VHF radio waves the same channels can be

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used again without objectionable interference if the equipment is separated by at least three to four hundred miles. This permits the channels to be repeated for every three groups.

One "common" frequency is assigned to all planes and systems SCS-2 so that any plane can communicate with any system. This frequency is needed when a plane moves from one group to another as might occur during reinforcements, for emergency landing of planes at fields occupied by another group. This frequency also permits communication between planes of any group or squadron.

Each group, which is the tactical unit normally assigned to one system SCS-2, has a "homing" communication frequency assigned to it. This channel is normally used for issuing instructions to the planes when the units of the group are returned to the airfield by means of bearings taken by the sector D/F station. This frequency also may be used for communication between squadrons in the group. There are three "homing" frequencies, one for each group.

Each group is assigned a "D/F" frequency which is used only for direction finding. The squadron leader's transmitter, or another designated transmitter in the squadron, automatically transmits a continuous wave on this frequency during a fifteen-second sector of each minute. Each squadron is assigned a certain fifteen-second period of the minute so that the portion of the minute during which the transmission is made identifies the squadron. Normally this channel is not used for communication.

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Each group is assigned three "squadron" frequencies, one of which is assigned to each squadron. These frequencies are used for communication between the ground stations and the squadrons.

The frequencies provided require the operation of five ground transmitters and receivers on one "common", one "homing", and three "squadron" frequencies. If a fourth squadron is added to the group, it must operate on either the "common" or "homing" frequency or share a frequency with another squadron. Each plane has four frequencies assigned to it - the "common", "homing", "squadron", and "D/F" frequencies.

SECTION IV

COMPONENTS OF CONTROL NET SYSTEM SCS-2

The system SCS-2 normally consists of the following components which are arranged to form a complete functioning system for the control of interceptor pursuit squadrons. (See Section XIII, Diagram No. 2).

1. Operations Block (Control Set SCR-561).

The operations block contains the units of equipment which form the control part of the system. The units are housed in a building sometimes referred to as the "operations block house" or "operations block building." It is not necessary that the equipment be located in a building of a particular size or construction. The housing of the control equipment should be adapted to the requirements of the site.

The control equipment may be located in the information center building or it may be located in a building adjacent to or distant from the information center. Section VI gives the physical and functional characteristics of the units which must be taken into consideration when laying out the control equipment.

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The following units are normally a part of the operations block:

- a. One signal officer's Control Unit RM-28-().
- b. Five Control Units RM-25-().
- c. Three intercept officers' Control Units RM-26-().
- d. One Distribution Panel BD-102-().
- e. One telephone terminal frame (if required).
- f. Telephone switchboard (if required).
- g. One or more intercept boards.
- h. One direction finder plotting board.
- i. One plotting board (operating board).
- j. One pursuit status board.

Items "e" through "j" are not supplied as a part of system SCS-2 since they are now normally a part of the information center and must be provided to meet the requirements of the particular installation.

2. Transmitter Trailers (Radio Sets SCR-562)

Each system SCS-2 has two transmitter trailers, Radio Sets SCR-562, each of which contains three transmitters BC-640-(). Cargo trucks are used to carry the four 90-foot masts AN-56, each of which mounts two dipole antennas RC-81-().

3. Receiver Trailer (Radio Set SCR-563)

The receiver trailer, Radio Set SCR-563, contains six receivers, BC-639-(). Cargo trucks carry the four 90-foot masts AN-56, each of which mounts two antennas RC-81-(). There are thus six transmitters and six receivers with two extra receiving and two extra transmitting antennas. The transmitter and receiver trailers are normally located in the vicinity of the operations block.

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4. Relay Transmitter and Receiver Trucks (Radio Set SCR-567).

The transmitter truck contains two transmitters BC-640-() and the receiver truck contains two receivers BC-639-(). The antenna truck carries two 50-foot masts, AN-57, each of which mounts two dipole antennas RC-81-(). The relay station thus consists of two transmitters, and two receivers, with two transmitting and two receiving antennas. These transmitter and receiver trucks are normally operated at a distance from the operations block transmitters and receivers to extend the range of the system.

5. Fixed "Fixer" Direction Finder Stations (Radio Sets SCR-565)

Three of these fixed "fixer" D/F stations are provided. Each equipment is located in a knock-down type building normally located at the apexes of an equilateral triangle approximately forty miles on a side.

6. Fixed "Sector" Direction Finder Station (Radio Set SCR-564).

One "sector" D/F station is supplied with each system. It is normally near the airfield at which the operations block is located, and is normally used for "homing" purposes.

7. Mobile Direction Finder Station (Radio Set SCR-566).

Each system has one mobile D/F station mounted in a truck. Although it is normally used as a spare for the fixed D/F stations it can be used as a "sector" D/F station at a secondary airfield, or may be used to extend the range at the fixed D/F stations.

8. Power Units PE-99-().

Four of these units and one shelter are supplied with the operations block. One unit and a shelter are supplied for each fixed D/F station, and one unit mounted in a two-wheel trailer is supplied with

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each transmitter and receiver trailer or truck and D/F truck. If no commercial power is available there will be three spare units per system as only one is required for the operation block.

9. Airborne Transmitter-Receiver (Radio Set SCR-522-()).

Each interceptor pursuit plane in the squadrons working with a VHF system must be equipped with one of the airborne transmitter-receivers. The main operating components of Radio Set SCR-522-() are also included in the mobile D/F station so that the station can communicate directly with the planes when used for "homing" purposes.

SECTION V

DESCRIPTION OF COMPONENTS

This section contains a brief description of the components of the system SCS-2 and goes briefly into their operations. (See Section XIII, Diagram No. 2).

1. Control Set SCR-561 (Operations Block).

a. Signal Officer's Control Unit RM-28-()

This unit is designed primarily for the purpose of enabling the

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signal officer to monitor the various transmitter-receiver channels. It also enables him to make certain inter-connections between the silence cabinet unit RM-25-(), and the remote relay transmitting-receiving stations. It also provides means for the signal officer to call and communicate with the relay stations or silence cabinets.

The unit is about fifteen inches square and four inches high, and is designed for table mounting. The top panel consists of a series of jacks for making connections to the remote relay stations and for monitoring the communication channels.

The unit is provided with a connecting cable and connector plug. The unit should be located so that the signal officer can see the intercept boards. Additional connectors are provided so that cable may be extended as required to connect into the Distribution Panel BD-102-().

b. Silence Cabinet Control Unit RM-25-()

The silence cabinet Control Unit RM-25-() is designed as an operating position for the remote control of one receiving-transmitting channel.

The unit has a vertically mounted panel containing the push buttons and switches necessary to establish a communication channel through the transmitting and receiving stations, and provided indications of the operation of the equipment, and inter-communication telephone facilities.

One of these units is normally located on a table or shelf approximately 2-1/2 feet deep and 2 feet wide in four silence cabinets. The fifth unit is mounted on a shelf in one of the cabinets to make two units in one cabinet.

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The silence cabinets themselves are small booths at least three feet wide by four feet deep which may be placed anywhere within the operations block as the connecting cable may be extended by means of the connectors provided to connect into the main distribution frame BD-102-(). The individual cabinets permit the operator to monitor and control each channel without interference from other channels or outside noise sources,

c. Intercept Officer's Control Unit RM-26-().

The purpose of the intercept officer's Control Unit RM-26-() is to provide a unit whereby an intercept control officer can select a squadron communication channel and communicate with the squadron.

The unit is table mounted and is approximately fifteen inches square and ten inches high with a sloping panel. A series of buttons is provided which permits the officer to select any one of the squadron communication channels. Indicator lights provide him with information on the availability of the channels. Communication is carried on through a hand set and a send-receive key.

The three control units provided in the system SCS-2 are usually located on a balcony overlooking the intercept board. One or more intercept boards may be used. The units are provided with connecting cable for connection to the Distribution Panel BD-102-().

d. Distribution Panel BD-102-().

The purpose of this panel is to provide the necessary connections between the units in the operations block and units external to the operations block.

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The equipment is mounted in a cabinet approximately two feet wide, eighteen inches deep and six and one-half feet high. Doors are provided on the back and front for access to the distribution frame and the change-over and relay panels. Jacks are provided for shorting out items of equipment which may become inoperative so that the system can still function. The necessary relays for carrying on communications are also provided in this unit. The most important of these is a special Relay Unit BC-687 which operates the relay stations, shifting to send or receive as required, and selecting either of the two channels provided by the two transmitters and receivers.

The cabinet is provided with a series of sockets mounted on the sides. The plugs on the cables from the various units in the operations block are inserted into these sockets to permit quick installation of the units and rapid interchange of units in case of failure.

In locating the distribution unit, space must be provided in back and in front of the cabinet and provision made for inserting the plugs on the sides of the cabinet.

e. Telephone Terminal Strips.

The telephone terminal strips provide terminals for all incoming cables and open wire telephones and communication channels, if terminal facilities in addition to those provided in the Distribution Panel BD-102-() are required. They may be located in any convenient place with sufficient space to make connections. The connections between the terminal strips and the distribution panel are made by the standard telephone cable.

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f. Telephone Switchboard.

Where the control equipment is not installed in the information center, a telephone switchboard may be required to provide the necessary telephone connections external to the system. The switchboard is not normally supplied as a part of the system SCS-2 because its size and use depends upon the requirements of the site.

g. Intercept Board.

The intercept board or boards provide a mounting for the map or maps used in making interceptions and a mounting for the necessary communication equipment. The three Control Units RM-26-() are located so that the interceptor pursuit control officers can overlook the boards. The intercept boards are not supplied as a part of the system SCS-2 since they should be built locally to meet the requirements of the installation.

h. Direction Finder Plotting Board.

The purpose of this board is to determine the location of the squadron from the information supplied by the direction finding stations.

This board is not supplied as a part of the system SCS-2 since it should be designed to meet the requirements of the installation. It will generally require a wall space at least 45 inches wide by 30 inches high. Protractor and straight edge equipment are provided for laying out the bearings as reported by the direction finding stations to obtain the location of the squadron. The maps used with this and the intercept boards must, of course, be provided locally.

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1. Plotting Board (Operations Board).

The main Aircraft Warning Service plotting board is not supplied as a part of the VHF system SCS-2. If a board in addition to that used in the present information center is required, it should be designated locally to meet the requirements of the installation.

j. Pursuit Status Board.

The pursuit status board provides information on the status of the pursuit squadrons.

Generally a vertically mounted board is used. This board is not provided as it can be fabricated easily locally to meet the requirements of the installation.

The intercept board or boards, and the pursuit status board are not normally a part of the information center. With the installation of the VHF system the present equipment may be used in the information center location or it may be transferred to the operations block if it is separated from the information center. The design and utilization of this equipment depends on the requirements of the installation and therefore may be set up as required by the situation.

2. Radio Sets SCR-562 (Transmitter Trailers).

Those trailers provide the transmitters for the communication channels between the ground station and the squadron leader.

Two house-type trailers K-35 are provided, in each of which are mounted three transmitters BC-640-() and all of the auxiliary equipment

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necessary to operate them. The transmitters are rack mounted so that individual units can be quickly replaced. The frequencies are crystal controlled. In setting up the transmitter for a particular communication channel, it is necessary to insert the proper crystal and then tune the various units for maximum output. Normally the frequencies are not changed during operation since a transmitter is available for each frequency used.

Each trailer contains a terminal unit which provides the connections to the transmitter and permits the operator to monitor the channels.

The antennas are vertical half-wave dipoles, two of which are mounted on the ends of a cross arm at the top of the ninety-foot mast. Three of these antennas are normally used with each trailer, with one as a spare. The antennas must be within a few feet of the trailers to permit connections with the transmission cables provided. From a technical standpoint the trailers need not be separated, but it is preferable that they be separated sufficiently so that a single bomb could not destroy both of them.

3. Radio Set SCR-563 (Receiver Trailer).

This trailer contains the receivers for the communication channels.

The six receivers BC-639-() and the auxiliary equipment are rack mounted in a house-type trailer similar to those used for the transmitters. A terminal unit provides connections between the multi-pair cable or field wire and the receivers with provision for monitoring by the operator.

The receiving antennas are identical with the transmitter antennas. The four masts each mount two dipole antennas.

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4. Radio Set SCR-567 (Relay Transmitter and Receiver Trucks).

This station contains two trucks which house the remote relay transmitting and receiving equipment.

One of those trucks contains two transmitters of the same type as used in the transmitter trailers. The second truck contains two receivers of the same type as used in the receiver trailer. A relay unit is provided for automatic selection of either of the two transmitter-receiver channels, and for shifting from send to receive operation. If a single telephone circuit to the operations block is provided, only one channel can be used at a time. Two circuits permit the use of both channels simultaneously.

5. Radio Sets SCR-565 (Fixed "Fixer" Direction Finder Stations).

Those three D/F stations provide bearings on the squadrons so that their positions can be determined by the D/F plotting board.

Those stations are located in knock-down type octagonal buildings twelve feet wide and thirty feet high. The equipment consists essentially of a receiver of the same type used in the receiver trailer and directional antenna which can be rotated to determine the direction from which the transmission from the plane is coming. This bearing is shown on a dial and after correction as determined by the calibration of the station is transmitted to the direction finding plotting board by telephone.

The direction finding station must be carefully oriented both as to location and azimuth and must be calibrated in order that they provide accurate bearings on the squadrons.

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6. Radio Set SCR-564 (Fixed Sector Direction Finder Station).

This fixed sector D/F station provides a means for "homing" the squadrons

The station is identical with the fixer stations in operation, construction and housing except that it includes provision for operation of one of the air-ground communication channels, normally the "homing" channel, when the station is used for "homing" purposes.

7. Radio Set SCR-566 (Mobile Direction Finder Station).

The mobile D/F station is normally used as an emergency replacement for the fixed D/F stations, and for the "homing" purposes at a secondary airfield. It may also be used to obtain fixes on squadrons in areas not satisfactorily covered by the fixed "fixer" stations.

The equipment is mounted in a truck and consists of a receiver and antenna assembly similar to that used in the fixed station with the exception that the antenna is arranged so that it can be lowered when the truck is in motion. The station is provided with a transmitter-receiver consisting of the main components of the airborne Radio Set SCR-522-() which can be used to establish communication with aircraft for "homing" purposes.

8. Power Units PE-99-().

This unit provides emergency power for the equipment normally operating on commercial power and furnishes the power required for those components not connected to commercial power.

The generator is driven by an air-cooled gasoline engine with the

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ignition suppressed to prevent radio interference. The unit provides a maximum of seven and one-half kilovolt-amperes of three phase power at 110 volts, 60 cycles. The units for the fixed portions of the system SCS-2 are provided with a small shelter. The units for the mobile trailer and truck components are mounted in small two-wheel cargo trailers.

Although these power units are designed for up to 500 hours of continuous operation, commercial power should be provided wherever practical. If commercial power is not available, it is necessary to operate the power units only when the transmitters are in operation, unless electric power is required for heat and lights.

All of the components of the system can be operated on either 110 or 220 volts, 50 or 60 cycle, single phase commercial power supply. The approximate power required for each component is as follows:

	<u>Equipment</u>	<u>Heater, Lights, etc.</u>
Operations block	*	*
Transmitter trailer (each)	3,000 Watts	2,000 Watts
Receiver trailer	1,000 Watts	2,000 Watts
Relay station	2,000 Watts	2,000 Watts
Fixed D/F station (each)	200 Watts	2,000 Watts
Mobile D/F station	200 Watts	2,000 Watts

*The power by the Control Set SCR-561 amounts to only a few hundred watts. The power used for heating, lights, etc., will depend upon the installation.

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9. Radio Set SCR-522-(). (Airborne Transmitter-Receiver).

The airborne transmitter-receiver SCR-522-() provides the airborne equipment necessary for communication with the ground, communication between the planes, inter-communication within the planes, and the necessary "pip-squeak" signal for reception by the direction finder stations.

The transmitter and receiver and the automatic control equipment are built into one unit. The receiver and transmitter each have four crystal controlled communication channels. These channels are set up by removing the transmitter-receiver from the plane and tuning it with special test equipment

The pilot is provided with a control box with five push buttons, four of which select the four communication channels and turn the transmitter-receiver on, the fifth being used to turn the transmitter-receiver off. An automatic Contacter BC-608-(), when desired, shifts the transmitter and receiver from the communication channel to the direction finding channel during a predetermined fifteen-second period of each minute to transmit either a modulated or unmodulated direction finding signal. At the end of this period the receiver and transmitter are automatically restored to the communication channel. The transmitter-receiver assigned to provide the direction finding transmission can be used for communication purposes only during the remaining forty-five seconds of each minute.

Because of the size and shape of the transmitter receiving unit, it cannot be mounted in some of the present types of pursuit planes. The equipment may be installed in P-40-E pursuit planes previously manufactured by