4/22/6/4

April Nov
1943 - 1944

ORIGINAL



9 RADAR DETACHMENT

MISCELLANEOUS DOCUMENTS

~~INCLUDING BRIEF HISTORY~~

Appendices

9 AUST. RADAR DET. R.A.A.

3 Nov. '44

HQ 1 Aust. Army.

9 AUST. RADAR DET. R.A.A.----BRIEF UNIT HISTORY.

| | |
|---|---|
| 28 Jun 43. | Unit formed in Brisbane. Under command of HQ Coast Arty. Brisbane. |
| 30 Jun 43. | Moved to Moreton Is. Q'land. Set established at Cape Moreton. Set not in action since Ordnance were not able to supply all the components. |
| 23 Jul 43. | Set in action. |
| 7 Jan 44 | Unit relieved by 14 Aust. Radar Det and moved to 1 Aust. Personnel S Staging Camp, Brisbane for movement to N.G. |
| 4 Feb 44. | Marched into 13 Aust. Personnel Staging Camp, Townsville . |
| 13 Feb 44. | Unit embarked. |
| 19 Feb 44. | Unit disembarked at Lae. |
| 4 Mar 44. | Set in action on Mt. Lunamun Lae. Reports passed to "N" Hy Bty and RAN Lae. |
| 22 Jun 44. | Unit released from operational role and warned for movement to mainland. All equipment returned to Ordnance. |
| 3 Aug. 44. | Movement to mainland cancelled. Equipment redrawn from Ordnance. Set to be reerected for training purposes when site was allotted by RAN Lae. |

Unit on Moreton Is for 6 months. Time in operation 4¼ months. (1491 operating hrs)

Unit at Lae for 9 months. Time in operation 3½ months. (1428 operating hrs).

R M Lazzarini .....Lieut.
O.C. 9 AUST. RADAR DET. R.A.A.

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ANOMALOUS PROPAGATION WITH CD RADAR.

9 Aust. Radar Det. R.A.A.

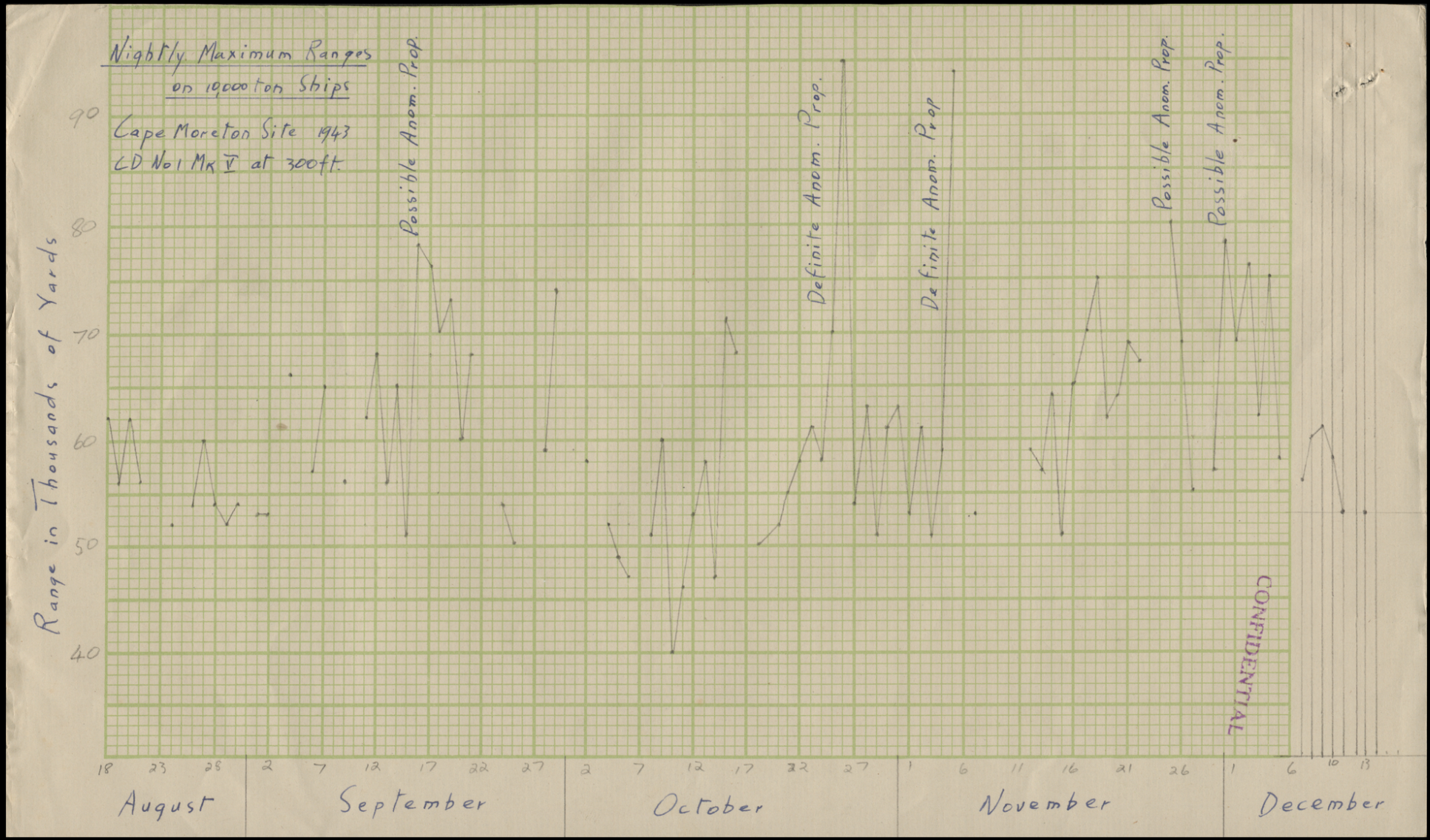
24 Nov. 44.

This unit has been on two operational sites, Cape Moreton, Moreton Is. Q'land from July 43 to Dec 43 and Lae NG from March 44 to June 44. On both sites a close watch was kept during the normal nightly operation for any instances of anomalous propagation. At Cape Moreton three definite and two probable occurrences were noted whilst at Lae only one doubtful instance occurred. It is understood that 6 Aust Radar Det. who were in operation at Milne Bay from June 43 to Dec 43 and at Finschhafen from Mar 44 to Jun 44 also did not observe any definite examples.

This experience of a years' operation in New Guinea indicates that anomalous propagation is very rare in the tropics and the general meteorological considerations appear to confirm this view.

The frequency of occurrence of anomalous propagation at each site can be best shown by an analysis of the performance of the set, over a period, on vessels of the same size. This has been done by drawing a graph for each site which shows the maximun range observed each night on 10,000 ton ships. The maximun, rather than the average range was chosen to reduce to a minimum such factors as the human element on the part of the operators in obtaining good ranges, and variations in the efficiency of the set. (The importance of the human element is shown by the fact that 30% of the operators of this unit have developed defective eyesight). These factors appear to be the main cause for the considerable scatter in the results recorded. The maximum scatter about the mean range due to these factors is approximately 10,000 yards above and below, and it is reasonable to assume that any greater deviations from the mean are due to anomalous propagation. In addition to these graphs, tables are appended showing all the ranges obtained on 10,000 ton ships for each night. These results may be worth statistical analysis.

Comparison of the graphs for the Cape Moreton and Lae sites, (which were both 300 feet) shows a marked difference, there being much greater scatter of the ranges recorded at Cape Moreton. This discrepancy may be due to some extent to the fact that two different sets were used, a CD No 1 Mk V at Cape Moreton and a CD No 1 Portable (Aust) at Lae, but this is not considered likely. From the operators point of view it would be expected that the ranges obtained with CD No 1 Mk V would be more consistent since this set has a better time base, is more reliable and generally easier to operate. The accuracy of this set at long ranges is not quite as good as



Nightly Maximum Ranges on 10,000 ton Ships

Lae Site 1944

CD No1 Portable (Aust) at 300ft.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that of the Australian set, but this would have very little effect on the scatter. The same team of operators was used on both sites.

However there is little doubt that the greater scatter of the Cape Moreton results is caused by fairly frequent anomalous propagation particularly as the larger deviations are all above the mean. The most definite examples stand out as peaks in the graph. More striking ranges and possibly more examples of anomalous propagation might have been obtained had it not been for the fact that the time base of CD No 1 Mk V only extends to approx. 95,000 yards. The Lae results appeared to be quite unaffected by anomalous propagation except in one doubtful case on the night of 20 Oct 44. when an echo was picked up at 80,000 and followed to 83,000 yards when it disappeared. This may have been a freak echo. The timebase of the Australian set extends to almost 200,000 yards.

A request was made by this unit to the Directorate of Meteorological Services RAAF for information concerning the meteorogical factors in operation on each of the four most outstanding examples of anomalous propagation at Cape Moreton. This information was published in RAAF Research Report List No 2, Section IV, Series 10, No 19 dated 4 Aug. 44. A comparison of the observed radar effects with this meteorogical analysis is set out below and an attempt has been made to designate the causative factor in each case.

A. Night of 26/27 Oct. 43:

This was the most outstanding occasion. 2 Convoys and 6 vessels were logged during the night. Abnormal conditions were noticed when the set was switched on at 1830 hrs and continued until approx. 0200 hrs when conditions reverted to normal during approx. 30 mins. All the shipping except one vessel was logged during the abnormal period, At 0400 hrs this vessel was picked up at 55,500 yards (normal pick-up). Pick-up ranges were as follows :

(1) a 200 ton vessel (normal range approx. 30,000 yards) at 63,000 coming from S.E.

(2) a convoy (normal range approx. 60,000 yds) at 88,000 coming from NNE.

(3) an unidentified ship at 88,000 coming from NNE.

(4) a 400 ton vessel (normal range approx. 35,000) ~~going SE~~ at 78,000 from SSE In addition a 500 ton vessel (normal follow range approx. 35,000) going SE was followed off the end of the time base (i.e. approx. 95,000). S/N when lost was 2/1. A convoy (normal follow, range approx. 60,000 yds) going NNE was also followed off the end of the time base. [S/N when last seen was 2/1.]

Abnormal conditions were also noticeable from the strength of the fixed echoes as well as from the shipping ranges. During the abnormal period all the fixed echoes, both within and beyond optical range, were increased. In particular a reference fixed echo bg 190 degs, range 35,000 (a section of the eastern coast of Moreton Island) the S/N of which was normally 2/1, was increased to 4/1. During the transition period between 0200 and 0300 hrs the fixed echoes became normal.

SIGNAL TO NOISE RATIO

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The meteorogical analysis of this situation discloses that at 2100 hrs a cold front passed over Cape Moreton and by 0300 hrs was about 90 miles to the NNE. However it appears that the conditions of temperature and humidity at the frontal surface were hardly sufficient to cause downward reflection or refraction of the radar radiation. It seems more likely that the abnormal ranges were caused by the duct of dry air streaming over the sea before and behind the cold front particularly in view of the fact that abnormal propation was observed from 1830 hrs i.e. 3 hours before the cold front passed over. The height of the duct was 700 ft at 1500 hrs and 159 ft at 2100 hrs. By 0300 hrs it had virtually disappeared. This duct probably had the effect of concentrating part or all of the radiation below its upper surface and thus increasing the field strength of the radiation close to the surface of the sea at the expense of useless radiation distributed well above the sea. This would account for greatly increased radar sensitivity at ranges less than the radio horizon and also at ranges beyond the horizon, particularly if the duct extended over the horizon.

B. Night of 5/6 Nov. 43. :

By this date a 150,000 yard time base had been added to the set. No shipping was logged before midnight but shortly after midnight a convoy (normal pick-up range 60,000) coming in from SE was picked up at 94,000. The S/N ratio increased rapidly to 4/1 then decreased gradually and the echo faded out at 81,000. The convoy was picked up again on the same bearing at 55,000 (S/N 3/2) and followed in to port.

Several other vessels were logged subsequently but the ranges were all quite normal.

..... .....

The meteorogical analysis proposes three possible causes the first of which, a duct fromed about midday and dissolved in the late afternoon, is eliminated by the time factor.

The third effect mentioned, a coastal psuedo front, is also eliminated by the time factor since it had probably been dissolved by midnight. Moreover it is indicated that the front would probably not extend far out to sea.

The second effect suggested appears very likely to be the cause of the abnormal propagation. A cold front lying NW-SE had passed over Cape Moreton at approx. 1400 hrs, and at 2100 hrs and 0300 hrs was 80 and 100 miles respectively out to sea with the frontal surface sloping back to 5000 ft over Brisbane. The temperature and humidity gradients at the frontal surface were possibly sufficient to cause downward reflection of the radiation which would certainly be at almost grazing-incidence. It may be assumed that this was the case and that some radiation normally distributed high above the sea was reflected down to the surface of the sea and formed an area between 81,000 and 94,000 yards from the set in which the field strength was comparatively high. In the area between 81,000 and 55,000 yards the direct radiation over the sea was of-insufficient field strength to give a detectable echo since it was reinforced by little or no radiation from the reflecting surface.

An important point arising from this observation is the fact that this skip distance phenomenon may be an indication that the causative factor is a normal frontal surface. It is hard to visualise a radar duct causing this peculiar distribution of field strength and it is understood that a coastal psuedo front would not normally extend far enough out to sea.

C. Night of 25/26 Nov 43.

Several vessels were logged during the night but only two of the ranges were abnormal and these occurred at approx. 0200 hrs. One vessel was picked up at approx 95,000 and the other at 76,000. In the latter case the S/N ratio was 3/1 when the vessel was first picked up. Neither of the vessels was identified.

On this night also faint side lobe echoes were picked up from a vessel at 19,000. These occurred 15 degs on either side of the main echo. Such side lobe echoes were only observed on two other ocassions on this site. It is possible but not likely that on this occasion the abnormal conditions may have been responsible for the pick-up.

.....

The meteorogical analysis reveals that a cold front lying NW-SE passed over Cape Moreton at 2100 hrs and at 0100 hrs it had moved 100 miles out to sea. This front is very likely responsible for the abnormal propagation. A possible radar duct which formed before the advent of the front is eliminated by the time factor,

It is considered that there was sufficient discontinuity of the temperature and humidity gradients at the frontal surface to cause downward reflection of the radiation so it is reasonable to assume this was the cause of the abnormal propagation.

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D. Night of 30 Nov/1 Dec 45.

This ocassion is not very definite from either the radar or the meteorological viewpoint.

Several vessels were logged during the night of which only one was picked up at an abnormal range. This vessel was picked up at 78,000 and it is reported that the echo faded out, was picked up again on the same bearing, faded out again and was finally picked up and followed in. Unfortunately exact details are not now available. This effect may possibly have been caused by variations in set sensitivity.

It is evident from the above account of the observed radar effects that the only indications to the operator of the existence of anomalous propagation are (1) Unusually great ranges on large ships and sometimes also on small ships whose pick-up range is normally less than the horizon range.

(2) The fading effect (as in instance B above) when an echo picked up at an unusually great range fades out and then reappears at the normal pick-up range.

(3) Unusually good reception of fixed echoes. Generally this applies to fixed echoes beyond optical range but sometimes may apply to those within optical range. This method does not give as definite and reliable an indication as the first two. It seems likely that abnormal propagation can obtain in one direction only at any one time and not necessarily over the whole of the arc of search.

Anomalous propagation is known to cause decreased, instead of increased ranges on some ocassions, for example when a radar duct is formed with its base above the sea surface. Definite examples of this are difficult to obtain since many instances of poor ranges recorded are probably due to lowered set sensitivity or bad operating. However one possible indication of the existence of anomalous propagation in this connection is the fact that sometimes the signal strength increases with

decreasing range much more rapidly with a bad pick-up than with a normal one. Similarly when a ship is followed to a much shorter range than normal the signal strength drops very rapidly as the ship passes out of range. In the four cases given b below the set and the operating were checked and can be ruled out as causes of the bad ranges.

Cape Moreton : (1) 19/20 Sep 43. A vessel passing port was picked up at 46,000 yards (bg.144 degs) and followed to 62,000 yards (bg.014 degs)

(2) Approx. 0500 hrs on 7 Oct 43. A 20,000 ton liner (normal pick-up range approx.75,000 yards) was picked up at 47,000 yards.

Lae : (3) 16/17 Apr. 44. A convoy passing port was picked up at 24,000 yards (bg. 120 degs) and followed to 47,000 yards (bg. 145 degs) approx. 1½ hours later.

(4) Approx. 0500 hrs on 29 Apr. 44. An 800 ton tanker (normal pick-up range 35-40,000 yards) was picked up at 27,000 yards (bg. 130 degs). The S/N ratio when the cho was first picked up was 4/1 but the vessel was not previously visible on the screen.

A point of interest would be to detremine whether the three causative factors mentioned in the RAAF report were in operation on any nights on which there was no evidence of abnormal propagation. Many nights could be selected from the tables attached on which the shipping ranges recorded indicate that conditions were quite normal. If it is found that the favorable meteorological factors often occur on such nights it may indicate that there are further factors necessary to cause anomalous propagation. This may be of particular interest in regard to the Lae site.

ATMOSPHERIC EFFECTS :

Atmospheric echoes are frequently picked up and have been detected as far as 150,000 yards. They are always assumed to be from rainstorms but is possible that they are sometimes caused by other atmospheric phenomena such as clouds, thunderstorms, frontal surfaces etc. On one ocassion at Lae an echo of S/N 5/1 and similar in appearance to a rainstorm echo was observed from a heavy rain cloud at a height of approx. 300 ft at 8,000 yards. There was definitely no precipitation from the cloud.

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Although rainstorms always give echoes there appears to be very little diminution of the radiation passing through them since there is never any noticeable decrease in the strength of the ship or fixed echoes directly behind them. It seems likely that a rainstorm, which may be regarded as an isolated column of saturated water vapour, can cause refraction of the radar radiation in the horizontal plane. Thus, depending on its shape, it could act as a lens or prism. In the latter case bearing errors may be caused but these would probably be negligible. In the former case an increase in field strength may occur behind the rainstorm due to the lens action. This appears to be borne out by the following instance. A ship passing port which had been picked up at 44,000 yards was being followed out when a very heavy rainstorm intervened between the set and the ship. The strength of the ship's echo increased and it was followed as far as 57,000 yards. The height of fixed echoes behind the rainstorm was also increased.(Lae 25 May 44).

It seems possible that low clouds might cause some upward refraction of the radiation but this should not affect the performance of these sets on shipping.

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# ESTIMATION OF SIZE OF VESSEL WITH CD RADAR EQUIPMENTS.

9 Aust. Radar Det. R.A.A
28 Jul '44.

(1) CD Radar sets can be used to give rough estimates of the size of the vessels picked up. The method used consists in comparing the relation between the range and the strength of the echo with a calibration chart previously made for the particular set and site. Normally the echo strength increases as the range to the vessel decreases. Operations Research Group Report No 74 (LHQ SM 3696) outlines two methods of expressing the strength of the signal; firstly as the signal to noise ratio, and secondly as decibels above noise. Both these methods have been tried by this unit and the former has been adopted since it gives results as good as the latter method and is much simpler in operation.

The calibration chart consists of a graph having range along one axis and S/N ratio along the other. To prepare the chart curves are plotted for each individual type of vessel. At least two curves should be recorded for each type of vessel since sometimes they differ slightly in position. When sufficient curves have been obtained the chart is divided into several areas each corresponding to a group of vessels roughly the same size. Suitable groups are :-

(1) Small floating objects.(including submarine periscopes).
(2) Fishing launches.
(3) Small naval craft ranging from surfaced submarines to corvettes, and including YMs,PCs,MLs etc,.
(4) Destroyers and merchant vessels of 1000 to 5000 tons.
(5) Cruisers and " " 5000 to 7000 tons.
(6) Larger vessels.

The calibration chart used on each site occupied by this unit together with representative curves are attached.

For use the chart is mounted under sanded celluloid and the following drill is used in operation:

(1) Adjust the gain control to give a ½ in of noise on the time base.

(2) To obtain S/N ratio keep exactly on bearing for approx. 30 seconds and read maximum S/N.

(3) Plot ppoints on the chart (a) When the vessel is first picked up.
(b) When the S/N reaches 2/1
(c) " " " " 3/1

(4) If S/N increases regularly as the range decreases then report the size. If not keep plotting until it does.

(5) Do not deduce size if abnormal ranges are suspected.

ORG Report No 74 points out that abnormal atmospheric conditions may cause abnormally great ranges. At these ranges the echo strength does not vary regularly with range and may even decrease with decreasing range. Some examples of this effect have been noticed and are discussed in a subsequent report on the influence of atmospheric conditions. In these cases deduction of size must be suspended until the vessel reaches its normal range.

It is emphasised that these estimates of vessel size are rough but in practice they have been found to be substantially correct. Most inaccuracies are due to the observed plot of the vessel being near the edge of one of the areas on the chart. Normally it is not possible to report vessel size until approx. 20 minutes after the vessel has been picked up.

.....

Another method of estimating size is available differing somewhat in principle from the above method. This depends on the rate of increasex of the bracketting angle as the range decreases. The bracketting angle is the angular distance between the two extinction position on either side of the ship echo. Its magnitude depends on the width of the horizontal polar diagram at the particular range and the manner in which it varies with range is determined by the shape of the polar diagram. In practice it has

been found with CD No 1 Portable that the bracketting angle observed on very close vessels is approx. $19^0$ using horizontal polarisation as is normal ( with vertical polarisation the maximum angle is $15^0$). The minimum bracketting angle, as measured on a ship echo which is just fading out of range is $6^0$ with both types of polarisation.

The bracketting angle varies with range for different sizes of vessels in much the same manner as does the signal strength. Consequently curves can be drawn for different types of vessels and a similar chart made up. There appears to be little to choose betwee the two methods except that the bracketting angle can be determined with rather more accuracy and consistancy than the signal to noise ratio. Some typical curves of bracketting angle against range are attached.

.....

ORG Report No 74 points out that the pick-up range of a vessel gives an indication of its size but is not sufficiently reliable owing to the occurrence of abnormal ranges. However it is of interest to compare the relations between the sizes of various vessels and their normal pick-up ranges. In this connection the size of a vessel is best expressed as its cross sectional area in an end on aspect since this is the main factor determining the echo strength.

Dimension of various types of vessels have been measured by means of a director and depression range finder and the cross sectional areas calculated. When a graph is drawn of cross sectional area against pick-up range of various types of vessels it is found that the relation between the two is roughly linear.

.....Lieut.
O.C. 9 Aust. Radar Det. R.A.A.

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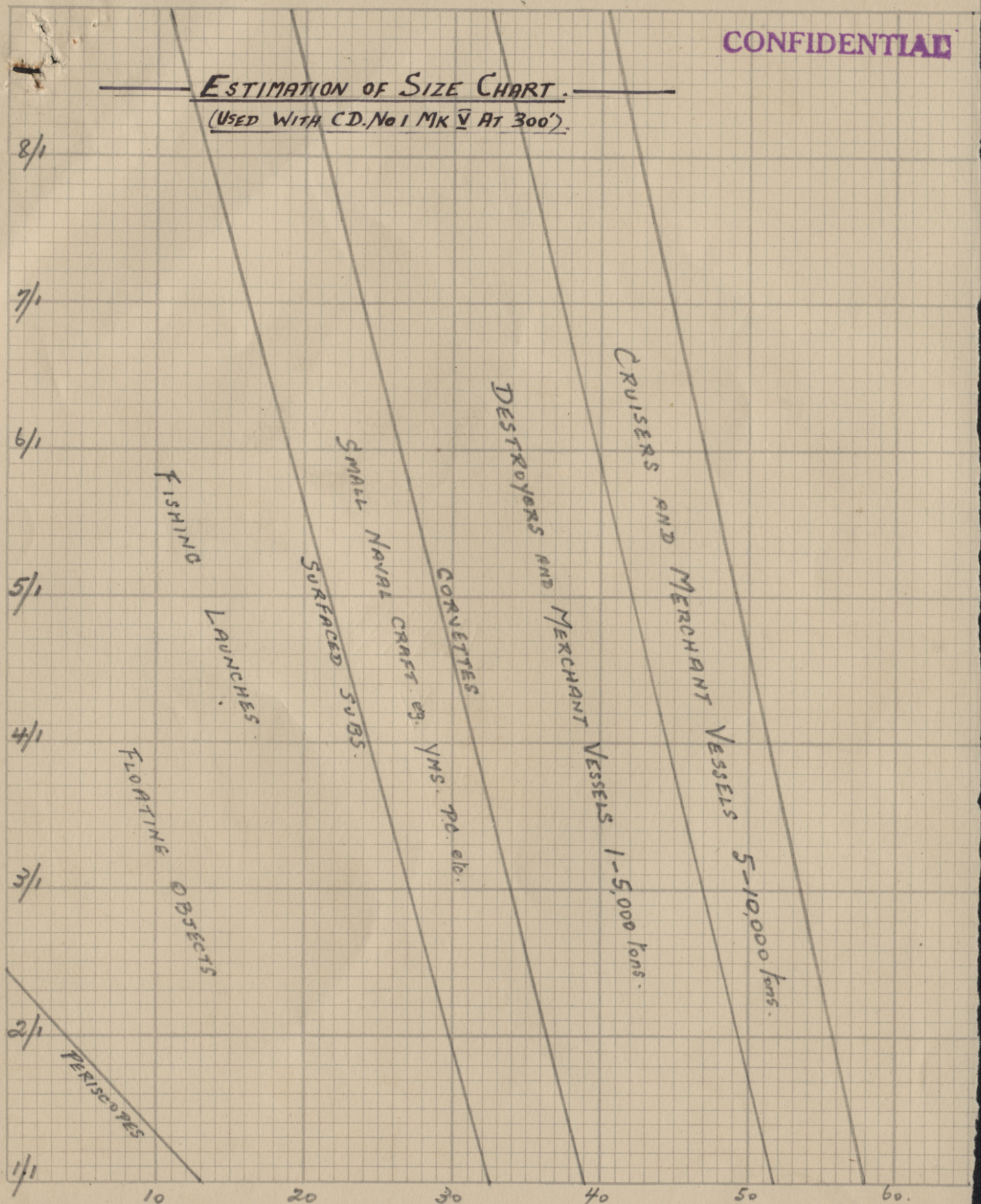
# ESTIMATION OF SIZE CHART.

(USED WITH C.D. No 1 MK V AT 300')



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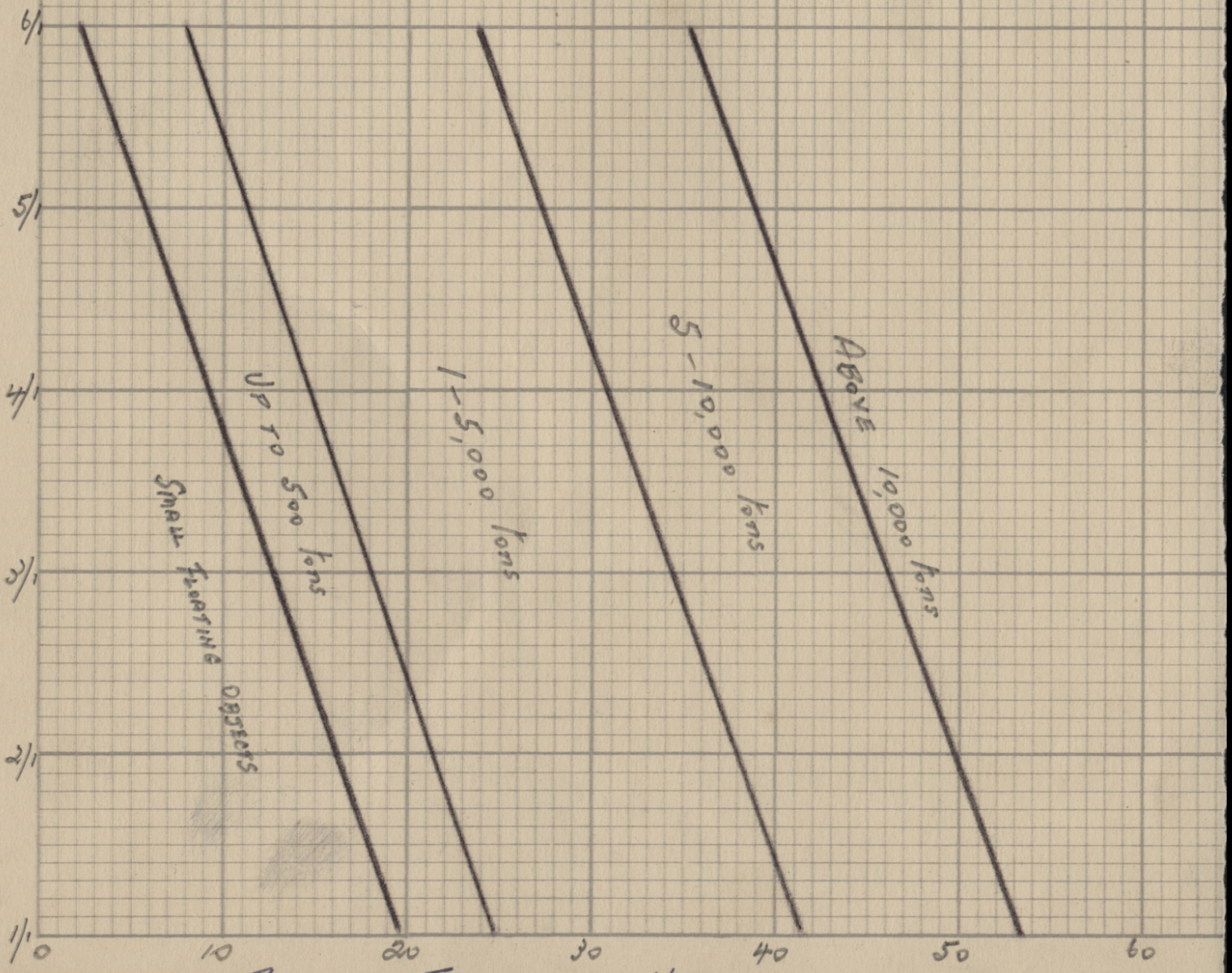
# ESTIMATION OF SIZE CHART.

(USED WITH C.D. No.1. PORTABLE AT 300')



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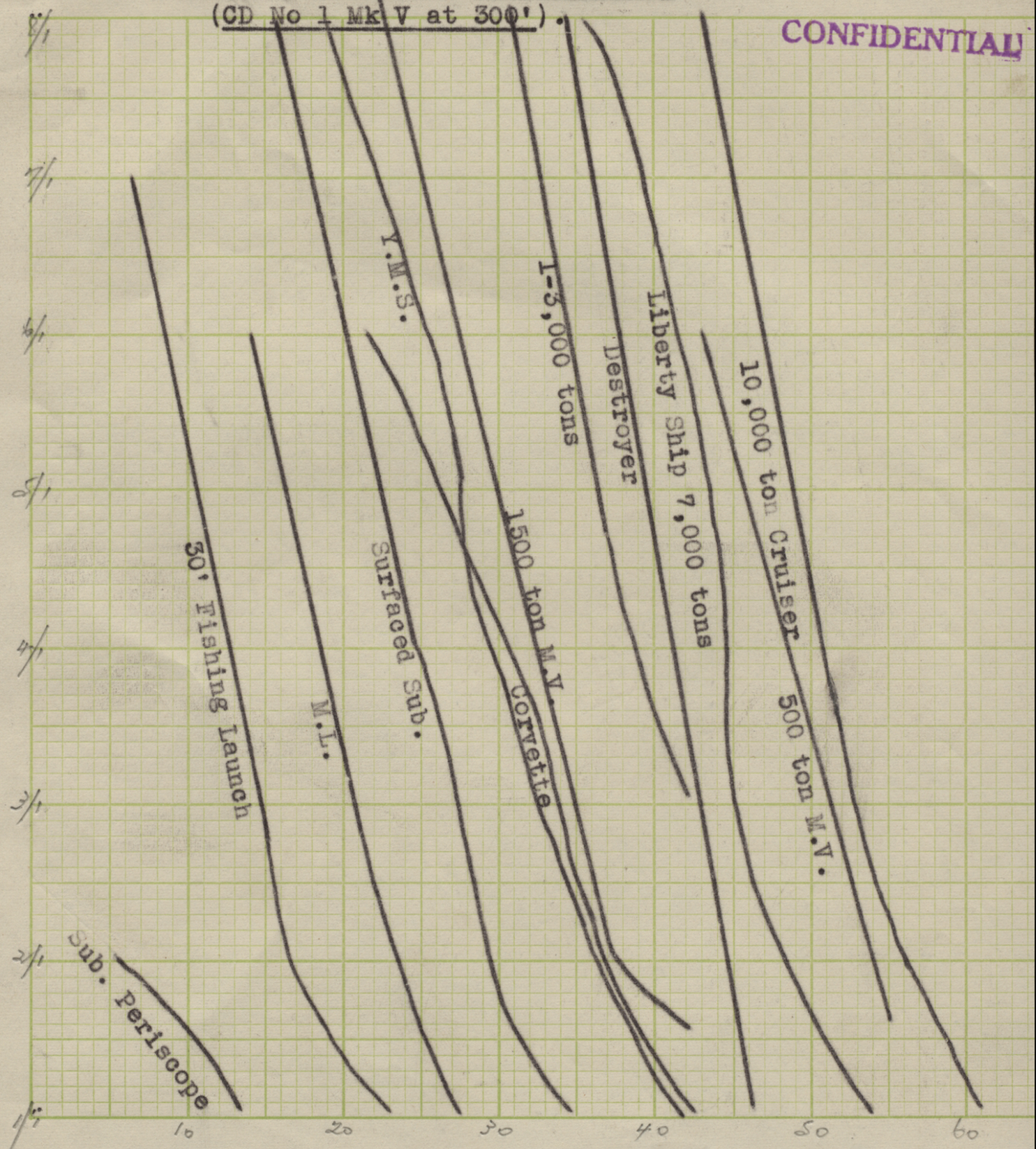
# SIGNAL STRENGTH / RANGE CURVES.

(CD No 1 Mk V at 300').



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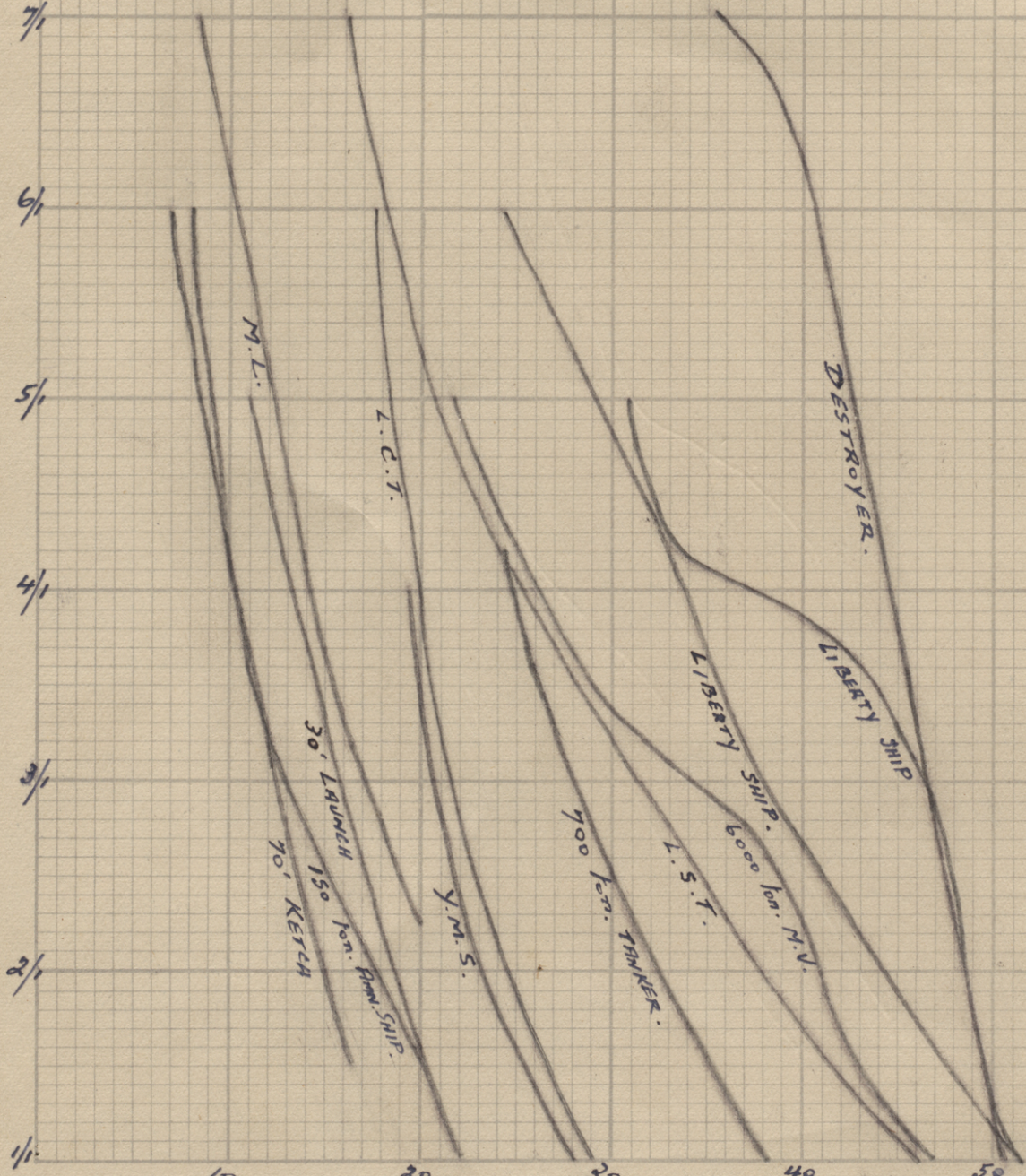
## — SIGNAL STRENGTH/RANGE CURVES. —
## (C.D. No 1 PORTABLE AT 300')



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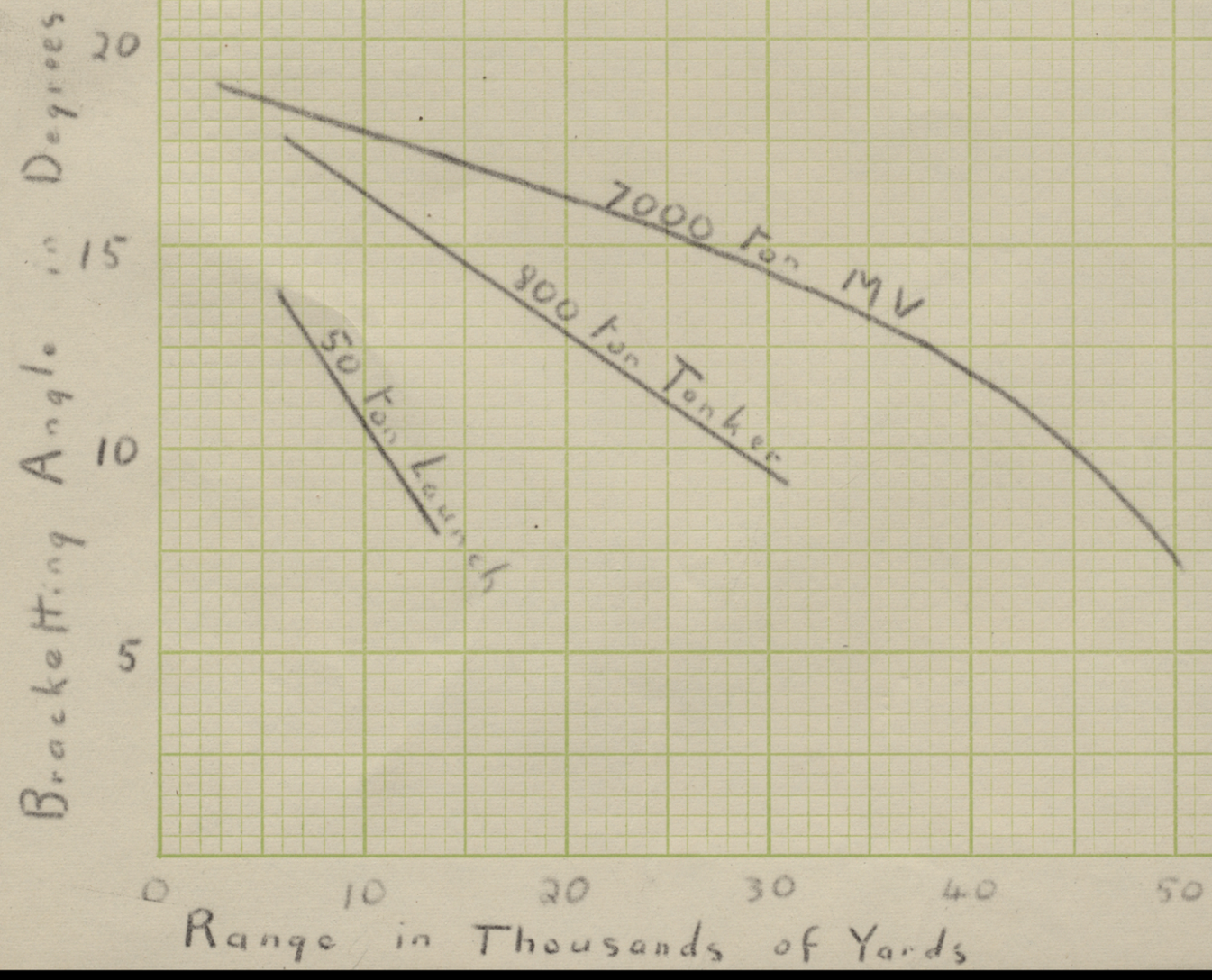
# Bracketing Angle/Range Curves
## (CD No1 Portable at 300')



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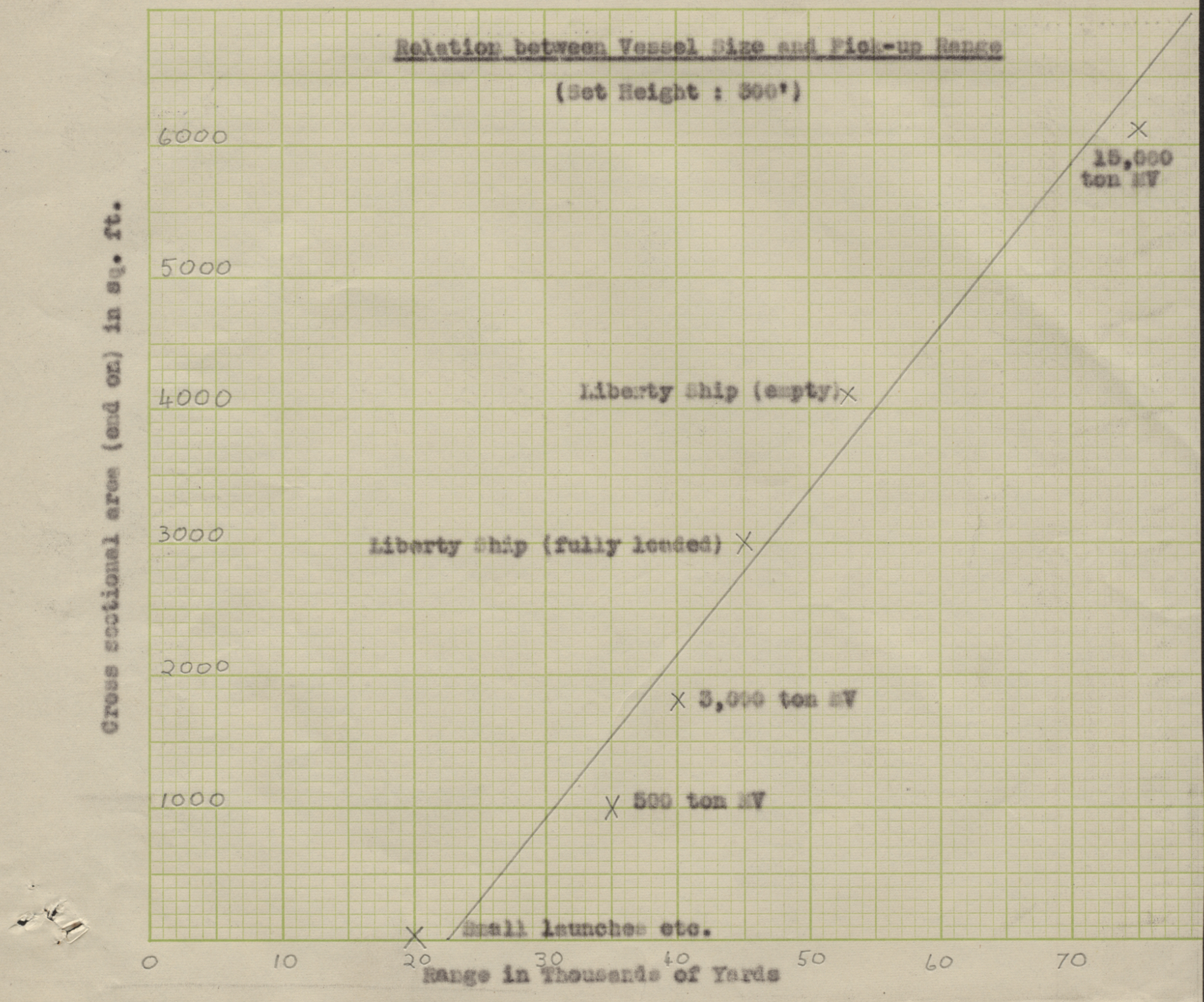

# DIMENSION OF VESSELS.

| Type of Vessel. | Beam | Length | Height to Deck | Height to top of bridge structure | Height to top of Masts | Cross Sectional Area End-On Aspect (Beam x Height to Bridge) |
|---|---|---|---|---|---|---|
| 15,000 ton M.V. | 80' | 560' | 37' | 76' | 135' | 6,100 sq. ft. |
| Liberty Ship (empty) | 64' | 425' | 40' | 64' | 98' | 4,100 " " |
| " " (fully loaded) | 64' | 425' | 25' | 47' | 81' | 5,000 " " |
| 5,000 ton M.V. | 44' | 297' | 15' | 41' | 93' | 1,800 " " |
| 500 ton M.V. | 31' | 199' | 11' | 34' | 56' | 1,000 " " |
| Small Launches, Army Barges etc. | 6' | 20--30' | . | 10' | | 60 " " |

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JUL 25 1944

# PERFORMANCE OF CD RADAR EQUIPMENTS.

## 9 AUST. RADAR DET. R.A.A.

This report is based on the experience gained by this unit during the past year. The unit has been on two different sites with two different CD equipments. At Cape Moreton, Q'land, CD No 1 Mk V was used. The radio components of this set is Naval Type 271 Mk III. At Mt Lunsman Lae, New Guinea, the unit was equipped with CD No 1 Portable (Aust), of which the radio component is Aust. 272 Mk I.

The results obtained with both sets are discussed, and since both sets were sited at roughly the same height, an opportunity is afforded of comparing their performances.

Many of the conclusions reached in this report are tentative and a number of assumptions have been made. This is due to the fact that it is not possible to obtain sufficient data on many points. It would be of interest to compare these results with the results obtained by similar sets sited at different heights.

The report is divided under the following headings :

Comparison of Ranges Obtained with CD No 1 Mk V and CD No 1 Portable.

Range limitations

Variation in Pick-up and follow ranges.

Detection of Aircraft

Side Radiation

Echoes from Miscellaneous Objects

Rainstorm Echoes

Interference

Reflection Effect

Points in Operation

R M Savage ..... Lieut

O.C. 9 Aust Radar Det. RAA.

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## COMPARISON OF THE RANGES OBTAINED WITH CD NO 1 MK V AND CD NO 1 PORTABLE.

| | CD No 1 Mk V at 300' | CD No 1 Portable at 330' |
|---|---|---|
| Merchant vessels 20,000 tons | approx.75,000 | |
| " 7000-10,000 " | 55000-65000 | 45000-50000 |
| " 5,000 " | 45000-55000 | 45000-50000 |
| " 500-1,000 " | 45000-50000 | 30000-40000 |
| " 200 " | .... | 25000-30000 |
| Tankers 7000 " | 40000-45000 | 40000-45000 |
| 800 " | .... | 35000-40000 |
| Cruisers | approx.60,000 | .... |
| Airer ft Carriers (7000) " | " 50,000 | .... |
| Destroyers | 40000-45000 | approx.45000 |
| LSTs | 45000-50000 | " 50000 |
| Corvettes | 40000-45000 | 35000-45000 |
| Y M Ss | 35000-40000 | 30000-40000 |
| Sub Chasers | 30000-35000 | " -35000 |
| Petrol Craft | 30000-35000 | 30000-35000 |
| Surfaced Subs | 25000-35000 | .... |
| M Ls | 20000-25000 | 20000-25000 |
| L C Ts | .... | 25000-30000 |
| Misc. craft 50-150 tons | .... | 20000-25000 |
| Water Transport Barges (30') | approx.20000 | 15000-20000 |
| Launches (30') | " 20000 | approx.20000 |
| Yachts (30') | " .... | 15000-20000 |
| Native lakatoi | .... | approx. 10000 |
| Sub. Periscope | 10000 (max) | .... |

.....

These results show that the performances of the two sets are practically identical with small vessels but with larger vessels better ranges are obtained with the English set. This is no doubt due to the fact that the beam width of this set is about half that of the Australian set and the wider beam (due to smaller reflectors) causes a greater reduction in the field strength which becomes particularly evident at long ranges. The beam widths of the two sets as measured by the "bracketting angle" on a close ship are approx. 8 degrees for the former and 16 degrees for the latter. (The bracketting angle decreases with increasing range according to the shape of the horizontal polar diagram).

The following figures are of interest:

| | CD No 1 Mk V. | CD No 1 Portable. |
|---|---|---|
| Diameter of reflector | 80 in | 40 in |
| Power gain of array | 2880 | 945 |
| Peak power | 8 KW | 30 KW |
| Average power | 6 W | 1.5 W |

The higher peak power output of CD No 1 Portable cannot compensate for the smallness of its reflectors since range is directly proportional to the diameter of array and only proportional to the fourth root of the peak power.

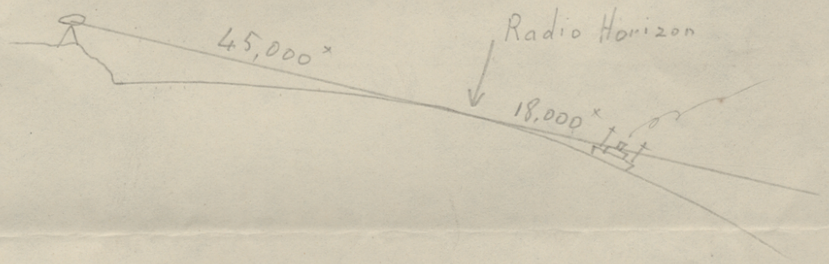
RANGE LIMITATIONS :

The maximum ranges obtainable with a CD set to various types of vessels may be divided into two classes :(a) Those limited by the horizon and therefore the height of the set (b) Those limited by the inherent sensitivity of the set. It is to be expected that only the largest types of ships will be affected by the first limitation and the second limitation will affect all smaller vessels.

From the results it appears that at 300' the ranges obtained with CD No 1 Portable on all types of vessels are limited by the sensitivity of the set only. The sensitivity of the set is insuffic for ranges on even the largest vessels to extend as far as the ra horizon at this height. Naturally with a lower sited set this ma

be the case. On the other hand the ranges obtained with GD No 1 Mk V are limited by the radio horizon in the case of vessels of approx. 10,000 tons and above. The ranges to all smaller vessels are limited by the sensitivity of the set. It seems therefore that for an early warning role it is of no advantage to site a GD No 1 Portable higher than 300', but it may be of advantage to site a GD No 1 Mk V at greater heights.

The correctness of the above deductions can be shown by comparing the ranges obtained by the two sets in relation to the actual radio horizon range at 300'. At this height the range to




the optical horizon is 45,000 yards (allowing for normal refraction). To this must be added the extra distance due to the height of the ship above water. The average height to the top of the bridge of a 10,000 ton ship is 50', consequently this distance is 18,000 yards. Hence the range at which the deck structure of the ship comes into view i.e. the maximum range at which it may be picked up or to which it may be followed, is roughly 65,000 yards. With GD No 1 Mk V the average ranges obtained on such ships were in the neighbourhood of 65,000 yards but with GD No 1 Portable the ranges rarely exceed 50,000 yards. Moreover in the case of the English set the ranges to 10,000 ton ships were greater than those to 5,000 tonners whilst with the Australian set the ranges to both types of vessels were the same. This also indicates that the sensitivity of the latter set is limited.

Furthermore these facts are supported by the ranges obtained on ships carrying radar sets capable of causing interference. Interference from another set causes much stronger echoes

signals than echoes, and it may safely be assumed that interference pick-ups will be limited only by the horizon. Interference from convoys of 10,000 ton ships is normally followed after the ship echoes have disappeared. The followin is a typical example with CD No 1 Portable. A convoy giving interference was followed to 51,000 yards where the ship echoes were lost. The interference persisted on the same bearing until 1½ hours later when it too was lost. This difference in time represents a travel of approx. 20,000 yards so that the range at which the interference was lost was approx.70,000 yards. It may safely be concluded that this represents the true horizon range in the circumstances. Hence the ship echoes were lost long before the horizon was reached. With CD No 1 Mk V only two cases were recorded of convoys giving interference. In both these cases the ships were lost at about 65,000 yards and the interference was lost about 10 minutes later. Hence it may be assumed that the ships were lost at the horizon.

VARIATION IN PICK-UP AND FOLLOW RANGES:

On any one type of ship the average pick-up and the average follow ranges are practically equal in the case of CD No 1 Mk V. With CD No 1 Portable however the average pick-up range is less than the average follow range. This is due to the fact that it is more difficult to pick up a faint echo on CD No 1 Portable than it is on CD No 1 Mk V. The reason for this is that the higher recurrence frequency of the latter set produces a denser "grass" in which a break can be detected even before the echo is higher than the "grass". The low recurrence frequency of CD No 1 Portable however produces a more diffuse "grass" and it is generally necessary for the echo to be higher than the "grass" for it to be detected. Frequently it is possible to obtain both pick-up and follow ranges on the one ship or convoy which is passing port. In these cases the pick-up range is generally less than the follow range, the difference on average, being about 5000 yards. Sometimes however the reverse occurs.

The ranges given for various types of ships in the tabl

above are only averages since the ranges obtained for each type of vessel are fairly evenly distributed over an extent of roughly 10,000 yards. This variation is due to a number of factors the most important of which are variation in atmospheric conditions, variation in set sensitivity and the human element on the part of the operator. Even variation in the height of the ship out of the water can have a distinct effect. For example on one occasion two identical Liberty ships were picked up travelling together. One which evidently had no cargo and was well out of the water, was picked up at 55,000 yards. The other, which was heavily laden and well in the water, was picked up at 45,000 yards. The aspect of a vessel has of course an influence on the echo strength. When a vessel turns from an end on to a broadside on aspect the signal strength increases by approx. 5 decibels (i.e. an increase of approx. 2 in the S/N ratio). In practice this is rarely encountered with vessels opening and closing port unless the shipping lane is bent.

Occasionally pick-up ranges are reported which are well above or well below the average pick-up range. For example a destroyer has been picked up at 65,000 yards (average range 40,000-45,000 yards) and a 20,000 ton merchant ship has been picked up at 47,000 yards (average range approx. 75,000 yards). The unusually large ranges are generally put down as being due to abnormal atmospheric conditions. The ranges below average obviously may be due to inefficient operation or a sharp decrease in set sensitivity but cases have occurred in which this is definitely not the cause. Abnormal atmospheric conditions may possibly sometimes decrease ranges instead of increasing them.

DETECTION OF AIRCRAFT :

It is well known that these sets are very restricted in their ability to pick up aircraft due to the narrowness of the beam and the virtual absence of side radiation. The only aircraft that can be detected are those that come directly within the beam, consequently at short and medium ranges only low flying aircraft can be picked up. Since the beam widths of CD No 1 Mk V and CD No 1 Portable are

roughly 8 degs and 16 degs respectively it follows that aircraft can only be picked up when they are at an angle of sight of less than 4 or 8 degs respectively. It is possible that the side radiation from these sets may be strong enough to enable aircraft at short ranges flying through an upper side lobe to be detected. If this is so it is to be expected that aircraft could be detected at angles of sight greater than 4 or 8 degs but no instances have been observed.

The following are examples of aircraft pick-ups with CD No 1 Mk

(1) Aircraft followed from 14,000 yards to 43,000 yards where it was lost in fixed echoes. Range at crossing point 12,000 yards. Estimated height 1500'. Hence maximum A/S is approx. 8 degs.

(2) Aircraft picked up at 22,000 yards and followed in to 4,000 yards S/N 4/1 throughout.

(3) Aircraft picked up at 30,000 yards and followed in to 25,000 yards It then turned and went out again the S/N increasing until about 25,000 yards and thereafter decreasing until the echo was lost at 30,000 yards

(4) Aircraft picked up at 65,000 yards and followed through several degs of bearing until it was lost at 67,000 yards.(This may have been a fixed "ghost echo" but it was moving at high speed.)

Examples of aircraft pick-ups with CD No 1 Portable :

(1) Aircraft picked up at 12,000 yards and followed in to 4,000 yards where it was lost in fixed echoes. Estimated height less than 1000'. Hence maximum A/S was approx. 5 degs.

(2) Aircraft followed from 3,000 yards to 20,000 yards, S/N approx. 3/1 throughout. Estimated height 1000'. Hence maximum A/S was approx. 6 degs.

SIDE RADIATION :

Definite indications of side lobes have been obtained with CD No 1 Mk V on strong echoes at short range. These weak side lobe echoes occurred 15 degrees on either side of the bearing of the main echo and were detectable out to 8,000 yards. At 3,000 yards the maximum S/N was 2/1.

On one occasion side radiation was detected on CD No 1 Portable

when the set was being used with vertically polarised aerials . The vessel was at 7,400 yards and the main echo was saturated. The side lobe echoes were picked up at infrequent intervals and lasted only a few minutes on each occasion. The S/N ratio was from 3/2 to 2/1. The echoes extended to 100 degrees left of the main echo (the right side was blocked out by fixed echoes) and in this arc up to three echoes of wide bracketting angle ( 20 dgs- 30 dgs) were discernable at exactly the same range as the main echo. These echoes definitely were not due to vessels.

No instances of side radiation have been noticed on the Australian set when used with horizontal aerials as is usual.

ECHOES FROM MISCELLANEOUS OBJECTS :

Echoes from small floating objects are often picked up and cause unavoidable false alarms. It is necessary to stress to non-radar personnel that a radar set does not differentiate between petrol drums and periscopes. Furthermore a faint echo from a small object frequently appears and disappears and, in a current, can simulate the expected behaviour of a submarine.

The following are examples of echoes which have caused false alarms. At Lae a faint echo (intermittent) appeared at 8,000 yards travelling west with a speed of 15 knots. CASLs were exposed and revealed a shoal of fish breaking water the surface of the water. A faint echo picked up at 5,000 yards was found to be a floating petrol drum when illuminated. A weak echo wasealso picked up from a floating log at 2,300 yards. Echoes out to 15,000 yards have been picked up from whales. These are mostly due to spray. It is understood that 1 and 6 Radar Dets have had echoes from floating cocoanuts.

Echoes have been noticed from the wash of a vessel. For example a separate echo of S/N 3/1 at 7,000 yards was picked up about 500 yards behind the echo of a corvette opening port at high speed. The distance of the wash echo behind the ship echo would depend on the range discrimination of the set. Echoes have even been noticed from the edges of areas of rippled water caused by wind action on very

still water. Such echoes are very intermittent but have been obtained out to 8,000 yards with a S/N ration of 2/1. On one occasion an instantaneous echo at a long range appeared simultaneously with a flash of lightning.

A peculiar effect was obtained from a tug which gave two identical echoes about 300 yards apart and on the same bearing. The set was operating normally and no reason for this effect could be found.

Wave clutter is greatly increased on CD No 1 Portable by the use of vertical polarisation and is strong enough to swamp faint echoes even when the sea is quite calm. Wave clutter on the Cape Moreton site extended to approx. 5,000 yards normally and as far as 20,000 yards in rough weather. At Lae it rarely exceeds 5,000 yards. Strong wave clutter can swamp quite strong ship echoes at close range. On the Cape Moreton site it was possible for a ship to approach close to the set through the dead area along the coast before coming into the area of search at quite short ranges. In such cases if the sea was rough there was a possibility of the ship echo not being detected even after it had come into the arc of search, due to it being swamped by wave clutter. To overcome this, on every fourth sweep the 0-15,000 yards time base was used with the gain turned well down so that ship echoes would stand out above the wave clutter. This precaution was only necessary in rough weather.

Inexplicable "ghost" echoes are occasionally picked up. These are weak echoes which appear at long ranges and disappear after a short time. In some cases they may be rainstorms but mostly they are fairly well defined single echoes. Generally they appear within normal range but sometimes they are at abnormal ranges. For instance at Cape Moreton a definite echo of S/N 2/1 appeared at 45,000 yards and disappeared after 10 seconds.

At Lae an echo of S/N 3/2 appeared at 73,000 yards and was followed in to 70,000 yards at a speed of 5 knots. It then disappeared. This range is much greater than normal pick up ranges on this site. It is possible that some of these echoes may have been caused by water-

spouts, which have been observed off Cape Moreton as high as 300'.

Fixed echoes on the Cape Moreton site extended to 145,000 yards, and on the Lae site to 140,000 yards.

RAINSTORM ECHOES :

These are picked up regularly and vary considerably in signal strength. A weak rainstorm at long range can be mistaken for a convoy if the speed of the rainstorm is within the range of normal ship speeds, as is frequently the case. With CD No 1 Mk V rainstorms have been detected out as far as 150,000 yards, but only to 50,000 yards with CD No 1 Portable.

There is evidently very little absorption of the radiation passing through rainstorms since there is no diminution in strength of ship or fixed echoes directly behind them.
Strong echoes can be followed through rainstorms if the signal strength of the echo is greater than that of the rainstorm, but weak echoes have been lost in them.

Both sets work efficiently in heavy rain and there even appears to be an increase in sensitivity. However the monitoring dipole of CD No 1 Mk V is shorted out by rain causing a low or a zero reading on the radiation meter.

An echo of S/M 5/1 and similar in appearance to a rainstorm echo was observed on on one occasion from a heavy rain cloud at a height of approx. 300 feet at 8,000 yards. There was definitely no rain associated with this cloud.

INTERFERENCE :

This has frequently been picked up from naval vessels such as MLs, destroyers etc,. It takes the form of "telegraph poles" and is never intense enough to interfere with operation. Frequently the interference is picked up before the ship echo appears or persists after the ship echo is lost; this has already been discussed above. The bearing of any interference picked up should be reported and is of

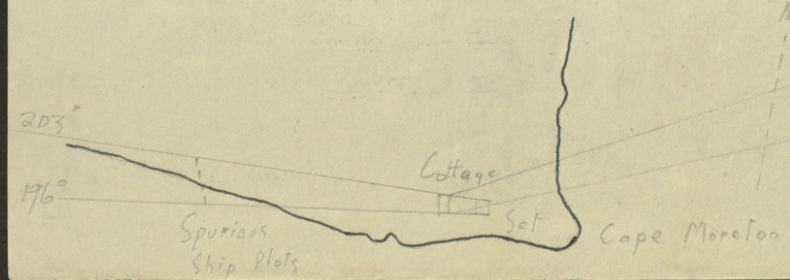
value in that it indicates that probably a naval vessel is on that bearing.

The bracketting angle on the interference is the same as the bracketting angle on th ship, but may be greater if the interference signal is very strong. The signal to noise ratio of interference can be estimated in the usual manner but unless the interfering ship is at extreme range, it is usually saturation.

Reflection Effect :

A peculiar reflection effect was observed on the Cape Moreton site. The arc of search on this site extended from bg. 345 degrees to bg. 190 degrees. The water and land area west of 190 degs was screened out by the lighthouse and the lightkeeper's cottage which were situated 50 yards south of the set. Frequently damped wave clutter was observed between bg. 196 dgs to bg. 203 dgs, i.e. in the dead area, and on several occasions ship echoes were picked up between these bearings at ranges from 5,000 to 9,000 yards. When plotted these ships appeared to be sailing in from the sea across the beach and up onto the island where they disappeared. These happenings only took place in wet weather.

These phenomena were found to be due to the fact that when the array was turned towards the lighthouse keeper's cottage the radiation was reflected from the front of the cottage back into the water area north of the set in which lay the normal shipping lane. The front of the cottage was exactly in an east-west line from the set it extended from bg. 196 degrees to bg. 203 degrees. Consequently when the array was on these bearings the reflected radiation was actually directed onto the sector from bg. 337 dgs to 344 degrees, but the echoes appeared to be coming from the area screened by the cottage.



POINTS IN OPERATION :

The process of inducing the Klystron to oscillate and then tuning it is made much easier by having two meters, one to read crystal current and one to read klystron current. Both these meters are provided in CD No 1 Portable, but in the case of CD No 1 Mk V only one meter is provided for the two meter sockets. However use can be made of the HT voltmeter which is actually a microammeter of the same range as the crystal current meter but is calibrated in kilovolts.

With both sets it is important that the correct klystron frequency be obtained. It is possible to have the sets operating, apparently satisfactorily but with reduced efficiency due to the klystron oscillating on some frequency other than the optimum frequency.

When the klystron has been tuned to the optimum frequency it comes a most important part of the operators' duties to keep it accurately on frequency. The klystron tends to wander in frequency continually, especially when the set is warming up or when the voltage of the power supply varies. Unless the operator keeps the echoes at maximum height by means of the klystron fine tuning control, the efficiency of the set is greatly reduced.

The expanded time base of CD No 1 Portable is not normally used for reading ranges in the early warning role since it is considered that the contracted time base is sufficiently accurate for this purpose. However the expanded time base is of value in determining, for instance, the number of ships in a convoy and for determining quickly, by the rate of movement, whether an echo is a ship or a plane. Similarly it can be used to indicate quickly whether a ship is stationary or moving. The expanded time base is of course invaluable when the set is being used in a fire control role. This has been discussed in a previous report.

Signal wires and power lines which have been erected in the path of the beam do not have any noticeable effect on the efficiency of the set provided they are not massed. Materials such as roofing paper or blanket have no effect on reception even when placed over the array. Hence non-metallic camouflage material

could be used to cover the set completely without affecting efficiency. Wire netting (2" mesh) across the front of the array of the Australian set causes a decrease in the signal strength of fixed echoes by approximately 4 decibels. Removal of the plywood covers increases the signal strength by approximately 3 decibels.

Diffraction of the radiation over or around obstructions such as hills and headlands can be quite pronounced if the obstructions are close to the set and it is often possible to follow ships behind such obstructions after they have disappeared visually. No diffraction has been noticed, however, if the obstruction is at a long range.

At least two datum points should be selected on each site, preferably in opposite directions and at varying ranges. The set should be checked on these periodically to check the range calibration and more particularly to ensure that the orientation of the bearing scale is correct. The best datum points are outstanding features such as isolated mountains, points of land etc. which give an outstanding and easily identified fixed echo. The range and bearing to these points can be obtained with sufficient accuracy from the map. Several reference fixed echoes should also be selected to check the performance of the set. Some of these should be within and some beyond optical range.

It should be borne in mind by the operators and by personnel using the shipping information from these sets that in most cases vessels picked up at the normal pickup ranges would, in daylight, be picked up visually before the set could pick them up. It can be said that all vessels picked up by CD No 1 Portable, sited at 300', could be picked up visually in daylight before the set could pick them up. In the case of CD No 1 Mk V on high sites the reverse is probably the case with large vessels.

When reporting convoys operators should make it clear that the number of vessels reported is the minimum number and is not necessarily the total number of vessels in the convoy. The report should take the form of "at least 6 vessels" for instance. When a convoy is first picked up generally only one or two vessels

may be detected and the number then increases as the range decreases However at medium and short ranges it generally happens that two or more vessels of the convoy combine to give a single echo, due to the poor discrimination of these sets, and although such an echo should beat, very often the beating is not noticeable.

The observed discrimination of both of these sets is approximately 5 deg. for bearing and 250 yds for range.

(Discrimination is the distance apart, or the angular distance in the case of bearing, that two vessels must be in order to give two individual echoes. At less than these differences the two vessels combine to give a single beating echo.)

The average operating time for these sets when used for early warning during close defence conditions has been approximately 400 hours per month or 13 hours per day. The Lister diesel used with CD No 1 Mk V uses approx. 183 gallons of fuel per month i.e. 2.4 hours per gallon. The Howard uses approx. 190 gallons per month i.e. 2.2 hours per gallon.

CONFIDENTIAL

SUGGESTED MODIFICATIONS TO GD. RADAR EQUIPMENTS :

9 Aust.Radar Det,R.A.A

20 Jul. 44.

GD NO 1 PORTABLE (AUST.).

Spares:

The present provision of spares is ample in most respects. However no spares are provided for the numerous connecting cables, plugs and sockets and in practice it has been found that these components (particularly the "E" cable, carrying the C.R.T. power supply) cause trouble due mainly to insulation breakdown and mechanical damage. It is suggested that either complete spares be issued for all the cables or else sufficient material be made available in order that a new cable or plug could be made up for replacement. This material would include several spare plugs and sockets, insulating material and sufficient lengths of the various types of cables.

The spares could also include some spare valve sockets of various types and a spare CRT socket.

The number of spare radio components supplied is almost sufficient to build a cathode ray oscilloscope. It is suggested that a circuit for an oscilloscope be provided utilising the present spare and any extra components could be added. The oscilloscope could be built on each site by the Armament Artificer and would be of value in the detection of certain faults.

Mechanical Modifications:

The present bearing scale is very unsatisfactory and limits the bearing accuracy of the set. The present bearing accuracy is ± 1° but if a scale accurate to 30 mins or better were provided the accuracy would probably be improved to ± 30 mins. This is important in view of the fact that the set may in future be used in a semi fire control role (see below). The present scale might be made f and more rigid, or alternatively an accurate scale mounted on t the hand drive with the present scale retained for the early w role.

At present there is no access to the slip rings without dismantling the whole set. This is not a serious fault since the sliprings give no trouble and if they did breakdown trailing leads could be used. However the fault might be rectified by making the four sides of the slip ring container removable instead of only one. A trench could be dug under the set to permit access. There are no spare slip ring brushes on the station list. It has been found also that rainwater can get into the slip ring box; it could be prevented from accumulating by drilling holes in the bottom of the box.

Operators find that they have insufficient "leg room" and this may have an effect on the efficiency of operation. It could be overcome by shifting the receiver base back approximately one foot. The front of the receiver could be supported by two pieces of piping at the corners.

There is a tendency for operators to kick and break the plugs at the bottom of the power pack unit. This could be overcome by fitting a removable piece of angle iron as a guard for the plugs.

The present method of securing the receiver blower motor to the bottom of its container is very unsatisfactory and will not stand up to normal handling. The present wooden support should be replaced by a metal frame bolted to the bottom of the container.

The reflector boxes are very liable to damage in transit. The plywood screens should be protected by removable battens front and rear. Containers of radio equipment should be marked "Fragile Handle with Care" in large red letters since the equipment is liable to receive very rough handling particularly in holds of ships.

Use of the canvas tent over the set should be regarded as a temporary measure only and a hut should be built over the set as soon as possible after installation. Space is so limited in the tent that efficiency of operation and maintenance is affected, and in particular the plotting table is too small.

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ELECTRICAL MODIFICATIONS:

Since the issue of the Test Set has been discontinued there is no satisfactory method of calibration other than the use of fixed echo datum points which is rarely accurate enough. A calibrator circuit similar to that used in 271 equipment, and preferably crystal controlled, might be built into the equipment or be issued as a separate unit.

The automatic voltage regulator on the Howard generator set is very unsatisfactory and cannot cope with the comparatively large voltage fluctuations caused mainly by the imperfect governor control of the engine. In practice it has been found that generally once or twice during a night's operation the voltage slowly changes in value by as much as 40 or 50 volts. This could be overcome by the use of a reliable voltage regulator, which could be issued as a separate unit and installed in the set or near the generators, or more cheaply, by removing the field rheostat hand control from the generator set and installing it in the set. The operators could then use hand control for large voltage variations in conjunction with the present automatic regulator for minor fluctuations.

Aerial Modifications:

It is considered that the present aerial design greatly detracts from the efficiency of GD No 1 Portable, mainly in regard to the small diameter of the reflectors and the plywood screen over the array. The performance of the set is inferior to that of GD No 1 Mk V. which has 60" reflectors. For example at a height of 300' the average range for 10,000 ton vessels is 45,000 yards to 50,000 yards with GD No 1 Portable and 55,000 yards to 60,000 yards with GD No 1 Mk V. In view of the fact that the peak power output of the latter set is much less than that of the former, it is obvious that the 40" reflectors are responsible for a large decrease in efficiency.

It seems that a consideration in the design of the may have been the fact that long ranges (eg.over 40,000) are required for normal coast watching. However it is important in mind that on many sites a major role is close watching of small craft and in particular submarine periscopes or part

surfaced submarines. For this role maximum efficiency and sensitivity are essential. It is doubtful if CD No 1 Portable could pick up a periscope at all, since CD No 1 Mk V. can follow a periscope to only 10,000 yards in the best of conditions.

The beam width of the radiation from a 40" reflector is roughly $16^0$ on close targets and $8^0$ from an 80" reflector. There is a common idea that the narrower beam width causes decreased efficiency even in surface searching. This is definitelt not the case and in practice searching with an $8^0$ beam is quite as efficient as with a $16^0$ beam. This is shown by the fact that the pick up ranges obtained with CD No 1 Mk V are better than those obtained by CD No 1 Portable in the same conditions. Indeed it would probably be possible to search with efficiently with a beam width less than $8^0$ without greatly retarding the present rate of search (approx. $2^0$ per second).

It is suggested that the present set could be greatly improved by installing 80" paraboloids. This would not detract from its portability in any way. The dipoles and their supports could be of the removeable type as in CD No 1 Mk1V, and one paraboloid would fit into the other and the pair enclosed in a crate. This arrangement would be just as portable and much more robust than the present system.

Removal of the plywood screens from the present aerial containers causes an increase in the height of the fixed echoes by about 3 decibels. If the present array is retained it would be a marked improvement to disperse with these screens (except for transport) and model the dipoles and supports on those of CD No 1 Mk1V. which are not shorted out by rain. In any case these reflector boxes are not waterproof and in the tropics the air inside the boxes is always very hot and very humid. The 40" paraboloids could also be packed as described above for the 80" paraboloids.

Consideration might also be given to the use of six aerial working with an 80" reflector, using a T/R switch as in CD No 1 Mk V. This should not involve extensive modifications and the T/R switch unit could be mounted on top of one of the other cubicles without taking up any extra space.

USE OF GD NO 1 PORTABLE AS A FIRE CONTROL SET :

A report has been submitted by this unit to HQRA Branch LHQ suggesting uses for this set as a portable fire control set in addition to its normal role. The set has already proved itself as a satisfactory bty. rangefinder in a practice shoot.

If this is adopted it would involve some modifications to the set. Firstly a satisfactory calibrator is essential as mentioned above. Secondly, the range measurement is made difficult and less accur to by the rhythmical wandering of the balance position which appears to be caused by the pair of time base amplifier valves. This factor has been fully discussed in the report referred to. A zero check switch, similar to that in the GS equipment, might be instalkmt warranted. In any case it is necessary to have the present screwdriver balance control replaced by a knob.

In addition to using the set as a bty. rangefinder it may be necessary in an emergency to use it for complete fire control ie. for both range and bearing. Obviously it is necessary to improve the bearing accuracy. This can be done to a limited extent by improving the bearing scale as suggested above. It is possible that beam swinging could be incorporated in this set without causing extensive modifications or detracting from the portability. An extra CRT for bearing has been tried out by this unit and works quite satisfactorily in parallel with the present CRT. It can be mounted on top of the transmitter unit so that the bearing operator uses the traversing control.

If the set is to be used for fire control it is necessary to add a head and breast set telephone set to the station list.

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GD No 1 Mk V.

Spares :

The list of spares in the HMF appears to be adequate in most respects. However the list is common to GD No 1 Mk IV and Mk V with the result that spares for the T/R switch unit of Mk V, in particular the GV 59 itself, have been omitted. This is important in view of the fact that this valve appears to have a comparatively short life. The GV 59 in the set operated by this det. broke down after 1800 hours due to shorting of the lips of the rhumbotron by a deposit, presumably copper oxide.

In this case also there is no spare cable and it is suggested that a length of concentric polythene cable and some spare pye sockets and plugs be included for replacements.

The set as issued to this detachment in June 1943 had very few spares and up to January 1944 it was impossible to obtain obtain any from Ordnance, with the result that the set was out of action for several weeks.

Mechanical Modifications :

The arrangement of the units under the bench causes unnecessary strain on the concentric cables. In particular the pre-amplifier unit should be turned at right angles to relieve strain. Also the transmitter unit should be mounted on a stand well off the floor to prevent the blower motor sucking in dust.

Mounting the plotting board over the bench takes up undue space. It should be mounted in a perpendicular position on the rear wall.

The bearing accuracy of this set also is limited by the bearing scale. A bearing scale accurate to 30 mins or better and with a finer pointer is warranted.

Electrical Modifications:

On most sites the existing 0-75,000 yards time base is insufficient since ranges beyond 75,000 yards are often obtai

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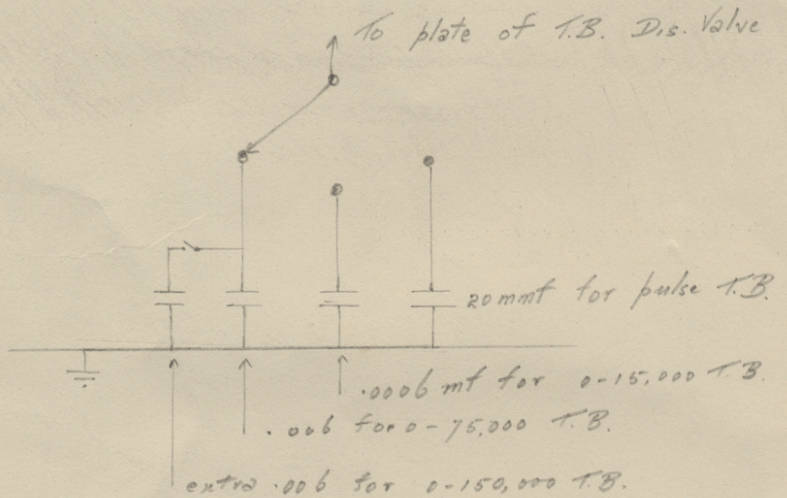
Electrical Modifications.

On most sites the existing 0-75,000 yards time base is insufficient since ranges beyond 75,000 yards are often obtained.

An additional time base from 0-150-000 yards is easily obtained by putting a 0.006 mf. condenser in parallel with the existing 0.003 mf. condenser for the 0-75,000 time base. A switch placed between these two condensers enables the new time base to be switched in and out. This time base has been found quite satisfactory in practice




A permanent "ghost" echo was originally present on all the time bases. This echo did not change with alteration in bearing; and the range, which was usually between 3,000 and 4,000 yards, depended on the setting of the transmitter H.T. It was caused by R.F. pickup on the lead supplying the ionising potential to the G.V. 59 and was eliminated by shifting the 100,000 ohm resistor in this line from its initial position in the submodulator unit and placing it at the actual terminal of the G.V. 59.

R.H. Jarvis Lt.
O.C. 9 Aust Radar Det RAA

CONFIDENTIAL

SUGGESTED AMENDMENTS TO THE W.E.T. OF A RADAR DET. (TYPE "A").

9 Aust. Radar Det. R.A.
17 Jul 1944.

GENERATOR SPARES:

Radar Dets. are at present issued with Howard (5KVA) or Lister diesel (15KVA) generator sets. In both cases the present WET provision of spare parts is insufficient. This is particularly the case with spares such as cylinder head gaskets, required for periodical decarbonising and overhauls, which must be carried out by unit personnel at frequent intervals since the average running time is about 14 hours per day.

When a Det. is supplied with a Lister diesel there may be no alternative power supply so a large proportion of spare parts is necessary, particularly when the det. is in an isolated area as is often the case. The manufacturer's list of spares and special tools as detailed in the WET is fairly comprehensive but is generally issued incomplete.

Spares for Howard sets are set out partly in the main body of the WET and partly in the station list for Radar Equipment CD No 1 Portable. It is suggested that the Howard sets and all spares be transferred from the station list to the main body of the WET.

A suggested list of additional spares to provide for routine overhauls and the most likely breakdowns is as follows:

HOWARD 5KVA petrol generator set (5 on charge).

| | |
|---|---|
| Cylinder head gaskets | 12 |
| Valves | 6 |
| Valve springs | 3 |
| Piston rings | 2 sets |
| Big end bearings | 2 sets |
| Gudgeon pins | 2 |
| Spark plugs | 2 |
| Slip ring brushes | 4 |
| Commutator brushes (the commutator brushes at present supplied are much too soft and last about 300 to 400 hours). | 12 |

LISTER 15 KVA diesel generator set (1 on charge).

| | |
|---|---|
| Piston rings | 3 sets |
| Injector assembly | 1 |
| Cylinder liner | 1 |
| Springs retaining gudgeon pins | 6 |
| Big end bearings | 3 sets |
| Compression change over valve assembly | 1 |
| Auxiliary chamber assembly | 1 |
| Fuel pump | 1 |
| Micrometer (for measuring piston clearance) | 1 |
| Tension spanner (for tightening holding down bolts of cylinder heads) | 1 |

The last five items are desireable but not essential.

.....

At present a Radar Det. is provided with three Howard sets. It is considered that two would be sufficient provided that they are the improved (1943) model and provided the necessary spares are supplied. This det. had very little trouble with three sets in four months' operation and two would have been quite sufficient.

Both types of generators would give better operation if a resistance frame were used. At present the generators are operated under a very light load; increasing the load by means of a resistance frame would ensure better running and less carbonising. For Howard sets the best value would probably be 50 ohms (1200 watts). And for Lister sets 12 ohms (4800 watts). One resistance would of course be sufficient for three generators.

SET SPARES:

Suggestions for additional spares for GD Radar equipments are included in a seperate report on set modifications.

TOOL KITS :

The tool kit for Armament Artificer (Radar) is more than sufficient. Many of the items are not required for normal maintenance. No provision however is made for the tools for the Mechanic MV who was recently added to the WE to maintain the generators.

Many of the tools required are already available in the Armament Artificer's kit but it is suggested that an additional tool kit be included in the unit WET containing at least the following items :

Box spanners (one set)
Feeler gauges (one set)
SAE spanners (one set)
Drifts (one set)
18" Crescent spanner
Multigrip pliers
Stilson wrench (small)
Ball pane hammer (one large and one small)
5/8" Screwdriver
Valve grinder (suction type)
Valve grinding paste
Gasket cement
Blue marking dye
Shimstock (one set)
Magneto files (two)
Magneto spanners (one set)
Gasket material (one roll)

.....

UNIT TOOLS :

A Type A Radar Det. usually has the role of installing sets in relatively inaccessible places. Consequently a certain amount of clearing, and building jeep tracks etc. is involved, and for this the following tools are required in addition to those already on the WET :

| | |
|---|---|
| Crowbars | 2 |
| Cross cut saw (40") | 1 |
| Block and tackle (two 2-sheave blocks 4" in diameter) | |
| Rope 2½" | 100 ft. |
| Knives Jungle | 5 |

Additional unit tools also required areas follows :

| | |
|---|---|
| Cold chisels | 1 |
| Bench vice 3" | 1 |
| Hand emery wheel | 1 |

CONFIDENTIAL

CAMP EQUIPMENT :

The role of a Radar Det. involves it being sit always on high ground. Consequently the supply of water is generally a matter of some difficulty. Although this is general a local RAE matter it may be necessary to obtain authorisation for the issue of a 150-gall water trailer if a truck is on charg

In this connection also a jeep trailer would be of great value and it is suggested that it be included in the WE with the jeep. It more than doubles the value of the jeep when used for the installetuon of the set, carting firewood and water etc..

A Radar Det. is generally located in an area where very little firewood is available. Conse uently some type of oil cooker would be of value.

Since a considerable amount of secret documents is always carried two padlocks and a large (steel) stationery box are required in addition to the small stationery box already on the WE

The amount of camouflage material on the WET is far in excess of requirements, and is very heavy and bulky. It is suggested that camouflage material be deleted from the WET entirel since it is always available from local RAE sources.

Other equipment on the present WET which is not required is as follows :

Insulators, containers cooking (Aust)
Machines mincing, small (Aust)
Scales arty. No 5 Mk I
No 5 Mk I

CONFIDENTIAL

WEAPONS :

A Radar Det. is frequently located in an isolated ar and often has to provide its own defence. It is possible that a may have to repel a small scale landing from a submarine or from barges. In addition to the weapons already provided it is suggest that four boxes of hand grenades be included in the WET. These could also be used for demolition of the set in an emergency. Possibly the issue of a 2" mortar or a Tk/A rifle might be warrant

The use of No 27 detonators and safety fuze for demolition is not practicable. Electric detonators and an exploder are essential.

The WET provides for carriers cartridge for personnel armed with rifles. It is suggested that these be replaced by pouches basic.

MEDICAL EQUIPMENT :

No authorisation exists for the issue of medical equipment which is most essential. The least required is a first aid kit complete and a bag of field dressings.

.....Lieut.

O.C. 9 AUST. RADAR DET. R.A.A.

CONFIDENTIAL

REPORT ON POSSIBLE ENEMY SUBMARINE IN LAE HARBOUR

9 Aust. Radar Det. R.A.A.

30 Jun '44

This report deals with the unusual happenings in Lae harbour on the night of 19 May '44. There appeared only two possible explanations of what took place. Either a Liberty ship came into and went out of the harbour without giving any indication on the Radar set (CD No 1 Portable) which was definitely operating efficiently, or alternatively a partially surfaced submarine was in the harbour.

The facts are as follows :( It should be mentioned that the Radar set, the Naval WSS and the BOP of N Hy Bty were situated within 30 yards of each other on top of Mt. Lunamun overlooking Lae harbour).

1. At 1845 hrs Radar picked up a vessel (No 1) at bg 110 degs, 55,000 yards, course bg. approx. 270 degs.(i.e. heading towards Lae). The vessel was followed in to 48,000 yards where the echo faded out and did not subsequently reappear. At approx. 1925 hrs Radar had definitely ascertained that the vessel had disappeared. The original echo was a fairly strong one and faded out fairly quickly. This fade out may have been due possibly to atmospheric conditions, but in this case the vessel would have been located again no more than 20 minutes later. The last speed of the vessel reported was 6 knots.

2. At 1915 hrs a vessel (No 2) showed a light at bg. 120 degs. WSS challenged the vessel which identified itself with the correct reply and passed its name as the "Edward Landis". At no stage did Radar pick up this ship although the set was operating efficiently and was locating other vessels in the vicinity.

3. Various signals passed between WSS and the vessel wherein the latter asked for its position and requested a course for Oro Bay. At about 1945 hrs on receipt of this message WSS requested Radar to plot the present bg. and range to the ship. Radar reported that they could get no indication of the ship although they could see its signal light at bg. 120 degs. Radar asked WSS to contact the ship by signal and ascertain its size and distance off shore in order to check the set. The ship replied that it was a Liberty ship and 3 miles out. Had this been so it would have given a saturation echo and the set could not have failed to locate it.

4. At about 2000 hrs WSS asked BOP for bg. and range to the ship's light. BOP passed the bearing as 121 degs and stated that they could not give an exact range on the DRF because they could not see the water line but only the light from which they deduced the range at approx. 18,000 yards.

5. Again a series of signals passed between the ship and WSS until 2115 hrs, during which the vessel stated that it had very few charts of this area. Throughout these proceedings WSS had stated that they were satisfied with the identity of the vessel and that the Port Director had contacted RAN Finschhafen from which the "Edward Landis" had been cleared that afternoon.

6. At the request of Radar No 2 CASL was exposed at 2135 hrs on bg. 120 degs and searched the area without success. WSS suggested that, as they had been in contact with the vessel 15 minutes previously they might try to raise it again. Accordingly the CASL was doused at 2142 hrs and WSS called the ship over a large area but received no reply. Although the ship had answered WSS signals 15 minutes before the light was exposed, it did not thereafter answer any signals from them.

7. At 2152 hrs No 2 CASL was again exposed at extreme left bg. and searched right. During its search it illuminated a small vessel (No 3) on bg. 102 degs, previously located by Radar and a large tanker (No 4) at bg. 115 degs. 12,000 yards which had been followed in by Radar from 56,000 yards. Both vessels were identified by WSS who requested that the tanker be not illuminated. The lights were not again exposed until this ship was clear of the arc of search, at 2249 hrs when the whole area was searched again without success.

It is evident that vessel No 1 was not identical with vessels No 2,3, or 4. Its unexplained disappearance is possibly not connected with the subsequent happenings in the harbour.

It can be stated quite definitely that the Radar set was operating at maximum efficiency throughout. At the same time that vessel No 2 was in the harbour the set was following in vessel No 3 which subsequently passed through bg. 120 degs. Also other ships at anchorage in the harbour were giving saturation echoes. A careful search was made for the vessel No 2 by OC detachment, the artificer and several operators and no sign of any echo was observed. The set was even laid visually on the vessel(s signal light with no result.

CONFIDENTIAL

It seems probable that an enemy submarine came into the harbour submerged. It surfaced sufficiently to enable the conning tower to be opened in order to signal WSS and obtain its position. As soon as the CASL was exposed the submarine submerged The range from the set must have been too great for the conning tower to be picked up. On this site the average range to a fully surfaced submarine would be approx. 30,000 yards. A conning tower alone would probably not be detected beyond 15,000 yards nor a periscope beyond 10,000 yards.

On the other hand if it were a Liberty ship, apart from the fact that it gave no echo, it is possible that it could have passed out of range of the CASL before it was exposed. Conditions for the light were good and its range must have been from 15,000 to 20,000 yards since the vessel No 3 was clearly illuminated at 12,000 yards.

.....Lieut.
O.C. 9 Aust. Radar Det. RAA.

N By dtg
per 9 Madandet

AUSTRALIAN MILITARY FORCES
(Chief of the General Staff)

SECRET

RA/YES

57/404/554

S.M. 4007

Headquarters,
Victoria Barracks.
MELBOURNE, S.C.1.
22 April, 1944

| | |
|---|---|
| RAA First Aust Army | (16) |
| RAA Second Aust Army | (10) |
| RAA N.G. Force | (18) |
| HQ RAA N.T. Force | (9) |
| HQ RAA 3 Aust Corps | (10) |

Copies to:- Section 22 GHQ, Adv LHQ, DDMO, ADMI, MGO (3), LHQ School of Radiophysics, LHQ School or Arty (AA), LHQ School of Searchlights.

## RESTRICTIONS ON THE USE OF BALLOON-BORNE REFLECTORS FOR RADAR CALIBRATION

1. Balloon-borne reflectors may be used for the purpose of calibrating Radar equipment, and measurement of upper winds provided that the reflectors do not employ devices obviously preferential for wavelengths shorter than ten centimetres.

2. In forward areas, care should be exercised in the release of such balloons, in order to reduce the possibility of reflectors coming to earth in enemy held territory, thus disclosing the frequency of Allied Radar equipments.

3. Sufficient copies of this memo are forwarded to ensure the following distribution.

two to each addressee
one per HQ Coast Arty in areas with CA or CD Radar equipment.
two per H.Q. AA Group
one per H.Q. Composite AA REGT.

R. Chilmore

1st Major-General,
M.G.R.A. L.H.Q.

RESTRICTED

Subject: SECURITY OF SPECIAL RADAR TRANSMITTER VALVES

RAA First Aust Army(AIF)
31 Oct 44

RAA 124

6 Aust Radar Detachment.
9 Aust Radar Detachment.

Enclosed herewith are copies of LHQ Memorandum 118701 of 28 Sep 44, and LHQ SM 11096 of 17 Oct 44.

for Lt-Col.
SORA I First Aust Army(AIF).

COPY

RESTRICTED

AUSTRALIAN MILITARY FORCES
(Chief of the General Staff)

Headquarters
Victoria Barracks

Melbourne SC 1
27 September 1944

In Reply
Quote (15/403/138) 118701

| | |
|---|---|
| HQ First Aust Army | (8) |
| HQ Second Aust Army | (10) |
| HQ Western Command | (6) |
| HQ New Guinea Force | (6) |
| HQ RAA NT Force | (4) |

Copies for information to -

MGO Branch (6); DMI (3); Naval Board DR (N) (2); MGRA (3)
Air Board DRS (2); Radiophysics Laboratory;
Ministry of Munitions

SECURITY OF SPECIAL RADAR TRANSMITTER VALUES

Reference SM 18613 of 27 July 1943, and SM 5361 of 16th March 1943.

1. The special transmitter valves known as Magnetrons used in Army Radar Sets CD No 1 Mk IV, CD No 1 Mk V, CD No 1 Mk V* CD No 1 Mk VI*, CD No 1 Portable (Aust), CD No 1 Mk IV (Aust), and AA No 3 No 1 (GL Mk IIIC APF) will henceforth be downgraded from SECRET to RESTRICTED. Security measures appropriate to this lower classification will be used forthwith.

2. Users of this equipment will continue to ensure that no valve or major component of Radar sets is allowed to fall into enemy hands unless it has been rendered permanently unserviceable.

(Sgd) John Minogue Lt-Col
for Lieutenant-General
Chief of the General Staff

COPY

RESTRICTED

AUSTRALIAN MILITARY FORCES
(Chief of the General Staff)

Headquarters,
Victoria Barracks
MELBOURNE SC 1

17 Oct 44

In reply please quote
(15/403/185) SM 11096)

HQ First Aust Army (6)
HQ Second Aust Army (10)
HQ Western Command (6)
Rear HQ First Aust Army (8)
HQ RAA NT Force (4)

Copies for information to - MGO Branch (6); DMI (3); Naval Board DR (N)(2) MGRA (3); Air Board DRS (2); Radiophysics Laboratory; Ministry of Munitions.

SECURITY OF SPECIAL RADAR TRANSMITTER VALVES

Reference this HQ Memorandum 118701 of 28 Sep 44.

Paragraph 1 of the abovementioned memorandum will be amended to include Magnetron CV 41 (Equipment RADAR AA No 3 Mk II) in the RESTRICTED classification.

(Sgd) John Minogue Lt-Col
for Lieutenant-General
Chief of the General Staff.

SECRET

ALLIED LAND FORCES IN SW PACIFIC AREA

SM24999 LHQ 28 Oct 1943

| | | | |
|---|---|---|---|
| First Aust Army | (10) | Q'land L of C Area | (10) |
| Second Aust Army | (10) | NSW L of C Area | (10) |
| 3 Aust Corps | (15) | SA L of C Area | (4) |
| NG Force | (11) | VIC L of C Area | (6) |
| NT Force | (4) | TAS L of C Area | (2) |

Copies for information to -

| | | | |
|---|---|---|---|
| | | DMI | (2) |
| D RADAR RAN | (2) | MGRA | (2) |
| D RDF RAAF | (2) | LHQ School of Radiophysics | (2) |
| MGO Branch | (6) | | |

SECURITY OF SPECIAL RDF (RADAR) TRANSMITTER VALVES.

Reference is made to LHQ Most Secret Memorandum SM2657, dated 8 Feb 43, relative to the above.

2. The secret quarterly return referred to in para 6 thereof is no longer required, such paragraph being amended to read as follows :-

"All units having such valves on charge will maintain a register by serial numbers of receipts and returns."

(signed) ?? for
Lieutenant-General
Chief of the General Staff.

Serial No. 16823

Distributed by G(SD) on 6 Nov 43 to -

| | |
|---|---|
| BRISBANE FRT | 3 |
| TOWNSVILLE FRT | 3 |
| CAIRNS FRT | 3 |



CCA (2)

Forwarded for info

AUSTRALIAN MILITARY FORCES

( Chief of the General Staff)

Headquarters, Victoria Barracks.
SM25455 Melbourne. S.C.1.

PUBLICITY - RADAR.

1. Recent press articles have revealed that the Allies made extensive use of Radar. This combined with the downgrading of the security classification of certain equipments may cause Radar operator personnel to disregard current security regulations. It must be emphasised that no discussion of RADAR with acquaintances or unauthorised persons is permitted.

2. It will be noted that publicity has been confined, as far as Army equipment is concerned, to the bare facts that-

(i) Radio waves are sent out which are refected from solid objects.
(ii) The future potentialities of Radar are almost unlimited.
(iii) The Army uses Radar to detect aircraft.

3. It is equally forbidden for Army Radar personnel to join in any speculation as to future developments of Radar or possible uses of it by the other services.

(Sgd) Major-General.
MGRA LHQ.

5 Nov. 43.

AUSTRALIAN MILITARY FORCES.

H.Q. Coast Arty Brisbane.
CALOUNDRA.
24/11/43.
Ref. 056/43/03.

O.C.
9 AUST.SPECIAL RADIO DET.
AUSTRALIA.

D.R.L.S.

SURFACE WARNING - TEST.

1. Reference test conducted recently with Allied submarine.

2. The following is the text of an H.Q. letter re report submitted by you.

"The results of this test form a valuable addition to existing records of performance of CD RADAR sets against very small objects"

.....Lieut.
I.O. H.Q. Coast Arty Brisbane.

Time of Despatch.1200.hrs.

SECRET

9 Aust Special Radio Det RAA
Australia
24 Sep 43

FC Coast Arty Brisbane
CI LHQ School of Radiophysics
OC 2 Aust Special Radio Det
OC 8 Aust Special Radio Det

Report on Submarine Cooperation

Herewith report on submarine cooperation carried out by this unit on 24 Sep 43.

The results indicate that the maximum pick-up range on a submarine periscope to be expected on this site is 10,000 yards. Futhermore in rough or even moderately rough weather it is doubtful whether a periscope could be picked up at all.

R.M. Lamont ..... Lieut.
OC 9 Aust Special Radio Det RAA

9 AUST. RADAR DET.R.A.A....REPORT ON SUBMARINE COOPERATION.

24 Sep '43.

The sea was calm with a long slight swell. There was very little wind and the wave clutter extended to approximately 5000 yards. The set was operating at maximum sensitivity.

Prior to submerging the submarine was travelling at 15 knots and gave a saturation echo. It submerged 4000 yards from the set at 1500 hrs.

On submerging ( which took approx. 30 seconds) the signal to noise ratio dropped to 2/1 and remained fairly constant at this level out to 10,000 yards. The echo from the periscope was intermittent ant the intervals during which it disappeared increased from roughly 2 seconds at 5000 yards to several seconds at 10,000 yards and approx. 2 minutes at 12,000 to 13,000 yards. The signal to noise ratio was 3/2 at 10,000 yards and at 11,000 yards the echo was hardly distinguishable from the noise. It was very difficult to follow the echo after 10,000 yards and at 13,000 yards it was lost.

While submerged the submarine proceeded on a course bearing of 107 degs. at a speed of 4 knots.It surfaced at 1700 hrs at a range of 21,000 yards and was immediately picked up, (Signal to noise 3/1) and followed to 36,000 yards where it was finally lost.

Visually the periscope was difficult to see even with a telescope and was lost at 7,500 yards. It was impossible to see with the naked eye. The periscope appeared to be of very small diameter and left no wake. It appeared to keep a constant height above the surface. The bulk of the submarine could not be seen below the surface even at 4000 yards.

It is concluded that on this site it would be possible to pick up a periscope only at ranges less than 10,000 yards.

Careful operation would be necessary and wave clutter of even moderate intensity would swamp the echo.

R M Lascorgne .....Lieut.

AUSTRALIAN MILITARY FORCES

SECRET

SUBJECT:- Coast Watching Radar

Headquarters,
Lae Base Sub Area,
9 Mar.'44.
RAA 25.

9 Radar Detachment.
"N" Hvy. Bty.
2I Aust. TK/A Bty.
2/3 Aust. Comp. A.A. Regt.
N.O.i/c.
H.Q. Base "E" U.S.A.S.O.S.

1. A coast watching Radar is now installed on Mt. Lunaman.

2. This det. is capable of locating and following the movements of all shipping and low-flying aircraft within its range.

3. All shipping plots registered by Radar will be passed to "N" Hvy. Bty. and N.O.i/c for identification.

4. All aircraft plots will be passed to G.O.R. for identification.

5. Range, bearing and movements of all unidentified plots will be passed immediately by "N" Hvy. Bty. to:-

2I Aust. TK/A Bty.

Gun Ops. Room.

H.Q. Lae Base Sub Area.

BRIGADE MAJOR(R.A.A.
(C.A.BOWEN.)
LAE BASE SUB AREA.

SECRET

TELEPHONE—

Australian Military Forces

~~Eastern Command~~

Please quote this Number when replying

| N/90/1 | | 44 |
|---|---|---|

*Address* "N" Hy Bty (Coast) RAA
AUSTRALIA
*Date* 6 March, '44

Port Director
R.A.N.
LAE.

REPORTING WAR SHIPPING

1. A Coast Defence Radar Set, tactically controlled by this Battery, is now in operation.

2. The set is capable of picking up shipping at 40 miles, and will be in operation during the hours of Darkness and thick weather.

3. The following scheme is therefore proposed :-

(i) All "sightings" by Radar will be passed immediately to Battery O.P., repeated War Signal Station.

(ii) Battery O.P. will be notified, through War Signal Station, if sighting is identified or is expected. No further reports of that sighting will be made unless required. Battery O.P. will notify Radar of identification.

(iii) Should indentification not be possible reports will continue to be made as in (i) at approx. 5 minute intervals, until sighting is identified or engaged.

(iv) Port Director will warn the Battery Duty Officer the E.T.A. of any allied war vessel before it reaches a range of 40 miles from the Battery.

4. With reference to sighting by Aircraft Reconnaissance, the following scheme is proposed :-

(i) Immediately notification of sighting is received by Port Director from Naval Liason Officer at Fighter Section, the Port Director will cause the Battery O.P. to be informed, through the War Signal Station, in the following terms :-

(a) Description of sighting by category and type

(b) Bearing and distance from some Air Reference Point (preferably Mt. Lunaman).

(c) Direction of movement and Speed.

(d) Time sighted.

5. It would be appreciated if you would have these schemes promulgated to those concerned, should they meet with your approval, or if you would suggest any ammendments you deem required.

..... Major A.I.F.
O.C. "N" Hy Bty (Coast) RAA.

Distribution
Port Director, R.A.N.
"B" M.R.A.A. LAE Base.
O.C. 9 Radar Detachment.
B.O.P.
File.

SECRET

# ACTION ON RECEIPT OF SHIPPING OR LOW-FLYING AIRCRAFT SIGHTINGS.

## A. WARNING FROM RADAR.

1. Mark Sighting Board with plot.
2. Report Sighting to Duty Officer, R.A.N. through W.S.B., giving
   - (i) Category and Type (if possible)
   - (ii) Bearing.
   - (iii) Range.
   - (iv) Direction of movement.
   - (v) Speed (if possible).
   - (vi) Time sighted.
3. Enter Shipping Log accordingly, and
4. Await recognition by R.A.N.
5. If sighting is reported recognised or expected, inform Radar and mark Shipping Log accordingly.
6. If sighting is reported NOT recognised, suspicious or hostile, inform, in the terms of A.2 :-
   - (i) Officer of the Watch, immediately.
   - (ii) Radar.
   - (iii) B.H.Q. 21 Tank Attack Bty. (through Lae Base switch)
   - (iv) G.O.R.
   - (v) Lae Base "G" Staff Duty Officer.
   - (vi) Mark Shipping Log "U.I."
   - (vii) Enter Message Log fully.

## B. WARNING FROM R.A.N.

1. Mark Sighting Board with plot.
2. Report sighting to Radar, giving all information received, in terms of A.2.
3. Report all information x in terms of A.2 to :-
   - (i) Officer of the Watch, immediately.
   - (ii) B.H.Q. 21 Tank Attack Bty. (through Lae Base switch)
   - (iii) G.O.R.
   - (iv) Lae Base "G" Staff Duty Officer.
   - (v) Enter Message Log fully.

4. Should warning come from G.O.R., carry out same proceedure as in B.3, substituting Duty Officer, R.A.N. for G.O.R.

## NOTE.

1. All tactical and operational information must be transmitted to the author mentioned in Section "A", in the order shown, without delay.

2. Radar will give each vessel a distinguishing number which will be include all subsequent reports concerning the vessel. The numbers will start from 1 time the set goes into operation.

Copy to Radar for Inf.

.....Majo
O.C. "N" Hy. Bty. R

9 MAR 1944

9 Aust Radar Det R.A.A
Australia
18 Mar '44

HQ Lae Base Sub Area
(Copy to "N" Hy Bty).

STANDING ORDERS FOR OPERATION.

Herewith copy of standing orders for operation as approved for the radar set manned by this unit.

An extra paragraph, ie. para 10 , has been added.

.....Lieut
O.C. 9 Aust Radar Det RAA.

SECRET

9 AUST. RADAR DETACHMENT R.A.A.----STANDING ORDERS FOR OPERATION.

TACTICAL.

(1) The role of the set is firstly, early warning and secondly, fire control (ie. as bty range finder). In the first role all reports will be made to the BOP by No 2 (plotting number). In the second role No 1 (set operator) will pass range and bearing continously to the BPR and at the same time No 2 will pass any information required to the BOP.

(2) The arc of search will be from bg 070 degs to bg 190 degs. The area between bgs 190 degs and 250 degs will not normally be searched unless in case of alarm or specifically ordered by BOP or the O.C, or No 1 of the watch. Shipping inside the area covered by the ML patrol will not normally be reported. This area is marked on the plotting board

(3) The set will be manned during the hours of darkness and also during CD conditions when ordered by the BOP. Operators will not stand down until the order "Revert to CB conditions " is given by BOP.

(4) Each vessel picked up will be given a distinguishing number which will be included in all subsequent reports concerning the vessel. These numbers will start from 1 each time the set goes into operation.

(5) On picking up a vessel its position will be immediately plotted and a second plot made 5 minutes later. The course bearing and speed will t then be immediately deduced and reported to BOP together with the time of the second plot and the range and bearing to the vessel at that time :- eg. "Radar calling BOP. Vessel No.....Time.....Bg.....Range...
...Course bg.....Speed.....Message Ends. Check back".

When possible an estimate of size of vessels picked up will be included.

(6) If any vessel is picked up outside the ML patrol at a range less than 20,000 yards, or which for any other reason appears suspicious it will be reported immediately to BOP and will be reported again 5 minutes later when course bg. and speed have been deduced.

(7) Subsequent plots on vessels picked up will be made on every sweep and reports will be made at 10 minute intervals until BOP informs that the vessel has been identified. All vessels will be treated as potential enemy vessels until identified.

STANDING ORDERS (CONTINUED) .

SECRET

(8) If a large number of unidentified vessels happen to be present in the area the plots and reports of each vessel may be made at intervals greater than ten minutes, the principle being that a thorough search must be maintained of the whole area in all circumstances.

(9) After a vessel has been identified no further reports will normally be made on it. However plots of all vessels in the area will be made at intervals of approximately 20 minutes in order to keep check of the movement of identified vessels. A report will be made immediately to BOP in the event of any of the following occurrences :-

(a) Movement outside of the normal shipping lanes.
(b) Unusually large change in course bearing.
(c) Vessel becoming stationary outside the port.
(d) Unexpected disappearance of the echo.
(e) Any unusual or suspicious occurrence.

(10) Any aircraft picked up will be immediately plotted and a second plot made 1 minute later. Course bearing will then be immediately deduced and reported to BOP together with the time of the second plot and the range and bearing at that time. A distinguishing number will not be given . eg. "Radar calling BOP. Aircraft pickup. Time.....Bg.....
Range.....Course Bg.....Message ends. Check back"

(11) The O.C will be immediately informed in the following circumstances:

(a) Breakdown of set or power unit.
(b) Breakdown of communications.
(c) Appearance of a vessel or other echo which cannot be identified by BOP.
(d) Declaration of alarm conditions.
(e) Any other unusual or suspicious occurrence.

(12) Personnel will not by any act or neglect hinder or prevent the efficient operation of the equipment. This will be treated as a most serious crime.

.....Lieut
O.C. 9 AUST RADAR DETACHMENT R.A.A