

# THE DEVELOPMENT OF AIR TRAFFIC AND THE USE OF AIR RADIOBEACONS BY SHIPS

by Captain (R) Jean DUPONT, French Navy

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The development of world air traffic has resulted in a considerable extension of radio aids to navigation available for aircraft.

Whenever these *radio aids* are situated near the coast and transmit on frequencies similar to those used by ships and by the marine radiobeacon and radio-direction-finder network, they can be useful in marine navigation.

1. — All books of radiosignals published throughout the world for the use of navigators include, in addition to marine radiobeacons, a list of the principal air radiobeacons which operate on mean frequencies near the coast and which may prove useful for surface navigation.

The number of stations and the information given regarding their operation differ according to the country issuing these publications, but instructions for use are similar and often fairly restrictive.

In a book covering the whole world the amount of information thus furnished is sufficiently large to warrant the definition of a policy of selection, with due regard to the suggestions of those concerned and to developments in air navigation.

2. — The navigational problems that must be met by planes flying at high altitudes at great speed are certainly very different to those encountered at sea.

It is a well-established fact, however, that marine radiobeacons are also used by aircraft.

The question was how far the converse was true for ships, to try to determine, at the level involved, the value of information to be derived from a fully developed system, covering in particular regions where marine radiobeacons are rare or non-existent.

3. — A brief recapitulation of the principal characteristics of air radiobeacons will permit a better definition of the problem.

Radiobeacons transmitting on mean frequencies in accordance with regular schedules or at the request of aircraft may be classified in two categories :

- a) Circular radiobeacons (N D B) (\*)
- b) Directional radiobeacons (R N G) (\*).

(\*) These abbreviations are those contained in the information manuals entitled *En route* (French aeronautical publications).

a) Circular radiobeacons, which are the most numerous and powerful, transmit a radiosignal in all directions.

Usually this signal is limited to transmission in Morse code, followed by a long dash.

b) Directional radiobeacons transmit a radiosignal defining two axes, used in the *homing* of aircraft.

This radiosignal generally consists of a long continuous dash in four small sectors of about 3°, and by the letters A (·—) or N (—·) in the four large sectors separating the preceding sectors.

It should be stated that the radiated energy is not the same in all directions, particularly the horizontal.

Most directional radiobeacons transmit their call signal in Morse in all directions every minute. They tend, moreover, to be replaced by very-high-frequency radiobeacons.

4. — The general operation of air radiobeacons does not differ notably from that of marine radiobeacons, but these radio aids, established near airfields, are usually located some distance from the coast in the cases which affect us.

The path of the waves may deviate on crossing the coastline, even if the distance covered over land is relatively small, and particularly over an area showing marked relief (\*).

The most frequent errors arising from irregularities in the propagation of radio waves have been studied in connection with marine radiobeacons.

With due regard to the remark made above, the general precautions to be taken are the same in both cases, all things being equal. The following is a brief summary :

a) Avoid taking observations one hour before or one hour after sunrise or sunset.

b) Be careful in the interpretation of results obtained at night, when, in particular, differences in range can occur to a marked degree.

c) Make sure that the bearing does not cut the coast at an angle less than 30°.

d) In the case of air radiobeacons, remember that if the bearing crosses a hilly region large errors (sometimes more than 5°) can occur.

5. It should also be pointed out that circular air radiobeacons transmit for the most part on continuous non-modulated waves (A 1) and that the directional radiobeacons transmit on continuous modulated waves (A 2).

Existing radio direction finders can receive equally either of the two types of transmission.

6. — The preceding recapitulation explains to a certain extent the cautionary remarks made above, and it was believed that the use of air radiobeacons by ships enabled at most a check on the information given by the system of marine radiobeacons or other methods of navigation.

(\*\*) This problem hardly ever arises in the case of aircraft flying at high altitudes.

Moreover, it is only fair to add that information supplied for air radiobeacons is usually much less complete than that given for marine radiobeacons.

The reason is fairly simple :

Although the Hydrographic Offices are kept regularly informed of the modifications or additions reported by the Aeronautical Services of their own countries they are, on the other hand, much less well acquainted with those in other countries (\*).

This information reaches them through Notices to Mariners, naturally after some delay which must be regarded as normal since the ships only use for their own benefit installations which are not intended for them.

7. — The only valid method of obtaining precise information about the use of these radiobeacons was to ask those who used them what their feelings were on the subject.

An enquiry was therefore conducted with French navigational companies.

Information supplied by fishing and yachting groups would have been extremely useful, but the volume of replies might have overshot the desired goal.

Since in any case the ships consulted possessed the most modern and complete equipment, it would then be possible to extrapolate the results obtained for less well equipped vessels.

With great goodwill and remarkable *esprit de corps*, three hundred French ship captains, sailing on commercial routes, have been kind enough to send us their opinions.

### RESULTS OF THE ENQUIRY

8. The questions asked were as follows :

- 1) Have you had the opportunity of using air radiobeacons :
  - a) which operate continuously ?
  - b) whose operation by *request* was caused by you ?
- 2) In the affirmative :
  - a) were the results obtained satisfactory ?
  - b) when obtained, was operation obtained easily ?
- 3) In zones already covered by marine radiobeacons, do you consider that air radiobeacons are of interest to navigators ?
- 4) In zones not provided with marine radiobeacons, do you consider it useful to have more complete information on air radiobeacons ?

(\* ) Although world documentation on air navigation is as complete as for marine navigation, adequate implementation by hydrographic offices is difficult owing to its volume and the necessity of selection.

In addition, and even though the tendency is towards stabilization, changes in time schedules and even characteristics are more frequent for air radiobeacons than for marine radiobeacons.

It is for this reason that people normally follow information given in the Notices to Mariners of each country.

9. — The replies were as follows :

Total replies : 300.

Question (1) :

a) 270 yes 30 undecided;

b) 2 yes 290 no.

Question (2) :

a) 250 yes 50 undecided;

b) no vote taken (see question (1) b).

The replies to questions 3 and 4 are not so easy to classify, so in analysing the results the general trend only is given.

It may, however, at this stage be pointed out that several of them underline the interest presented by radiobeacons and that the great majority of ship captains would like to have available a maximum amount of information, especially as concerns positions, times of transmission and range.

Thus, in a total of 300 replies :

90 % claim to use continuous air radiobeacons;

80 % consider the results obtained satisfactory with certain qualifications.

On the other hand, although 10 % of ship captains hardly use these radiobeacons, 10 % have been particularly enthusiastic about the results they have obtained (\*).

10. — We shall now try to analyse the significance of the preceding figures, taking into account the shades of opinion and remarks already expressed.

A. In the first place it was discovered that ships only use continuous air radiobeacons (or at least those which function in a continuous manner according to strict time schedules), but that radiobeacons which only function on request are never used (apart from the odd exception).

There are two reasons for this :

a) Captains make it a rule never to call on radiobeacons reserved for aircraft, thus avoiding interference with air traffic;

b) In addition, calling frequencies are not usually included in the ranges of waves used by ships, unless a *naval* coastal station is able to act as a relay.

B. Circular radiobeacons are always preferred to directional radiobeacons, which are hardly ever used and will probably be replaced eventually by high-frequency transmitters.

Less powerful than the circular radiobeacons which frequently exist nearby, directional radiobeacons determine axes of navigation whose azi-

(\*) These figures have been rounded off in order to present the general trend as exactly as possible without complicating interpretation.

muths do not always correspond with the needs of ships, and propagation at ground level does not give very good results.

An example may be cited of the case of a ship captain who, arriving at Tunis, anchored in La Goulette roads in fog, used the circular radiobeacon of El Aouina, and declared himself very pleased with the results.

No mention was made of the directional radiobeacon located in the same area.

C. As regards the value of the results obtained, the following qualities are emphasized :

Continuous or semi-continuous circular air radiobeacons are :

- Powerful and clear;
- Easy to get a bearing on;
- Ranges generally exceed 200 miles, and are definitely longer than those of marine radiobeacons;
- They are not jammed by Consol beacons;
- Their frequencies are well separated.

On the other hand, the influence of the relief can sometimes give rise to important errors, and irregular readings are also obtained at night in certain regions.

D. One ship captain underlined the interest held by these radiobeacons for yachting.

E. Numerous captains have requested that some of these radiobeacons be marked on French charts, and claim that certain foreign countries have been doing this for some time.

11. — From the total response the following conclusions may be drawn.

— Continuous air radiobeacons, or those which operate for known and specified periods, are useful, even in areas already covered by marine radiobeacons, because their range is frequently longer and they are convenient to use (especially in making landfall).

— They enable useful checks in the areas we have just discussed.

— In certain parts of the world air radiobeacons are the sole radio aids to navigation and, as such, are held to be invaluable provided that their operation is continuous or semi-continuous.

— Directional radiobeacons are practically never used.

The French Hydrographic Office intends to furnish maximum information on continuous and semi-continuous air radiobeacons, showing in particular :

- Operational schedules when known;
- Range or power.

This is already the policy in certain countries where in principle only continuous air radiobeacons are shown, and in this case information similar to that given for the marine radiobeacons is supplied.

The elimination of directional radiobeacons will continue progressively, beginning with those located near circular or marine radiobeacons, and retaining only those which are isolated from any other radio aids to navigation.

The insertion of air radiobeacons on the charts poses fairly complicated problems, because certain of these may be moved without urgent warning other than to the Aeronautical Services.

This question is at present being studied, and the possibility might be considered of showing only the most important and stable of these radiobeacons on the charts, due attention being paid to their range, and especially to the existence or non-existence of marine radiobeacons in their vicinity.

#### ANNEX

The following regions are those where air radiobeacons appear most useful and give satisfactory results :

- North Sea;
- French Coast;
- English Coast;
- Spanish and Portuguese Coasts;
- Balearic Islands;
- Egyptian Coast;
- Algerian, Tunisian and Moroccan Coasts;
- Azores, Cape Verde Islands;
- African Coast;
- Madagascar;
- Arabia, Persian Gulf;
- Red Sea;
- India;
- Australia;
- Canada;
- United States of America;
- Mexico;
- Central America;
- South America.

*Note.* — This information naturally reflects the distribution of the main commercial routes travelled by French shipping, and is not limitative.