Siting of Repeaters

Search and Rescue communications on VHF are becoming more widespread and have proved to have many advantages. There is no time wasted between scheduled transmissions as with HF and the radios used are lighter and more convenient.
Search teams in the field appreciate being able to monitor the progress of the search.
Search Controllers are able to quickly divert teams and resources at any point in time.
Hand-held VHF radios have an effective range of 500 metres in wet bush. This can be extended considerably with the use of VHF repeaters or lightweight cross-band repeaters positioned to provide maximum coverage.

There have been many instances where Base operators have found that they have better communications with teams in the field on simplex (talk-around) than through repeaters which have been poorly sited. This paper is offered in an attempt to assist in the correct location of repeaters whether they be standard VHF Repeaters or the smaller Cross-Band (Pole-top) type of repeater. A separate paper will be prepared to compare the virtues of each type of repeater.

There is no substitute for experience, and every location has its' own particular problems, but these points are referred to avoid some of the difficulties experienced in the past:

1. **Consultation**
   The boundaries of the search area should be defined to determine the coverage required. It may be necessary to deploy more than one repeater to achieve complete coverage.. The Communications Manager and the Search Controller should discuss the problem together and investigate the various options for the repeater site(s). If the chosen site is a success, they share the credit - if it fails, they share the blame.

2. **Access**
   It is preferable that the site chosen for the repeater be readily accessible. If the defined search area changes or is expanded, it may be necessary to retrieve and re-locate the repeater.
   VHF repeaters are fairly heavy and should not be carried long distances. For long or steep hauls, the use of a cross-band (pole-top) repeater should be considered.
   Repeaters are fairly complicated and there is much to go wrong. Failure may result from a loose connection in either the coaxial cable or the battery supply, or the battery itself may have expired. There may be times when it is necessary to change the channel being used because of interference. These alterations or repairs can best be carried out quickly and efficiently if the repeater is located close to base or accessible by road.

3. **Locating the best site**
   The worst place to install the repeater is under the canopy in dense bush. Choose a location where at least half the length of the aerial can protrude above the bush or scrub. Cross-band repeaters could be installed by climbing a tree and fastening the poles to the trunk of the tree to ensure that the aerial has a clear view over the search area.
   One of the most common mistakes is to choose the highest available site. The nature of VHF vertical aerials is to radiate signals sideways and at an angle **upwards.** Apart from the effort in carrying the equipment to a high point, there will be an effect which gives better comms to field parties furthest away from the repeater. As field parties move closer to the shadow area under the repeater, signals will become weaker or even disappear.

A lower hill or mound within the search area could be ideal and it is easier to set up and retrieve the repeater by search parties moving through the area as part of their normal routine.
By locating your repeater in an area **below** the search area, the radio signals can travel up the valleys to the parties in the field. .
It is most important that the repeater is sited not only for the field parties but also so that Base has access.
There are many theories as to why repeaters work so well in the bush, which is an unfriendly environment for VHF. In practice, it has been found that best results are achieved by placing the repeater in a position where the radio signal is not too far above or below the forest canopy. It is thought that the signals are able to skip along the tops of the trees or scrub in a manner similar to skipping a stone across water. This may explain why the low angle of entry is more successful than a high take-off point.
In those parts of the country where there is little or no bush coverage, it is probably better to mount the aerial closer to the ground - perhaps even on top of the repeater itself.

4. Multiple repeaters

If the search area is large, or if a large SAREX is taking place, it may be deemed necessary to install two repeaters. Placing the repeaters on the same site should be avoided. It has been known for the radiation from one repeater to affect the other to such a degree that the microprocessor chips inside the repeater have become contaminated and need to be re-set in the workshop. There could also be problems with the repeaters de-sensing each other or in some instances, cross-modulation may occur.
Should there be no other choice but to install them on the same general site, the repeaters should be located at least 20 metres apart and separated by ground contours.
The decision to utilise more than one repeater would also increase the number of operators and equipment required at Base.

5. Installation

It is preferable that at least one member of the party installing the repeater has had previous experience. A recommended practice would be to set up the equipment under supervision before leaving base to ensure that it works and that it is on the correct frequencies. There are many different types of repeater and any problems would best be solved before leaving base.
On arrival at the proposed site, the Base station should be called on a hand-held radio to ensure that Base will be able to access the repeater once it is installed.
If it is now considered that the site chosen may be too high and could transmit over the heads of the search teams, the aerial could be installed with a pronounced lean in the direction of the search area so that there will be some radiation in the downward direction.
It is most important that at least part of the aerial be above the bush canopy. If this is not possible, radio to Base for further instructions. A clearer site lower down may be preferable to a higher altitude.
In all cases, the repeater should be protected from the weather and aerials securely fastened so that they are not blown over by high winds.
After installation, operation of the repeater should be checked with Base. Careful note should be taken of the location and the Grid Reference should be transmitted to the Communications Manager.

6. Base setup

There are many considerations when choosing the site for Base. There should be consultation between the Search Controller and the Communication Manager before a final choice is announced.

As far as communications are concerned, Base should be located away from high tension power lines, out from under the bush canopy with room for HF aerials if required, and with potential to operate simplex to search teams prior to repeaters being installed, or in the event of repeater failure.

Because of the need for transportation of heavy batteries and equipment, good vehicular access would be preferred.

Aerials should be mounted on poles which are at least 7 metres tall. This may not be necessary for repeater access, but could make simplex contacts possible for teams outside the repeater coverage area or in the event of repeater failure. At least 2 sets of poles should be available for use at base. Cables and equipment should be checked after each operation to ensure they are in good repair.

7. Care of the equipment

When the repeaters, poles, cables and aerials are being transported either by road or in packs, it should be remembered that this is not military-spec equipment. In vehicles, the repeater is best placed on a seat or cushion. The aerial should be secured alongside poles, or with the poles in a proper carry bag. Cables should be neatly coiled without twists.

Any defects after use should be noted on paper and left with the equipment. If log sheets are provided, they should be completed to record the proper history of the use of the repeater.

The repeater and associated equipment and cables should be checked carefully after each operation by a designated person and batteries re-charged ready for the next operation.

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