GROUND RADIO COMMUNICATION ACTIVITIES
OF
THE SIGNAL CORPS GROUND SIGNAL AGENCY
1930 - 1944

Development activities of the Signal Corps in connection with Ground Radio Communication(Vehicular and Field Sets) are conducted at Fort Monmouth, N. J. Since 1930 the Development Organization Laboratories have functioned under successive names which the War Department organization policy has dictated as follows: Signal Corps Laboratories, Signal Corps General Development Laboratory, Signal Corps Ground Signal Service, Signal Corps Ground Signal Agency.

Three main periods characterize the development work of the Radio Section since 1930. These may be called the Peace Period, Defense Period and War Period.

During these periods, the major emphasis of work assignments by the Radio Section may be summarized as follows:

Peace Period 1930 - 1939 - Completed high frequency development program for Infantry and Field Artillery, Company and Battalion sets. (SCR-131, -171, -163, -178, etc.). Initiated and completed development of Tank and Combat Vehicle Sets for Mechanized Cavalry. (SCR-189, -193, -209, -245)

1937 - 1938 - Developed and invented practicable radar circuits and equipment, and gave successful demonstrations which were the basis of the accelerated development program.

1939 - Developed experimental Frequency Modulation, Very High Frequency, Ultra High Frequency and Microwave equipment. Demonstrated this equipment to the Using Arms and consulted with their Boards regarding a development program for a series of sets meeting their tactical

1939 (Contd.) - requirements. As a result of this foresight, approved military characteristics were available for a comprehensive development program to meet war needs long before Pearl Harbor.

Defense Period 1940 - 1941 -

1940 - Vehicular Radio Section initiated an energetic development program to insure that military radio communication would be free from vehicular ignition and electrical interference. This program resulted in the suppression of all military vehicles.

1941 - Initiated development program based on Armored Force Military Characteristics submitted as a result of work accomplished in 1939 in Frequency Modulation, Ultra High Frequency and Microwave equipment. This development program covered a complete line of sets and resulted in the adoption of the first FM radio sets for tactical use. Tape facsimile was also developed for use with vehicular radio. These sets became the SCR-299, -506, -508, -528, -538, -509, -510 and Tape Facsimile RC-58. Completed the Armored Force development program, conducted service tests and prepared necessary procurement data for large scale production. Initiated development for other branches including the following sets: For the Field Artillery - SCR-608, -628, -609, -610, -808, -828. For the Coast Artillery - SCR-543, -593 - For the Infantry - SCR-284, -300, -536 - For the Cavalry - SCR-511, -583.

War Period 1942 - 1 February 1944 -

1942 - Directed rapid expansion of personnel and facilities; provided production engineering liaison necessary to insure satisfactory production of new sets; provided engineering and development assistance to the crystal industry to expand their facilities to meet tremendous demands; completed new developments including SCR-543, -593, -608, -628, -609, -610, -808, -828.

War Period 1942 - 1 February 1944 -

1942 - Carried on parallel developments of the Armored Force and Field Artillery FM sets designed to eliminate or reduce the use of crystals in event of supply difficulties. These sets were the SCR-708, -808, -710, -810, -709, and -809.

1943 - Particular attention was paid to field supply and maintenance problems; unsatisfactory reports were analyzed. Officer and engineering personnel were sent to theatres of operation to introduce new communication equipment and systems, such as Radio Set SCR-300 and Radio Relay Systems, and to Arctic climates for Winterization Tests; equipment improvements dictated by tactical use were put into effect through field modifications and current production changes; emphasis was placed on moisture proofing and tropicalization as a result of SW Pacific experience; multi-channel radio relay systems were developed and placed in production such as *AN/TRC-1, -3 and -4, #AN/TRC-5, -6 and -8; new communication sets developed and placed in production. *SCR-694, -AN/TRC-2, #SCR-619, *SCR-399, *SCR-499;

*-production #-development

Special attention given to straightening out Army Air Force engineering problems particularly in connection with extensive use of commercial equipment by that Force.

During the 10 year peace period 1930 - 1939, radio engineering personnel averaged 15 engineers. These engineers had to form the nucleus of a rapidly expanding organization after 1940 which increased from 15 engineers to Radar (Camp Evans) 1145; Production Engineering,(Fort Monmouth) 745; Suppression (Detroit Signal Laboratory) 499; Crystal Branch 109; Radio Direction Finding 580; Vehicular and Field Radio 305. The total personnel of the Signal Corps Ground Signal Service and the Signal Corps Ground Signal Agency

at this time was approximately 14,000.

For the ten year period, 1930-1940, development was completed and production started on approximately 18 sets. Average development time was 2 years. In the next 3 years, development was initiated and completed on approximately 45 sets. The average development time was 4 months.

In June 1940, the Vehicular and Field Radio Sections were organized with a nucleus of only 6 radio engineers - 2 in the Vehicular Radio Section, and 4 in the Field Radio Section. The engineers were faced with the task of building up an organization and initiating an immediate development program for approximately 9 sets, which was expanded to 51 sets for the next 3 years.

The Radio Communication Section advocated and developed equipment in conformance with certain general policies and principles enumerated below. These policies have been the subject of considerable controversy but have now been confirmed as basically sound both by the outstanding performance of the equipment and through later investigation by other authorities.

High Powered Vehicular Radio Transmitters - Transmitters would be as high powered as conditions would permit; for example, Vehicular SCR-299 400 watts (CW - Voice) British, no equivalent; SCR-193 75-100 watts (CW - Voice) British, no equivalent; SCR-245(CW 15 watts - Voice 15 watts) British No. 19 CW 15 to 20 W - Voice 4 to 5 W.

Quarts Crystals - It was felt that to assure the maximum of military communication and to overcome the problem of netting as many as 30 stations on the same frequency as required in the Armored Force, the use of quarts crystal-controlled oscillators was the only sure answer. The general policies were as follows: High frequency sets to be both master oscillator and crystal controlled; Master oscillator sets to incorporate a crystal calibrator, thus each set to be its own frequency meter; VHF sets to be crystal controlled -

each set to carry all crystals for total number of channels, SCR-508, -528, and -510 carry 80 crystals each - SCR-608, -628, and -610 carry 120 crystals each; number of types of crystals to be held to minimum, (3 types covered over 99 per cent of requirements). This indeed was a most bold policy. It meant expansion of a highly specialized industry from a few thousand crystals per year to hundreds of thousands per week. That this was successfully done is one of the major accomplishments of the war on the part of both industry and the Signal Corps.

Frequency Modulation - Early investigations by design engineers of the Signal Corps Laboratories convinced them of the merits of Frequency Modulation, and that its use in military radio would be highly advantageous. The advantage of FM were at that time the subject of hot controversy among the experts, both within and without the government agencies. Therefore it was a major decision on the part of the Signal Corps Laboratories to pioneer in its adoption to military radio sets. The outstanding performance of these Army FM sets and the later espousal of FM by others, is a tribute to the foresight and sound judgment of Signal Corps Officers and Engineers.

Very High Frequencies for Short Ranges - Contrary to all previous work and study on the most usable range of frequencies, the Signal Corps Laboratories' investigations in 1939 indicated that the frequencies 20 to 80 megacycles offered many advantages for short range military communications, particularly the band 20 to 40 mc for short range mobile work. These frequencies were relatively free from static, skip phenomena, night effects and distant station interference. Man made static and vehicular ignition interference were more severe, but these were satisfactorily brought under control by the development of FM sets and the application of ignition suppression to all military vehicles. Many people, particularly the British,

were opposed to the use of these frequencies in the belief that they were useless in hilly or mountainous countries, however, usage and repeated tests and demonstrations by the Laboratories proved that the effects of hills was greatly over emphasized. The FM set in the band 20 - 40 mc consistently out performed sets in the 2 - 9 mc band. (Later British and National Defense Research Committee Reports confirmed the Laboratories' opinions).

Strategic Materials - As a result of far sighted design planning in 1940 and 1941, when the critical shortages of materials became apparent after Pearl Harbor, very little material substitutions were necessary in the new line of radio sets. All sets for vehicular installation and transportation, such as SCR-299, -508, -528, -543, -608, -628, etc. were originally designed using steel instead of aluminum. However, an energetic program of substitution for other materials was carried out.

A few of the outstanding radio sets may be briefly mentioned as follows:

Radio Set SCR-299 and -399. A high powered highly mobile communications unit capable of operation while in motion. Originally developed for the Signal Corps as the "100-mile radio set", its outstanding performance and versatility on the battle fronts under the most unusual exigencies have "saved the day" for its users time and again. Not only our Ground Forces utilize this radio set in large numbers, but the Air Forces, as well as the Chinese, Russian, British and French Forces of the Allied Nations. This set has become well known to all through current radio publications as the set that "always gets through."

Frequency Modulation Sets as exemplified by the SCR-508, -608, and SCR-509 - 609 series have revolutionized the art of mobile and field radio communication over short distances. These sets, with their instantaneous selection of different frequency channels and ability to operate through

electrical interference, both man-made and natural, have made possible new concepts of battle tactics. The newest addition to these FM sets is the Infantry SCR-300, popularly called "The FM Walkie-Talkie."

Radio Relay Systems using Radio Set AN/TRC-1. This set will permit the rapid installation of the equivalent to a long line telephone circuit capable of operating with carrier telephone equipment to provide 3 simultandous voice circuits and 4 teleprinter circuits on one radio frequency channel.

Frequency Modulation has revolutionised radio communication, by developing freedom from static and all other noises, thus making radio communication an essential equipment for vital communication.

The American Army is the only Army in the world equipped with tactical radio communication sets, utilizing the advantages of this latest revolutionary FM invention in the radio field.

The success of an Army in modern warfare depends more than ever before, upon the reliability of its communications. The burden of coordinating the fast moving action of tanks, artillery and infantry in battle, has placed new demands on radio. These demands call for equipment providing the utmost freedom from ignition and electrical noises, static, and interfering signals. Their communication range must remain unaffected by time of day or night, weather or geographical location. It is estimated that all these requirements are being met by Army's FM radio sets.

These FM sets developed by the Signal Corps Laboratories in cooperation with the radio-industry are the result of a major investigation undertaken by the Signal Corps three years before Pearl Harbor. When the treacherous Japs struck, the Signal Corps was ready with new and modern radio sets which could be placed into mass production with the least possible delay.

In 1937 Major E. H. Armstrong's steel tower appeared on the top of the Palisades, near Alpine, New Jersey. It was evident to Signal Corps engineers that this "thunder-defying" type of communication, popularly called "FM" was able to offer far more than crystal clear staticless reception in homes within a fifty mile radius. These same technical characteristics, it was believed, might well transmit a clear message to a tank in battle through the severe ignition interference and track static produced by a dozen machines in column. If so, FM would be a military weapon fully as effective as any produced for modern coordinated warfare. With this in mind, the Signal Corps began a series of tests and experiments to find if FM would be the secret of success. The Signal Corps conducted several comparative tests between development models, both FM and AM. These tests were performed at Fort Knox, Kentucky, where the models were subjected to gruelling tests under all conditions. The result of these tests gave the victory to FM. These two models were immediately put into large scale production and were used on all American fighting fronts during World War II.

As a result of one of the outstanding characteristics of modern warfare, the great mobility of units and their frequently wide separation from one another, radio communications far outweigh wire communications, in the Army and in the Navy in World War II. Of the Signal Corps $5,000,000,000. communications equipment procurement program for the year 1943, approximately 90 per cent is destined to be spent on radio.

Wire communications have the advantage of providing greater security, messages sent by wire cannot be intercepted or jammed by the enemy as easily as radio messages, but the difficulties of transporting wire, and installing it over vast distances, and in jungles, and other forbidden terrains are, of course, very considerable. In combat theaters, wire communications are used

down to the regimental echelon. Forward of that, communications are generally by radio.

In making bridgeheads, Signal Corps troops are usually among the first to land. Radio communication is maintained between the bridgehead and the ship, and on shore wire is laid laterally and forward. By the time artillery is in a position to fire, wire communication has been established at the firing point and the command posts.

In Naval communications, wire naturally plays even less a role than in the Signal Corps and the Navy's use of radio communication is proportionately higher. Radio is used by the Navy not only for long-distance communications, but also for short range work between the ships and planes of a modern task force.

The total radio production in this country which in late 1942 stood at $30,000,000. a month, a year later rose to $250,000,000. per month, representing a considerable greater rate of increase than that of the total war production. All such production is for the Armed Services, and the following is only a partial list of radio products in use: radio for tanks, aircraft, battleships, cruisers, submarines, destroyers, field sets for the Army's public address systems, radio compasses, direction finders and altimeters.

The impact of these vastly expanded military communications, and of other purely war time considerations, is felt in every other branch of communications. All efforts in manpower, material, service and in broadcasting content, testify to the fact that radio is among the chief weapons of war.