

VF - RADIO FREE EUROPE

# RARET



INSTALLATION  
& FACILITIES

LISBON  
PORTUGAL

SURVEY REPORT  
of  
SOCIEDADE ANONIMA de RADIO RETRANSMISSAO (RARET)  
Lisbon, Portugal *(Added entry)*

At the request of the New York office of Radio Free Europe the writer went to Lisbon, Portugal for the purpose of looking over the operations and technical plant of RARET. The period spent out of the country was from February 29 to March 15, 1952. The following comments and impressions are being given as the survey report.

Dwight A. Myer,  
Technical Field Director  
Westinghouse Radio Stations Inc.  
Washington, D. C.  
March, 1952

82

## INTRODUCTORY

Radio Free Europe is a division of the National Committee for A Free Europe. The Sociedade Anonima de Radio Retransmissao (hereinafter referred to as RARET) is a corporation and sixty percent of the Members of the Board of Directors are Portuguese.

It has been stated:

"Radio Free Europe was organized to carry out a program of anti-communistic propaganda directed toward the people of the Soviet satellite countries by means of radio broadcasting. It operates on the theory that these people will listen to radio programs just as diligently as do the people in the United States, if such programs are presented in a manner that captures the popular fancy and if they are broadcast with sufficient power to cut through the severe interference conditions of the European broadcasting band. Assuming this can be done, Radio Free Europe also believes it possible to maintain interest in such programs even while weaving a subtle theme of anti-communistic propaganda in the form of news commentaries, comparisons, dramatic satires, messages from escapees, instructions on how to avoid border guards when escaping from the country, etc. In this way, it is felt, the people of the Soviet satellite countries will be enabled to learn the truth about life outside the Iron Curtain and compare it to the life behind it, thus bolstering the hopes of those being subjected to communism against their wills, discouraging acceptance of it and perhaps, in the end, eliminating it."

Radio Free Europe's European activities are centered in Germany and its offices and studios are located in Munich. From Munich

it programs short wave transmitters in Biblis and a 135 kw transmitter located at Holzkirchen. The Holzkirchen transmitter operates on 719 kc and has its transmissions beamed toward Czechoslovakia.

From the start both the short wave and medium wave broadcasting from Germany has been a success as far as accomplishing and bringing about the results which R. F. E. hoped to achieve. It was felt nevertheless, that the transmissions from Germany should be augmented by other and additional transmitters beaming toward the target area from a different location and direction. The 135 kw, 719 kc, transmitter at Holzkirchen was and is doing effective work with its sky-wave transmissions into Czechoslovakia but it is a medium wave transmitter and medium waves often can be effectively jammed by relatively low-powered jamming transmitters located at strategic points in highly populated areas such as cities and towns. The short wave transmitters at Biblis were getting in their effect but in these cases the sky-wave propagations into Czechoslovakia are one-hop transmissions and are somewhat susceptible to a certain amount of jamming. A study was inaugurated to determine the most suitable place or places where such additional facilities could be placed.

## WHY LISBON?

The services of A. D. Ring & Co., one of the most competent radio engineering consulting firms in the country, were engaged to survey the European area and recommend locations or zones where, from an engineering standpoint, it would be advisable to place short wave transmitters for transmission into the Soviet satellite countries. In making such recommendations there were several cardinal points which had to be kept in mind and balanced one against the other.

The first of these points was to determine the frequencies or parts of the radio spectrum which the Cairo Conference had allocated for this type of broadcasting.

The second was the consideration of the specific frequencies which were made available to Radio Free Europe for their use and, if such frequencies were shared by other interests, how could Radio Free Europe best employ them for their purpose and still protect other possible users.

The third point of investigation was the action of these frequencies as related to optimum frequency over the transmission path to the target area.

A fourth point was the consideration of signal fading at the target. Not much can be done about the fading aspect as fading varies inversely with distance to the target area. No general precaution can be taken as fading is a characteristic of short waves.

We can say the fifth point was the question of the kind or type of receiver most likely available to those listening behind the Iron Curtain. Was this receiver selective, sensitive and tunable over the whole band and if so did its response remain constant over the

whole band? If not, at which end of the band was its performance best?

The final point (and a very important one) was the study of the transmission path and best location of a transmitter to be installed by the Russians which could most effectively jam any proposed new R. F. E. transmitter. In considering this point, estimates were made as to the probable daily jam-free hours of operation an R. F. E. transmitter might have from various possible locations.

A discussion of short wave transmissions can become quite complex and involved. It is a highly technical subject and no attempt will be made in this report to go into the matter. It suffices to say the action of short waves is somewhat variable and varies diurnally, seasonally and in accordance with the sun-spot cycle. Over the years data have been collected and tabulated and now it is possible to predict the action of short waves with a reasonable degree of accuracy. In making their study the engineers of A. D. Ring & Co. used as part of their reference material, the Bureau of Standards Central Radio Propagation Report, Series D Bulletin and the Signal Corps Propagation Unit Technical Report No. 9 for sun-spot number of 20, estimated as being accurate for the period 1952 to 1956.

As a portion of the material submitted as a result of their studies, the engineers of the A. D. Ring & Co. presented a map of Europe and the Mediterranean section upon which they indicated the target area and sections of that part of the world which their studies indicated would be first, second and third choice for an additional R. F. E. short wave transmitter installation. The map is included in this report and is shown as Figure 1. It will be noticed that the first choice of location is all of Portugal, the western part of Spain, all of Spanish Morocco and part of French Morocco. Lisbon, Portugal is therefore in the optimum zone for short wave transmission to the Soviet satellite countries when viewed from an engineering standpoint.

When seeking a new location for R. F. E. transmitters there were factors other than engineering which had to be taken into account. Certain countries, due to political reasons, would not permit an enterprise such as R. F. E. to operate within their borders.



In choosing a new location, the availability and topography of the land, the availability of power, roads and general accessibility, the type of nationals which were to be employed, the possibility and quality of transmission circuits from Munich all had to be considered.

Portugal seemed to ideally fit all the requirements of the problem. This country is far removed from the Soviet field of influence and the political feeling in Portugal is anti-communistic. Portugal has historically been a country which has not been disturbed by the European wars, its Government is stable, progressive and traditionally peaceful. Lisbon is easily accessible by water and air transportation and land was found available and excellently suited for the technical needs.

Transmission from Lisbon to the target area could be accomplished by the two-hop route and its location to the west of the target presented some benefit to be obtained against the Russian one-hop jamming from the east. Transmission from the west versus jamming from the east gave an additional advantage due to the periodic daylight-darkness differences existing at the mid-point of the two transmission paths. (This could work as a disadvantage in Munich's transmission from east to west to feed programs to Lisbon.)

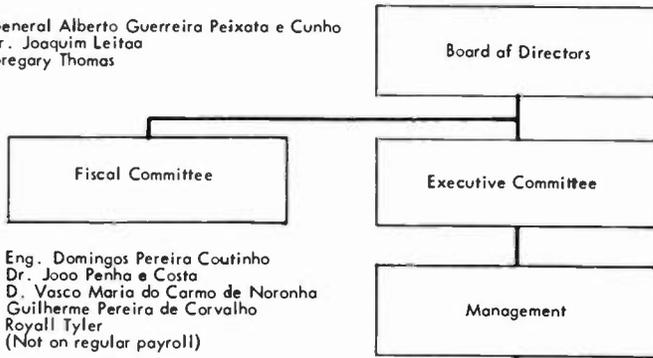
The choice of Lisbon, Portugal, has proved to be a very fortunate and wise decision. The manner in which the many facets of the problem were examined, probed and weighed, indicates sound and mature judgement in system management and engineering. The National Committee may be grateful that they have in their organization men with the acumen and power of penetration of thought needed for this step and the other possible future steps which may be under advisement.

Of course, before the Lisbon site became a reality, there were many and sundry items which had to be ironed out and clarified with the Portuguese Government. These points will not be discussed in detail, yet it should be brought out that some fine negotiations have evidently taken place when permission has been granted for a private enterprise of a foreign origin to operate within the borders of one country for the purpose of harassing and embarrassing another country.

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President - General Alberto Guerreira Peixata e Cunha  
 Vice Pres. - Dr. Joaquim Leitao  
 " " - Gregory Thomas

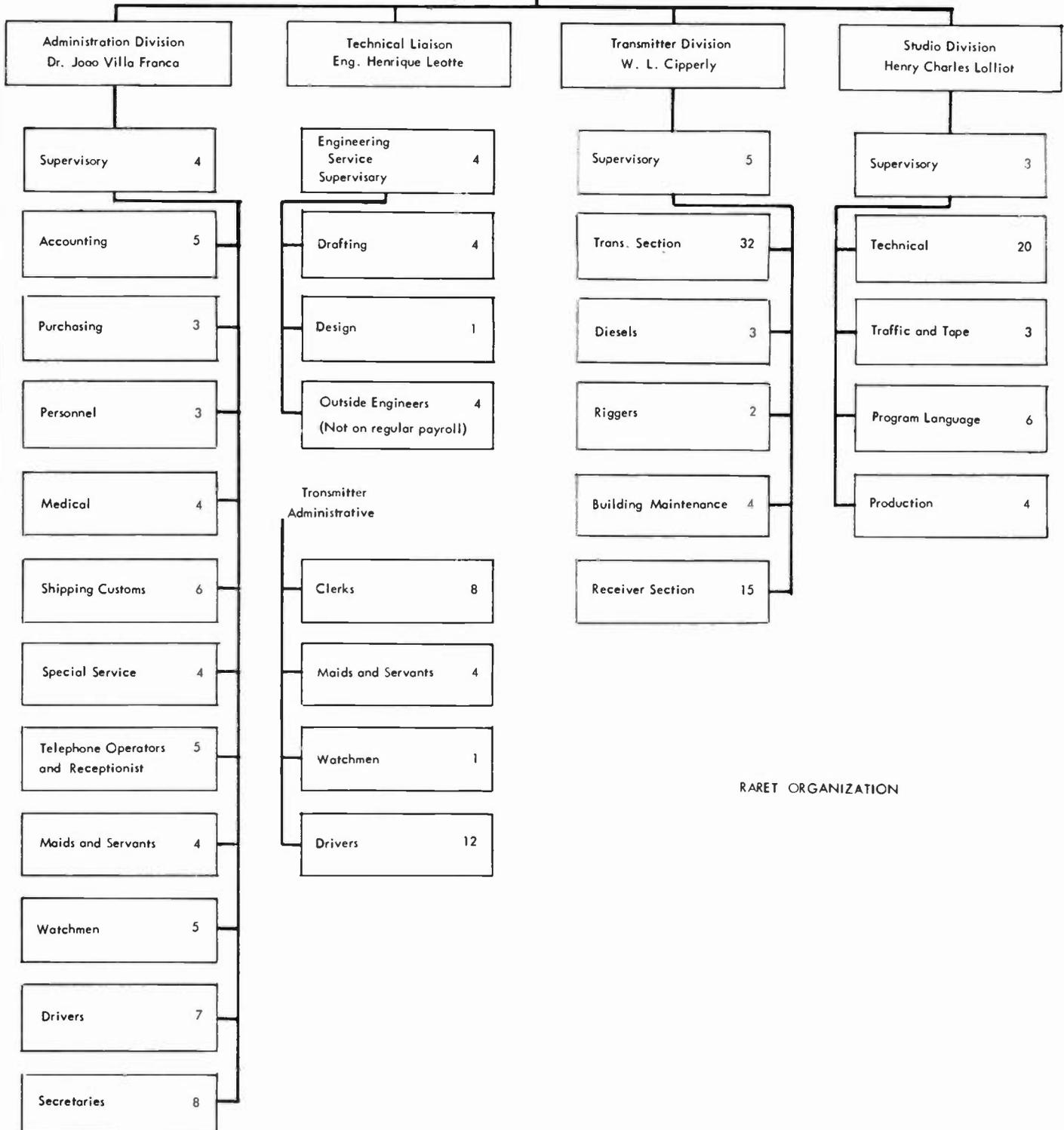
Directors - George P. E. Caesar, Jr.  
 Thomaz Pinto Basto  
 Dr. Antonio de Certima  
 Dr. Antania Quadros Serro  
 Pedro Brito e Cunha  
 Spencer Phenix  
 Secretary - Dr. Ruy Leitao



Thomaz Pinto Basto  
 Dr. Joaquim Leitao  
 George P. E. Caesar, Jr.

President - Eng. Domingos Pereira Coutinho  
 Members - Dr. Joao Penha e Costa  
 D. Vasco Maria do Carmo de Noronha  
 Guilherme Pereira de Corvalho  
 Royall Tyler  
 (Not on regular payroll)

George P. E. Caesar, Jr.  
 Eng. Manuel Bivar  
 Kenneth Owen



RARET ORGANIZATION

## RARET ORGANIZATION

Figure 2 shows a representative organization chart for RARET. This chart is not completely accurate and should be taken as being symbolic in nature. The organization was being classified while the writer was in Lisbon and perhaps is not even yet finalized. It will be noted that certain groups of employees have been left without a supervisory head. At the time of preparing the chart, the organizational planning had not progressed sufficiently to tie all members of the staff together.

The formation of RARET and its personnel planning and allocation follows along the usual lines of other foreign subsidiary companies owned by United States interests. By this is meant that RARET conforms to the practice of having the United States "owned" foreign company considered as under the control of the country in which it is located. This procedure is required by the laws of the foreign country for maintenance of sovereignty and is not unjust. The numbers of persons and their job classifications may seem unusual when compared to American industry procedure, but here again this phase of operation in other countries, especially the Latin countries, is not unexpected.

While in Lisbon, several questions were raised about the number of persons engaged in various activities. In a few instances it appeared as though the departments were over-staffed while in others there were apparently too few to properly conduct the work. All questions were answered more or less satisfactorily. When the answers were not entirely clear or convincing, the writer assumed he was not fully understanding the problem. Those that he understood satisfied him and having accepted the organization in part, he accepted it as a whole by inductive reasoning.

The numerals in the boxes on the chart describing a position or

job classification indicate the number of persons engaged in that particular classification. The chart shows there are approximately 200 persons on the payroll of RARET. This number does not include the members of the National Guard assigned to RARET.

From observation all signs point to complete harmony in the organization. Everyone seemed to know his job and was handling it in a business-like manner. The Portuguese engineers definitely gave the impression that they were satisfied in their work, competent in its execution and had confidence in themselves. It appeared, at all points in the system, that the equipment was in good hands.

The organization of RARET is laudable and worthy of praise. All have worked diligently and must have put in long hours to arrive at their present stage of progression. Everyone, particularly the Americans, is imbued with a driving force and to account for the reason becomes somewhat difficult. The esprit de corps and comradeship of the group is a pleasant experience to witness. There was no evidence of dissatisfaction or discontentment and certainly no personality grumbling. Apparently the New York office has "given them their heads" and not held the reins so as to interfere with their movements. The men feel that they are engaged in a war, a war of a high order, a war of minds. . . and they have accepted the challenge.

The ability of the group cannot be doubted nor disputed. It is not a question of whether they can do it - they have already done it - they have performed - they have demonstrated. Upon looking back over the schedule of events during the last twelve or fourteen months, the speed with which things were accomplished is forcibly brought out:

January		1951	Negotiations started in Lisbon
March	5	1951	Preliminary antenna proposal made
April	5	1951	Final drawings for curtain antennas ready
April	20	1951	RARET formed
May	11	1951	"Barbara" left Germany for Lisbon
July	4	1951	RARET is on the air using "Barbara" from Gloria
September	1	1951	Construction started on Gloria transmitter building
October	16	1951	Transmitter building broom-clean and ready to take some equipment

December	25	1951	First 50 kw short wave transmitter goes on the air for regular operation
January	14	1952	Second 50 kw transmitter is made ready for program operation
February	5	1952	Third 50 kw transmitter is made ready for program operation
February	27	1952	Fourth 50 kw transmitter is made ready for program operation
March	5	1952	Czech language program moved from "Barbara" site into main studio building putting the new studios into operation for the first time
March	15	1952	Hungarian language program is moved from "Barbara" site into main Lisbon studios

### SYSTEM LAYOUT

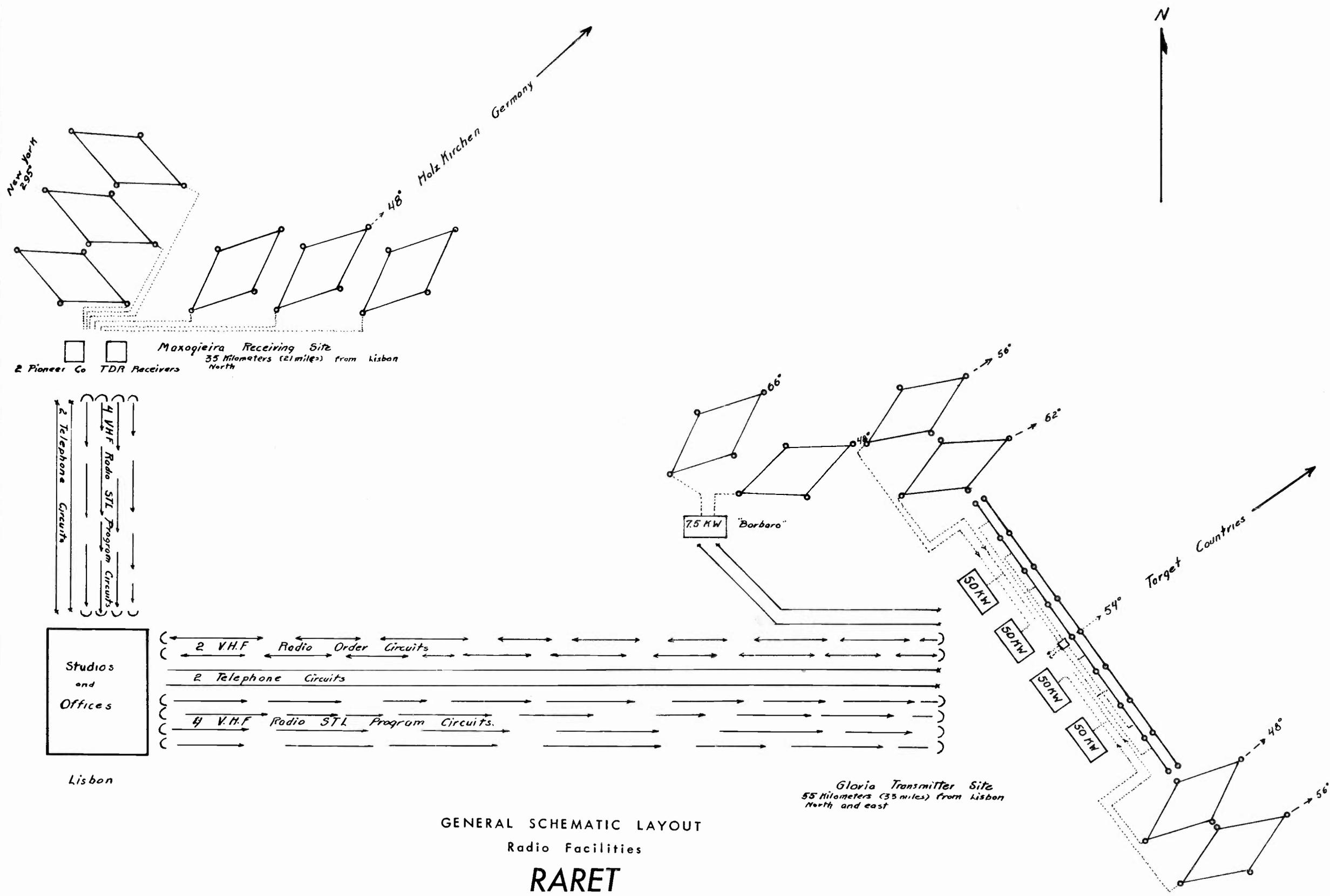
Figure 3 (overleaf) gives a schematic layout of the RARET system as it will be set up when completed.

## RECEIVING SITE

The receiving site is on leased land at Maxoquiera, near Benavente, about 35 kilometers (21 miles) north of Lisbon. At this site there are three rhombic (directional) antennas aimed toward New York and three rhombic antennas aimed toward Germany. Two Pioneer Company TDR receivers (triple diversity receivers) are installed and at present both TDR's are, or can be, used for picking up the short wave transmission from Holzkirchen. These transmissions from Holzkirchen are beamed on Lisbon and carry the program material from Munich to RARET for re-transmission from Lisbon to the Iron Curtain countries.

Until March 5, 1952, the programs received from Holzkirchen were sent over metallic wire circuits to the original, but temporary, studio location at the "Barbara" transmitter site at Gloria. At this point they were put on tape or looped through to the main transmitter at Gloria for simultaneous re-transmission. On March 5, the Czech language program was moved downtown to the main office and studio quarters in the Garagem Monumental in Lisbon. March 15, the Hungarian language program followed and now all studio activities are taking place in the main Lisbon studios. The programs from the receiving site are sent to the main studio by a wire circuit and are processed at Lisbon and then sent to the main transmitter at Gloria over a wire circuit.

When the system is completed, the programs will be sent to the main studios over STL (studio transmitter link) VHF (very high frequency) radio circuits. Also the programs from the studio to the main transmitter will be sent over the same type radio circuits. RARET is fortunate in having a topography which will permit the use of these radio circuits without the need of relay stations. Line-of-sight conditions prevail to all of their operating points. To date, the STL



GENERAL SCHEMATIC LAYOUT

Radio Facilities

**RARET**

Lisbon, Portugal

Note - Layout not correct as related to scale of distance nor direction from Lisbon

FIGURE 3

transmitting and receiving equipment has not arrived in Lisbon and for this reason wire circuits are being used between the several locations. The STL antenna towers have been installed at the studio, receiving site and at the main transmitter and these erected towers are awaiting the arrival of the VHF equipment to go into operation.

At present the three rhombic antennas pointed toward New York are not used. The New York feed to R. F. E. occurs daily and is sent to Europe over Press Wireless facilities. The transmissions from America are picked up in Germany and then processed for transmission to Lisbon.

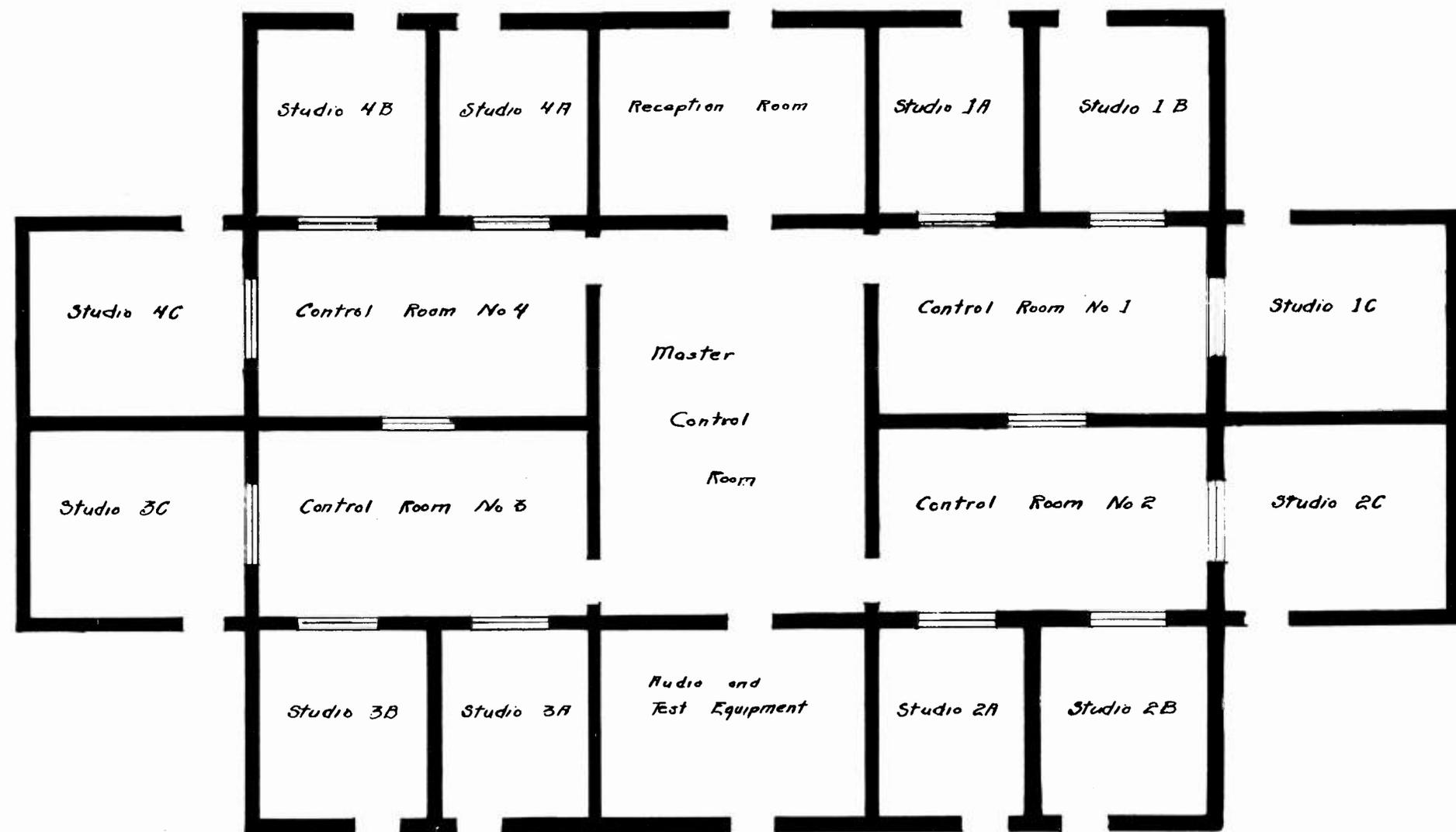
## STUDIOS AND OFFICES

The studios and offices are located in the Garagem Monumental, Praco do Areerio, Lisbon. The studios and the general program activities are on the second floor while the offices are on the third. The Garagem Monumental building is of recent construction and is located in a new apartment district of Lisbon. While it is not in the outskirts of the city, it is well away from the Chiado or business section of Lisbon. It is understood the building code or zoning requirements of the studio district are somewhat rigid and this will tend to maintain the quality of construction surrounding the RARET Lisbon offices.

A fairly representative sketch of only the active studio quarters is shown in Figure 4. This sketch is not accurate as it was drawn from memory after the writer returned to the United States. It is not drawn to scale but one eighth inch to a foot will give an approximation of the room sizes. Program offices, shop, toilets, studio entrance and corridors are in the area surrounding the studio quarters but are not shown. An automobile ramp permits passenger cars and trucks to drive from the street directly to the studio entrance on the second floor.

As will be seen from the sketch, the studios are arranged so as to provide one master control room in the center of the area with four smaller control rooms, numbered 1 to 4 inclusive, opening off from the master control room. Each of these four control rooms has three studios associated with it and this cluster of control room and three studios will be operated together and function as a unit. This unit is then assigned a language and each language a transmitter and frequency. Each of the studios in a cluster will be given a specific activity such as recording, editing or live broadcasting.

As stated above, the Czech and Hungarian language programs



RARET STUDIOS  
Lisbon, Portugal

FIGURE 4

have already moved into the new studios, taking up half the space. It is planned to add other languages to the broadcasting schedule with Polish probably being the next new language to be included.

The arrangement of the studio operating quarters is perhaps the most efficient that could have been devised. It takes a minimum of floor space and with its high percentage of common walls, requires a minimum number of square feet of wall construction. The compact set-up makes for lower labor cost inasmuch as all studios in one cluster can be viewed from the associated control room and in this way the control room doubles as an equipment room and studio control booth. Even the switch-overs from one transmitter or frequency to another or from one language to another can be handled instantly and with assurance due to the adjacency of the clusters.

The acoustical wall treatment in the studios is cork. The ceilings are covered with an off-white composition block having a high degree of noise absorption. The floors are cork tile. The walls are made of hollow tile plastered on the outside and, for the most part, cork lined on the inside. Double glass windows are provided between control rooms and studios with the glass elements non-parallel to deflect and avoid sound transmission. While many of the studio walls are common, there was no need to make them double walls as the acoustical level to be handled is low. By this is meant it is not intended to broadcast live shows which would have a musical organization using kettle drums, harps, cellos, double-bass viols, bass drums or other high-energy-content sound sources.

The person or persons who planned these studios knew the problem well and planned carefully in order to take advantage of available space and construction materials. It is fortunate that Portugal is a prime source for cork and tile as well as competent and honest labor.

Before leaving the studios, it should be mentioned that these quarters are all inside rooms. The ventilation is to be obtained by small ducts placed in the ceilings of the various rooms and the air pulled out by a blower. The studios were only about 85 percent finished during the first part of March but from observations made, it is believed this ventilating scheme will prove inadequate and larger

ducts and more powerful blowers will have to be installed. This will be easy to bring about as sufficient space exists above the ceilings to install ducts of any size. Portugal's summer weather is an unknown factor but it may even be desirable, at some later date, to install packaged air-conditioning equipment for this space. These units come in 5 and 10 ton sizes (and other sizes) and will run about \$650.00 per ton installed. As a quick estimate, 10 tons will be sufficient.

While the ideal of "one-floor" operation was not obtained, RARET is provided with the next best and has a two-floor operation. The offices on the third floor occupy a smaller area than the studio quarters. As indicated above, construction was still under way during the first part of March and the offices, like the studios, were showing carpenter's and plasterer's tracks. The individual offices are not large and are certainly not lush. As a matter of fact the opposite impression was given; they were cold, esthetically barren and scantily appointed.

The space made available for the studios and offices is sufficient at present. RARET is young and is bound to grow. It is to be expected that normal expansion will eventually bring about a snug fit at this location. The third floor comprises an area of 55 meters by 10 meters or 550 square meters. The second floor area is 44 meters by 28 meters or 1232 square meters. This is a total of 1782 square meters or approximately 16,000 square feet. The rental for this combined area is \$6,000.00 per year or approximately \$0.37 per square foot. This rate, compared to rentals in the United States, is, of course, extremely low.

## BARBARA TRANSMITTER

Barbara, the 7.5 kw mobile transmitter, is the mascot and has justly won her place in the R.F.E.'s Hall of Fame. She performed nobly in Germany and is now giving her all in Portugal. Standing at the edge of the Gloria property, she and Hotel Jackson represent the acorns from which great oaks grow.

The Barbara transmitter and its associated speech equipment and emergency diesel generator are mounted in trailer-trucks and operate from trailer housings. Two rhombic antennas are available to this transmitter permitting it to swing its beam 18 degrees.

During the day, or from 9:00 AM to about 4:30 PM, GMT, the Barbara transmitter is used as a code transmitter. At 9:00 AM, Munich starts its radio feed of the Czech language program to Lisbon, which is broadcast simultaneously by Lisbon and put on tape for evening repeat. The Russians continually try to jam this Munich feed to Lisbon and too often are successful. To guard against this eventuality, a pre-determined code (consisting of two letters of the alphabet) is set up between the RARET receiving point and Munich. If Russia jams one frequency, the code letters are sent to Germany (ICW) over the Barbara transmitter and Holzkirchen switches to another frequency. The code letters sent from Barbara signify or tell Holzkirchen what new frequency should be used in making the switch. There are times when the Russian jamming is quite successful and a great deal of switching back and forth between frequencies takes place. Barbara therefore functions as protection to the Czech language program during the day. If much of the Czech program is lost due to Russian jamming, Lisbon asks for and gets repeats for the lost portions after the day's transmission schedule is over. The recovered lost portions are then, through editing, spliced into the recording tape and a complete and coherent transcription is obtained.

The writer is of the opinion that this jamming of the Munich feed is occurring all too frequently and RARET has trouble on its hands. The Munich to Lisbon circuit is an extremely important link, the Achilles heel, so to speak, of the RARET system and this jamming problem is going to have to be met sooner or later. Propagation characteristics are favoring the Russians as both transmissions are occurring in the same direction and probably from relatively close points of origin as far as circuit path and length are concerned. A land line circuit would probably be out due to cost of erection, permission to erect and maintenance expense. A micro-wave radio circuit, even if slot transmission through the Pyrenees was used, would be out of the question for the same reasons. Several relay points might be used on short waves so the entrance into Lisbon could be from west to east and on another frequency. For example, a circuit could be set up from Munich to the British Isles to the Azores to Lisbon and thereby enter Lisbon from the west, on an optimum frequency. It would be ideal if, in some way, it could be arranged for the last hop to be FM or some sub-carrier arrangement. None of the above ideas are sound and are merely mental ramblings, but it is believed some different approach will have to be made to this problem.

At 5:00 PM, GMT, and continuing until midnight, the earlier recorded Czech language program sent down from Munich, is repeated over one of the 50 kw Gloria transmitters on 7695 kc and the Barbara 7.5 kw transmitter on 7285 kc.

The Barbara automotive transport equipment is maintained in good condition. The trailers have been mounted on concrete blocks. . however, the tires are on the wheels and inflated, ready to take to the road on a moment's notice. The trucks are also kept ready for instant use. The tanks are full of fuel, the batteries are charged, engine oil clean and ready for a long haul. Aside from normal wear and tear, this mobile unit is in good condition with no sign of decay or deterioration in evidence.

## GLORIA TRANSMITTER

The Gloria transmitter installation consists of four RCA Type BHF-50A short wave transmitters operating on 6, 7, 9 and 11 mc. These transmitters and their associated pieces of equipment are installed in the main transmitter building with the front panels in sets of two-in-line with each group of two transmitters facing each other. The transmitter's individual control console is located immediately in front of its respective transmitter. Speech and test equipment is mounted in racks in a straight line along the rear wall. Thus, the transmitters and the rack equipment are laid out in a "U" formation with the open part of the "U" facing toward the main entrance foyer and visitors' reception room. This is a standard accepted layout as it allows the engineers on duty to easily and quickly move from one transmitter to another and gives clear supervisory vision to all test and metering equipment. The transformers and other power equipment is located behind each transmitter, properly installed in a fireproof vault.

Within the main transmitter building there is also included the maintenance shop, tube and spare parts storage room, offices for the supervisory personnel, a small emergency studio (doubling as an office), toilets and locker rooms, a first aid room and medical office, a galley and meal service rooms, and other space allocations which would be expected to be found in an installation of this caliber. There is also a large area off to the side of the main transmitter room which can be used as a storage or garage space, but is primarily provided for additional transmitter expansion.

The transmitters had been installed in rather rapid succession and had all been turned over for operating service by the end of February, 1952. There were any number of remaining odds and ends which were yet to be taken care of and it can be assumed that these

will be attended to just as soon as time permits. There were a few minor "bugs" in the transmitter to be ironed out and the transmitter crews were taking them in the order of priority of importance, doing first things first.

(It was too early to make a technical inspection of the plant. This was a new house and they had just moved in. There were several points of the installation which could be questioned but such questioning with a critical intent would have been unfair. By August or September, 1952, the job will be completed and in its groove, then a technical inspection might properly be made.)

As indicated in Figure 3, the four 50 kw transmitters are at present each provided with a rhombic antenna and thus, all four transmitters can be operated simultaneously, each working into a separate rhombic antenna. Figure 3 also diagrammatically shows the curtain array which, when completed, will be used instead of the rhombic antennas.

The transmitter operating schedule employed at this time is somewhat as follows. Each morning at 6:45 AM and continuing until 2:20 PM, the Czech language program, recorded the previous day on tape, is broadcast over three of the 50 kw transmitters using the frequencies of 9607 kc, 9695 kc and 11,915 kc. At 5:00 PM and continuing until midnight one of the 50 kw transmitters, on 7695 kc, broadcasts the Czech program recorded earlier that same day. At 6:00 PM and continuing until 11:15 PM, three of the 50 kw transmitters broadcast the Hungarian program on 7145 kc, 7295 kc and 9607 kc. This Hungarian program is sent down from Munich to the receiving site at Maxoquiera and looped through direct to the transmitters. All times given in this paragraph are GMT.

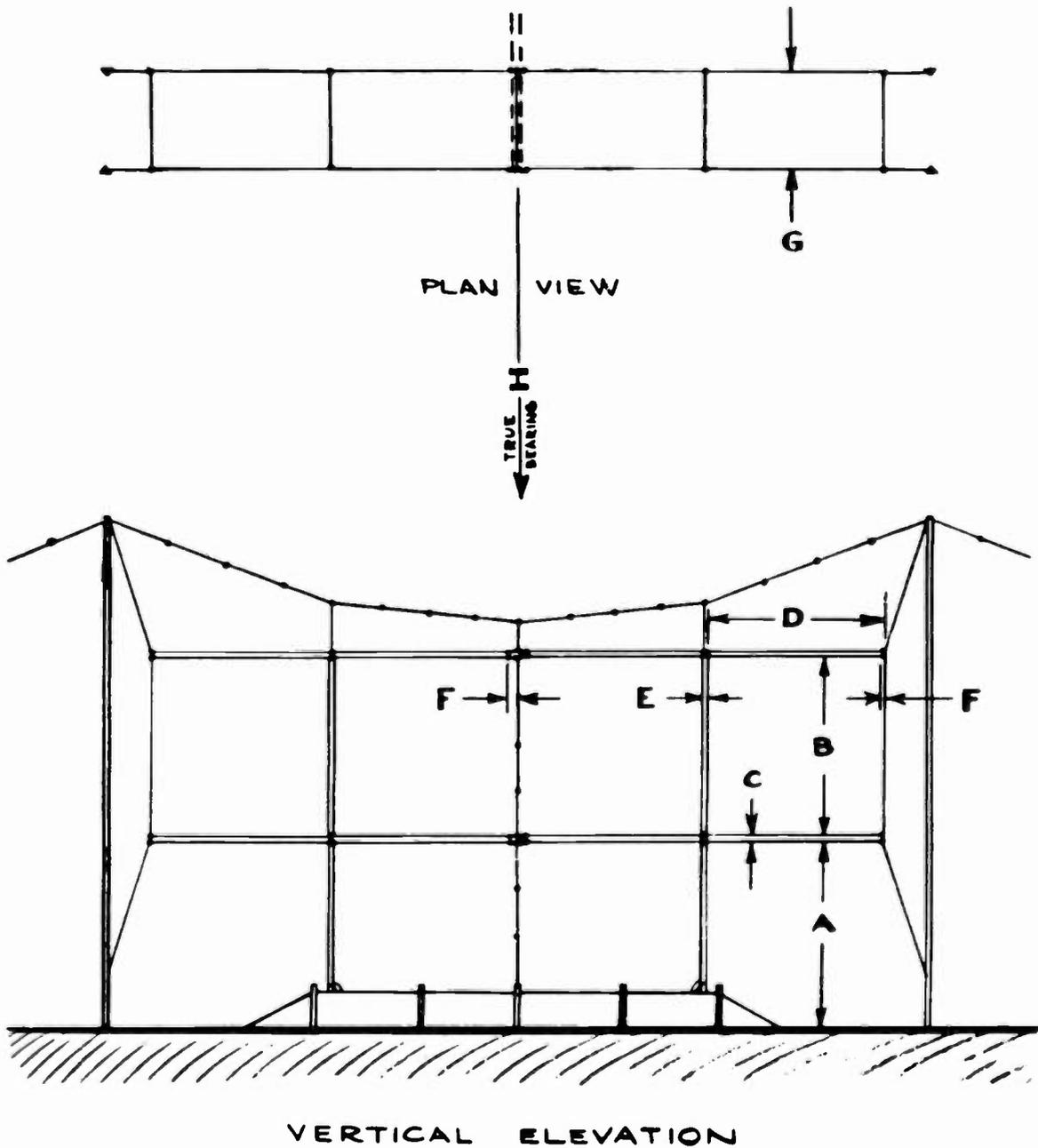
For an emergency power supply and to supplement the regular electric power source there have been installed two, 250 kw, diesel generators as well as a smaller diesel generator. These diesel generators, together with their fuel tanks, transformers and switching gear, are in the power house a short distance from the transmitter

traveling crane, highly polished copper fuel lines and brass fittings would be a stationary engineer's delight. Upon inquiring concerning the performance of the diesels, especially their starting action and length of time required to get up to full speed, the attendant gave them a clean bill of health. Diesels are unquestionably the type of prime power mover to have on the higher kilowatt capacities such as those under discussion, even though a diesel requires regular and conscientious maintenance to insure instant starting. A diesel is ideal for continuous, long hour periods of operation, but where intermittent and short periods of operation are the practice, they sometimes will exhibit the aggravating tendency of not wanting to start.

## CURTAIN ANTENNAS

The curtain antennas, now in the process of installation at Gloria will, when completed, represent the ultimate in short wave antenna design. The curtain antenna array of RARET consists of two rows of guyed steel towers, each row 2409.6 feet between end towers with the spacing between rows being 38.8 feet at the widest point. The array consists of a line of eight antennas and their reflectors. The antennas have been designed to operate in the 6 mc, 7 mc, 9 mc and 11mc band. The antennas for the two higher frequency bands are physically smaller than those for the lower frequency bands. The height of the antennas is a factor of the vertical radiation characteristics desired for the Lisbon to target paths. The electrical arrangement of the antennas is such that the flexibility of the transmitting plant will not be impaired. Any or all of the 50 kw transmitters may be directed toward any target zone on any of the four frequencies, separately or simultaneously. The antennas have reasonably broad banded characteristics. A sketch of one of the antennas is shown in Figure 5 with pertinent dimensions given in Figure 6. A curtain antenna, as compared to the rhombic, is considerably more expensive to erect. However, its performance over the rhombic makes its original cost well worthwhile.

It is understood there was, initially, some discussion as to whether four 50 kw transmitters would be provided for Gloria, or whether this number of transmitters would be reduced but the powers of the individual transmitters be increased to 100 kw. Doubling the power of a transmitter merely increases the power ratio by two, or 3 decibels (3 DB in radio engineering parlance). The increase in power is of course helpful, but from the ear response standpoint, the 3 DB gain is hardly noticeable. It has been stated by authorities that the average human ear cannot detect a power or signal level change of less than 2 DB. Increase in gain or radiated power can compara-



VERTICAL ELEVATION

RARET  
 Lisbon, Portugal  
 Curtain Antenna Dimensions  
 (Courtesy A. D. Ring & Co. Washington, D. C.)  
 FIGURE 5

**Lisbon, Portugal**  
**Curtain Antenna Dimensions**

		6 - 7 Mc Antenna	9 - 11 Mc Antenna
Height of Lower Radiator	(A)	69	43
Vertical Spacing of Radiators	(B)	77.6'	48.5'
Spacing of Element Wires	(C)	4	2.5'
Maximum Element Length	(D)	77.6'	48.5'
Line Spacing	(E)	2	2
End to End Radiator Spacing	(F)	5' to 15'	3' to 10'
Radiator to Reflector Spacing	(G)	38.8'	24.2'
Antenna Orientation	(H)	54°T	54°T

**Site Dimensions** - A rectangular plot approximately 2600' by 1000' is required for the antennas. The long side of the plot being oriented 144°True.

**FIGURE 6**

tively easily be obtained by the use of directional antennas. It was surely the preferred decision to have four 50 kw transmitters rather than a lesser number of brute force higher powered transmitters. It was preferable from almost every standpoint as increased flexibility of operations was obtained along with a reduction of initial and recurring operating and maintenance costs. With the four 50 kw transmitters, the possibility of operating on powers of 100 kw has not been sacrificed as two of these transmitters may be paralleled by diplexing thus making 100 kw powers available to RARET.

As stated above, directional antennas are designed and employed to concentrate all the radiated energy in one direction or beam. Directional antennas make it possible for the same frequency to be used at other stations by other interests and therefore effects a more efficient use of the radio frequency spectrum. A rhombic antenna will have or bring about an increase in power ratio of twenty-five times that of a non-directional antenna. This corresponds to an increase of 14 to 15 DB.

A curtain antenna has all the advantages of a rhombic, plus a very important additional advantage of being able to swing its beam to a certain extent. This moving of the beam is referred to as "slewing". A rhombic, after it is once erected, remains pointed in one direction and its beam therefore cannot be swung. A curtain antenna has the faculty of permitting its beam to be swung or slewed slightly, making it equal to two rhombics. At RARET one 50 kw transmitter will be assigned or worked into either one high band or one low band curtain antenna. Either of these curtain antennas may be slewed at will, giving the over-all effect of one 50 kw transmitter being assigned to four antennas of the rhombic type. A curtain antenna, compared to a rhombic, designed, factor for factor, will probably have a gain, over the rhombic, of 7 DB or a power gain of approximately five times.

Figure 7 and Figure 8 are maps of Europe upon which the Soviet satellite countries have been darkly shaded. Yugoslavia and Albania have been shaded, but somewhat more lightly. Yugoslavia is no longer considered as being under the influence of U. S. S. R., however its government is communistic and it and Albania, being in the twilight zone, can still stand some "treatment".

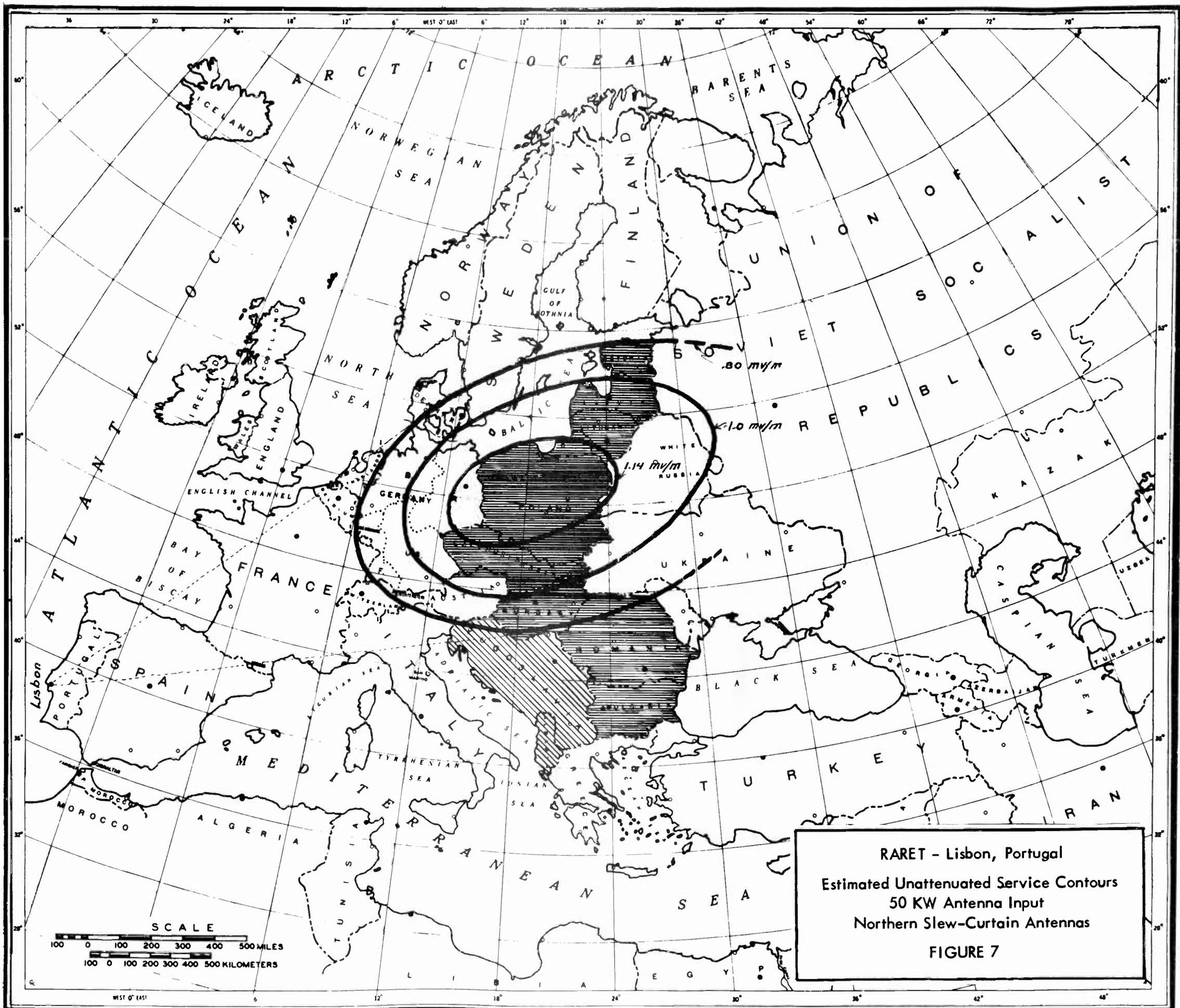
Figure 7 shows the coverage of a curtain antenna when put on the northern slew and Figure 8 shows the same curtain antenna's coverage when electrically switched to the southern slew. This instantaneous electrical slewing is a distinct advantage of the curtain antenna as it allows an increase in signal strength of approximately 3 DB, or double the power, over a given area. This is of importance when it is remembered that the target countries embraced by the north and south slews include a great number of different languages, particularly those in the south, where many languages are still alive but date back to countries which have not existed as separate entities for over thirty years.

NOTE: Figures 7 and 8 are merely representative and are not submitted in this report as engineering exhibits. The contours shown will vary for different frequencies. They will also vary for different times of the day and night, times of the year and periods of the sun-spot cycle. They will also be affected by magnetic storms.

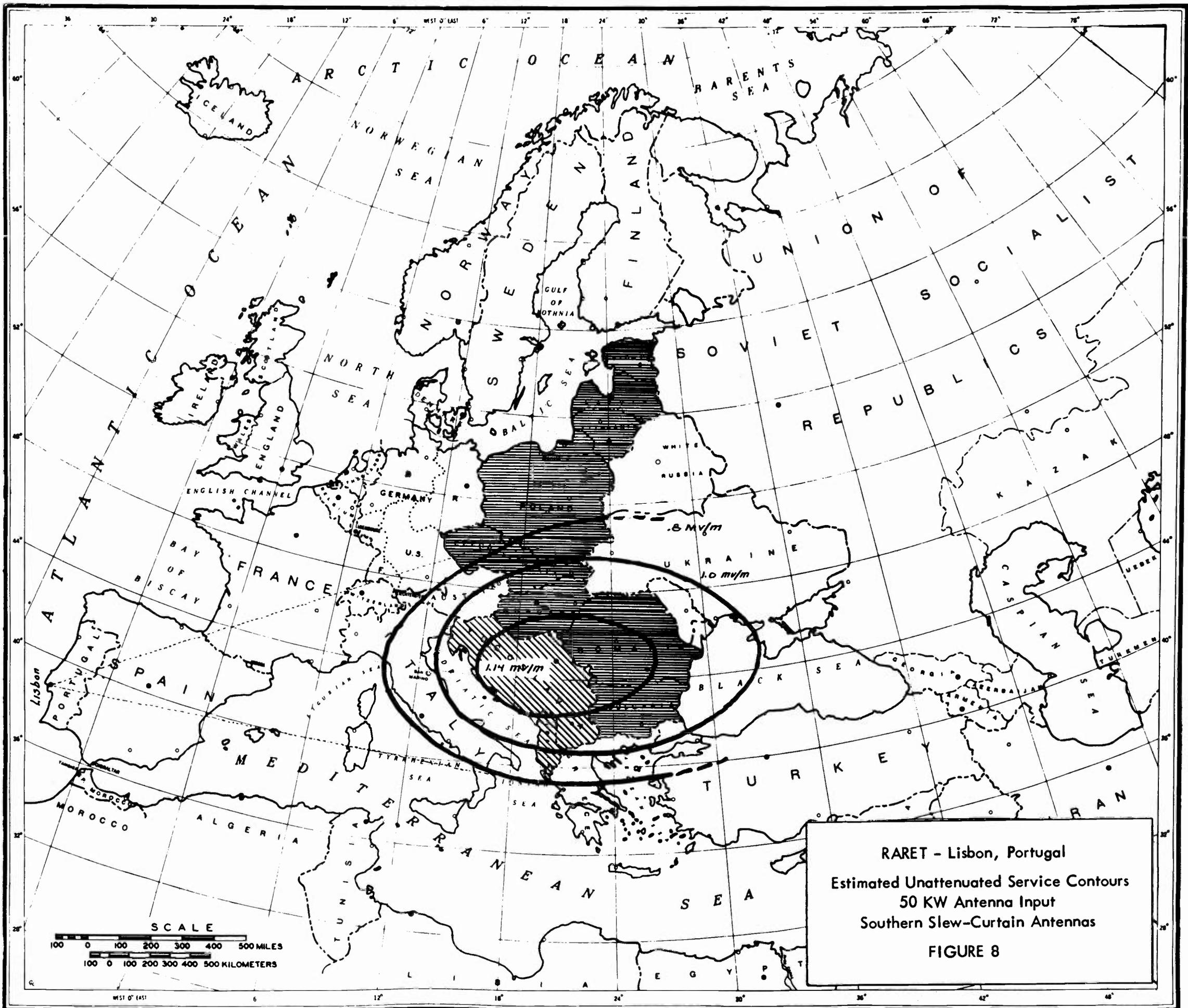
When the decibel gain of a RARET curtain antenna is added, it is found that it totals approximately 35 DB or a power ratio of at least 250 over what could be obtained from the transmitter operating into a non-directional antenna. The curtain antennas are the most practical and efficient means for increasing received signal strength and controlling the direction of the transmissions. Their employment at RARET is to be commended and their use is another indication that the management is acquainted with and governed by the dictates of good system's engineering practice.

The writer visited the Voice of America installation at Tangier, Spanish Morocco. The "Voice" has been a big user of rhombic antennas and have approximately twenty-five rhombics erected at Tangier. It is reported, from a reliable source, that the Voice of America is now changing or preparing to change over to curtain antennas at some of the points of its system.

The Gloria curtains are not completed. The Stainless Steel Company's towers have been erected and painted with tower obstruction lights mounted in place. The curtain wire and suspension cable



RARET - Lisbon, Portugal  
 Estimated Unattenuated Service Contours  
 50 KW Antenna Input  
 Northern Slew-Curtain Antennas  
 FIGURE 7



is on hand and it is believed all items for its erection are in stock with the exception of the special bronze fittings needed to clamp the curtain conductors in place. There was an error made in the shipment of certain types of these fittings and RARET is having substitute fittings made up locally (in Portugal). Replacement of the curtain winches is necessary as those delivered for the job are too light and badly underdesigned.

It was thought there could be detected a tendency to slack off on pushing of the erection of the curtains. The men at Lisbon have been working hard for the past year. They have done a remarkable job and it is only natural that now that the major part of the construction and installation is over they would feel inclined to want a change of pace. All four of the 50 kw transmitters are operating and they have four rhombics at Gloria, so perhaps it is felt there is no great need for the curtains. This tendency (if it does exist) to drag their feet a bit on the curtains is not new and is understandable. It has been experienced at other locations. The curtains should be completed and put into service as quickly as possible.

## CONSTRUCTION AND COSTS

The Portuguese construction diet consists of brick tile, roof tile, wall tile, cork, marble and plaster. This repertoire may sound limited but they do quite well with it. Their construction is fairly fireproof, intensely practical and, in general, makes considerable sense. Certain points of their building schemes would run into trouble with the building codes of our larger American cities and, on the other hand, some of their construction practices would be frowned upon by our American labor unions. In erecting the Gloria transmitter building, the writer was told that the Portuguese bricklayer laid 1400 bricks a day. With three shifts, the Gloria transmitter building was completed, broom-clean, in 46 days.

Upon entering the transmitter building, the first impression received is that of largeness. Its ceilings are high and the corridors and many of its rooms are finished in a glaring white plaster. The effect received from the high ceilings and hard white walls, coupled with the white marble floors, is one of hollowness. After the first impressions wear off and RARET's situation is reconsidered, the building and its accouterments take on a more rational status. This installation is about 35 miles from Lisbon and it is therefore necessary to make it entirely self-sustaining. The types of buildings erected were, to a certain extent, under the dictates and supervision of the Portuguese Government. The franchise agreement provides that the RARET installation will be turned over to the Portuguese Government after the expiration of a certain number of years, at an agreed price. The Government had some voice in determining what kind of buildings were going to be turned over to them.

While going through the construction period it was the smart thing to provide sufficient room for all contingencies and any foreseeable expansion probabilities. The transmitter building as well as the

rest of the buildings are of simple and plain construction. The main equipment room of the transmitter building has its floor and walls of cork. The use of cork helps to deaden the reverberation of the room. The cork finish is attractive and, being one of Portugal's chief products, was not costly. The corridors and rooms with the marble floors represent another instance where Portugal's home product was put to use. The specifications of construction called for metal air ducts for the transmitter cooling. It was stated that the contractor made the ducts out of marble as this was cheaper than the sheet metal. The marble used for the air ducts was unpolished and was composed of rejects from the quarry.

The transmitter building has an area of 1,382 square meters, or 12,438 square feet.

There was budgeted for the transmitter building 2,860,000\$00 or approximately \$98,620.00.

Money spent on the transmitter building up to February 29, 1952:

Construction	1,749,301\$00
Electrical	120,000\$00
Total	1,869,301\$00 or \$64,458.00

NOTE: Rate of exchange used is 29 Escudos to one U. S. dollar.  
Using 9 square feet to one square meter.

The cost of the transmitter building as of February 29, 1952, was \$5.20 per square foot. Based on an estimated average height of the transmitter building of 16 feet, the cube foot cost was \$0.32. It is probably safe to say the construction cost of this building in the United States would be three times the amount shown above.

In addition to the building and structures required for equipment purposes, RARET is providing living quarters for its Gloria personnel. These quarters are arranged in the following manner:

2 Type A houses. These are one-family houses. The house has

two stories and consists of a living room, den, dining room, three bedrooms, kitchen and bath.

4 Type B houses. These are also one-family houses of two stories and are the same as the Type A with the exception that the den is omitted and the rooms are generally smaller.

10 Type C houses. These are two-story, two-family houses about the same as Type B with the exception that they are slightly smaller.

B. O. Q. (Bachelor Officers' Quarters) This is a two-story dormitory-type building. There will be provision for five women on the first floor and accommodations for nineteen men on the second.

The total housing project will take care of 26 families and 24 single persons.

The Type B house has a floor area of 10 meters by 9.2 meters on each floor and the total floor area is 184 square meters or 1,656 square feet.

Money budgeted for the four Type B houses is 858,000\$00 or \$29,586.00. As of February 29, 1952, the charges against each of these houses were as follows:

Construction	195,700\$00
Electrical	13,860\$00
Electrical Extras	1,378\$00
Water Heating	<u>2,489\$00</u>

Total	213,427\$00	or	\$7,359.00
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The cost of the Type B house per square foot as of February 29, 1952, was \$4.44. On an estimate of a 9 foot ceiling height, the cubic foot cost was \$0.49.

None of the homes listed above is completed and it is estimated it will be May 15, 1952 before families will be able to occupy them.

As previously stated, a short trip to Tangier was made and while there, the Voice of America property was briefly inspected. The Tangier "Voice" installation was built under the supervision of the U. S. Navy. The cost of the "Voice" structures per square and cubic foot is not known, as are the conditions connected with its design. It is a safe guess, however, that the "Voice" costs ran considerably higher than those of RARET.

It is believed that most of the operating people of the Voice of America at Tangier are Americans or Englishmen. The "Voice" does not supply or provide living quarters for its personnel and leaves this problem up to the individual employee to solve. The VOA runs busses, at periodic intervals, between the city of Tangier and its plant, located some miles out of town. In talking with two of the engineers, they both said they were happy and preferred that arrangement. One expressed his feeling by saying, "I don't want anyone telling me where I have to live!"

The situation of RARET at Gloria is not comparable to the VOA at Tangier. Gloria is 35 miles out of Lisbon and there are no nearby towns that offer acceptable housing facilities. If busses were run from Lisbon to Gloria, the employees would have to spend two and one-half hours a day travelling, either on their own or RARET's time. American employees will probably be more difficult to satisfy than the Portuguese. Regardless of nationality, all employees are human. The good that RARET is attempting to do in providing the communal housing can be lost sight of. The employees grouped together at Gloria may find their lives becoming monotonous. RARET may have to give some thought to the industrial or employee's relationship aspect of the Gloria operation.

every technical phase of the Lisbon installation. All of the actual costs, or up-to-date costs, were about in line with what would be expected but he was impressed by what appeared to be the rather high original budgeting or estimating figures. In some instances the estimated cost of a project was just about twice what the actual cost proved to be. Working in a foreign country where so many unknown factors may exist justifies conservative estimating but from here on it might be expected that future estimates come a little closer to the target.

## ACCOUNTING

The remarks to be made here are hardly of sufficient importance to be given a heading, or even included in this report.

In making inquiries as to the cost of certain construction, rental of space, etc. some very brief contact was had with a few members of the Administrative Division at the Lisbon studio location. In asking questions as to the cost of specific projects, there was brought out for inspection a card index file which is used to segregate the various items of cost in accordance with numbered accounts, set up to conform with the accounting procedure as established. The cards are maintained with the entries being made in longhand with the total expenditures against the project being brought up to date as of the end of each month. While the writer was not able to read or interpret many of the entries, the person in attendance with the card file was able to, almost immediately, give intelligent and proper answers to the questions asked. (This was done in spite of the handicap of the language barrier.)

It is understood that N. C. F. E., R. F. E. and therefore, RARET, being non-profit organizations, operate tax-free. The statement was made at Lisbon that all expenditures were capitalized. There were entries in the accounting records which referred to temporary construction, temporary use, rented facilities, or other items of an expense nature. Upon asking whether these items were carried in an "expense category" and were deducted from the "capital account" the answers received were rather vague and somewhat on the fuzzy side. At the accounting level upon which the discussion took place it was believed the people did not know what was meant nor did they appreciate the rather fundamental distinction between the two accounts.

It is not the purpose of these few paragraphs to question the

accounting of RARET. The writer is not qualified to do so. His 30 years experience with a large corporation has given him a high respect for accounting, regardless of how distasteful the subject may have been through the years. The men at RARET have done a magnificent job in the construction and provision of the extensive facilities. In doing this work, large sums of money have been expended in a very short time. All credit is due to the organization. Nevertheless, the impression was received that perhaps some of the records, or at least some of the accounting history, was still stored in the minds of the department heads in the organization. Time passes rapidly and memories cannot always be relied upon. Personnel changes occur in any organization. It is not known what the future holds for RARET. In years to come it may be desirable or necessary to go back over the cost history of the plant, using a fine tooth comb, in an attempt to prove some presently unforeseen point. In this event, clear-cut records, rather than memories are to be preferred.

## SAFETY

The combined operations of the studio, receiving site, "Barbara" transmitter and the main transmitter, represent a comprehensive layout and will involve the services of many different types of individuals. During the months to come the personnel conducting these operations will run the gamut of emotions ranging from dullness caused by the drabness of boredom to moments of thoughtlessness occasioned by unexpected emergency pressure. Under these conditions, accidents may occur and this possibility should be kept in mind.

The types of accidents likely to occur at the studio and receiver locations may be classified as being similar to those which might be anticipated or experienced in the home or any light-industry plant. The usual industrial medicine cabinet and the prominent posting of a doctor's telephone number are considered to be adequate protection.

At the "Barbara" transmitter and the main transmitter, the personnel is subject to more serious accidents, namely, those due to electric shock. Medical facilities comprising a rather fine first aid room, together with a staff of doctors and nurses, is being made available at Gloria. Plans are also under way to prepare a safety manual for RARET. It is hoped that as soon as possible the transmitter crews will become acquainted with the Prone Pressure method of artificial resuscitation and regular drills in this method will be instituted.

Burns resulting from contact with radio frequency circuits will be first, second or third degree burns and can be treated by the nurses or doctors. Electric shock, resulting in unconsciousness and caused by contact with circuits carrying voltages up to approximately 600 volts, AC, very frequently results in death even though every effort is made to save the victim. Under these conditions, the heart is put into ventricular fibrillation (spasmodic flutter) and artificial resus-

citation will not help. The chances of recovery from solid contact shock with the voltages in the lower range are rather low, probably not more than ten to fifteen percent.

A type of electric shock frequently encountered in radio transmitting plants is that caused by contact with high voltages, particularly the high voltage bias or plate supply circuits of the transmitter. In these instances the immediate application of the Prone Pressure method of artificial resuscitation is of paramount importance. Case histories of radio stations and public utility installations in the United States indicate the chances of recovery from this type of shock, when the Prone Pressure method is immediately and properly applied, will be relatively high, or about eighty-five percent.

In the United States the Red Cross gives courses in first aid and many radio stations encourage, or even require, their transmitter crews to take this course. The small expense of the course is paid by the station. If any similar course is available in Lisbon, it is suggested the transmitter crews of RARET be encouraged to take it.

## PUBLICITY

It is not known what the National Committee for Free Europe's attitude is toward publicity concerning its activities overseas. It is known, however, that the average American's knowledge of the splendid work the Committee is doing is meager, to say the least. It is quite possible the Committee is purposely not publicizing its work.

The operation of Radio Free Europe, both in Munich and Lisbon, together with the results which are being obtained, would seem to be a publicity gold mine and offer an excellent vehicle for feature stories of the Reader's Digest, Saturday Evening Post, or Collier's caliber. There is unquestionably a wealth of story material available at both of these locations. A number of stories could be written about certain individual members of the staff. For example, Henry C. Lolliot, is a one-man international organization by himself. His experiences in the Pacific area, his internment in a Japanese prison camp, his work in Germany, culminating in the wild, four-day, 1,600 mile ride across Europe to meet "Barbara" at the Lisbon docks, and the original establishment of RARET's first "Barbara" transmissions, July 4, 1951. All of these experiences would make interesting reading. George Caesar can provide many anecdotes and commentaries in connection with his work at RARET. The extensive and varied engineering work, planned and performed by Bill Cipperly, simply could not have occurred without automatically forming the basis for many a yarn. Kenneth Owen can give a serious but enlightening account of the complexities of international broadcasting together with the difficulties encountered when attempting to disentangle the interlaced ambiguities of the international frequency assignments as they exist today.

## SUMMARY

The summary of the RARET installation can be made in a few words. The whole undertaking has been accomplished and become a working reality in an almost unbelievably short time. The quality and performance of the work completed is first-class and the funds expended are probably below what would be considered normal.

The men in charge of the operation are competent. They know what is expected of them and attack their work with energy and zest.

The spirit of the organization transcends anything heretofore witnessed. The whole group thrives under pressure. It is proud of RARET and the work it is doing.

The men at Lisbon have more work to do. Gloria must be completed and all the loose ends put in place. The studios will have to be put in shape and the arrangements for the additional language broadcasts must be perfected. At the rate they are going, another six months will make a big difference in the appearance of the physical properties and the work load of the facilities.

The future holds new experiences and new problems. The personnel of RARET will look upon these future problems as new opportunities to demonstrate its ability and prove its worthiness of the trust which Radio Free Europe and the National Committee has placed in it.