High Frequency Communication in Antarctica

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ABSTRACT

Three kinds of communication equipment were used by the Second Indian expedition team dur ing their stay at Antarctic. These were High power HF transmitter TS 545CD/T/BEL High power HF transmitter MPT 1770 (MACE). Transportable HF trans receiver station MHM 300 (BEL) and Man packed trans receiver LHP 219 BEL.

The equipment was used to establish a contact between the Base camp and India Base camp and *Dakshin Gangotri* and the Base camp with the ship and the field parties.

The high power communication sets—400 watts and 1 5kW transmitter however failed to contact COMCEN Bombay though all the messages sent by COMCEN were received except on the days of magnetic storm.

100 watts trans receivers which were installed at Base camp and *Dakshin Gangotri* likewise failed to establish communication link although drapol antenna had been used. The frequency of transmission was 16 440 MHz Modifications in the arrangements to the form of using whip antenna and changing the frequency of transmissions to 3 500 MHz helped to the extent that the base camp could receive messages from the *Dakshin Gangotri* camp-a distance of 80 km but the reverse was not possible.

In communication with helicopters it was observed that as long as the helicopter was flying at an altitude of 600 m the Base camp could with the help of 200 watts transmitter be in contact with the Chopper even upto a distance of 100 km. No sooner the Chopper would come down to an altitude of 100 in the Communication would stop. The manpacked 15 watt sets were not found suitable for the working condition in this continent.

INTRODUCTION

The following equipments were earned with the Second Indian Scientific Expedition to Antarctica for high frequency communication.

(a) Manpack trans-receiver, LHP 219 (BEL)

Specification

Transmitter power	15 Watts (Max)	Power source	24V DC
Frequency range	2 to 30 MHz, in steps of 1 kHz	Consumption	1 5 Amps (Max for TX) 180 MA (Max for RX)
Mode of operation	SSB, AM, CW	Size	18' X 12 X 4"
Receiver sensitivity	*2 V*	Weight	10 kg
Antenna	3 1 m Whip		

(b) Transportable HF trans-receiver station MHM 300 (BEL)

Specification

Transmitter power	100 Watts (Max)	Power source	24V DC or 220V AC (with MPSU attachment)
Frequency range	2 to 30 MHz, in steps of 1 kHz	Consumption	14 5 Amps for TX and 180 mA for RX

Mode of operation	SSB, AM, CW	Weight	50 kg
Receiver sensitivity	*2 V*		
Antenna	7.1 m. Whip and open wire dipole assembly.		

(c) High power HF transmitter TS 545 CD/T/BEL

Specification:

Transmitter power	400 Watts (Max.)	Consumption	1.6 kVA
Frequency range	1.6 MHz to 25.2 MHz in steps of 100 Hz.	Size	1.5 x 0.5 x 0.3 m
		Weight	200 kg
Mode of transmission	SSB, AM, CW		
Power source	220V AC. 1Ø		

(d) High power HF transmitter IMPT 1770 (MACE)

Specification:

Transmitter power	1.5 kW (Max.)	Power source	220V A.C. 3Ø
Frequency range	4,6,8,12,16,22,25 MHz Marine mobile bands in steps of 100 Hz.	Consumption	3 kVA
		Size	1.6 x 0.65 x 0.535 **m**
		Weight	236 kg
Mode of transmission	SSB, AM, CW		

(e) HF Receiver RS 512 (BEL)

Specification:

Frequency range	1.6 kHz to 25.6 MHz continuously tunable.	Sensitivity	1 V
		Power source	220 VA.C., 1Ø
Mode of operation	AM, CW	Consumption	40 VA

(f) MF Receiver HN 419 (BEL)

Specification:

Frequency range	100 kHz to 25.6 MHz continuously tunable.	Sensitivity	1 V
		Power source	220V A.C. 1Ø
Mode of operation	SSB, AM, CW	Consumption	40 VA

(g) MF/HF Receiver R 700 M (MACE)

Specification:

Frequency range	100 kHz to 30 MHz continuously tunable.	Sensitivity	0.7 V
		Power source	220V A.C., 1Ø 24V D.C.
Mode of operation	SSB, AM, CW	Consumption	35MA

COMMUNICATION OBJECTIVES

The equipments described above were to be used for the following purposes

(i) To establish a contact between ship and base camp, between base camp and parties going out for field work,

(ii) Base camp to *Dakshin Gangotri* and

(iii*)* Base camp to India

INSTALLATION AND OPERATION OF HIGH POWER TRANSMITTERS

The two high power transmitters were transported in the form of modular sub assemblies. Both the transmitters were assembled at the base camp by incorporating these separate modules into the main frame. During the installation and operation of these transmitter several detects developed and were rectified in due course of time. These are detailed in Appendices 1 and 2.

Installation of high power transmitter antenna :

(a) Two masts each of 48 feet height were erected.

(b) The guy ropes holding the masts were strengthened tying them with nylon ropes the other end attached to wooden stakes burried one metre deep into ice.

(c) A three wire folded dipole antenna was raised on these two masts pointing towards Bombay, at 150° from North.

Once the antenna was erected communication with India was tried 400 watts and 15 kW transmitters were used to contact COMCEN Bombay, but COMCEN did not acknowledge the base camp. Base camp was receiving COMCEN clearly except on the days ot magnetic storms during which the ionospheric absorption goes high COMCEN Bombay was using 5 kW transmitter and had a directional antenna pointed towards base camp.

These communication trials were carried out from 15th January, 1982 till 14th February 1983.

OPERATION OF LOW POWER TRANS-RECEIVERS

100 W trans-receivers were installed at two stations. One at the base camp and another at *Dakshin Gangotri* (D G), which was 100 km away from base camp. The location of D G was in a valley surrounded by hills. Two dipole aerials were erected at those two stations and communication link was tried. The frequency of transmission was 16 440 MHz. The two stations could not communicate with each other both in voice as well as in C W.

Station at D G then was shifted to a higher place and instead of dipole a 7 1 m whip antenna was erected. Similar type of antenna was erected in base camp on top of the hut to gain height. Ground radials were spread to make an artificial ground. With this change the mode of propagation was a vertically polarised wave supported by ground. Even after this change the communication was not through.

Now, the frequency of transmission was changed to 3500 MHz. This was done because ice, which does not support the ground-wave propagation much, attenuates higher frequencies more than lower frequencies. The aerial at base camp was changed to end fed 100 m long were antenna. Antenna at D G was still 7 1 m whip. With this change communication was tried again. Now base camp could receive D.G. intermittently but D.G. could not receive base camp. Even after changing the aerial to end fade long wire antenna at D.G., communication was not through. An effort was made to raise the antenna height at base camp by tying a balloon at the other end. This also did not help in getting the communication through.

Just to ensure that the sets are working and with medium power set D.G. actually be contacted with vertically polarised wave supported by ground, Russian station Novolazarovskya near D.G. was tried at 3.650 MHz. With this station communication was through. Later, it was found out that at Novolazarovskya a directional rhombic antenna with high power transmitter is being used.

Another experiment was carried out with the help of a helicopter, when it was flying to D.G. and high power 400 watts transmitter. As long as the helicopter was flying above 2000 ft. base camp was in contact with it but when it started to land D.G. and height was reduced to 500 ft. the signal strength started reducing and as it landed communication was cut off.

15 watts, HF trans-receiver gave a range of 3 to 5 km with 3.1 m whip antenna. The frequency used for communication was 16.440 MHz. On one isolated occasion a contact was obtained over a distance of 22 km. An effort was made to find an attenuation pattern for high frequency radio waves on the ice shelf. Fig 1 shows the sharp decline in signal strength at higher frequencies.

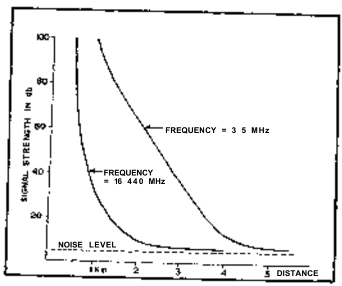

Fig 1 Diagram showing variation of signal strength with distance at different fequencies

OBSERVATIONS AND CONCLUSIONS

High power transmitter receivers

Since most of the time spent in installing and servicing of the transmitter and antenna systems, not much time could be spent on actual communication trials. However, it was observed that reception signal from COMCEN Bombay was exceptionally good. It was felt that if a direction antenna with a higher gain was used there would be greater possibility of two way communication. The power source for the MACE transmitter, namely, the three phase diesel generators was a major source of problem because of its difficult starting procedure and repeated failures. It was felt that large systems such as high power transmitters should preferably be taken in complete assembled and mounted form. They should also be rigorously tested in this condition prior to the commencement of expedition. It was observed that 400 watts transmitter was not very suitable for servicing in via, with the limited facilities available. This is one factor that must be kept in mind while acquiring equipments in future.

Low power trans-receiver

The 100 watts trans-receiver sets worked satisfactorily as per their specifications. However, their operation as far as the transmission efficiency was concerned was hampered by the ice covered terrain. It was felt that these sets would be suitable for vehicle mounted operation in communication with base camp having a high power transmitter and high gain antenna.

The manpack 15 watts III trans-receivers were not found very suitable for the working conditions, namely, for parties going out on reconnaissance trips on snow scooters and on foot. This was due to three reasons.

(a) The process of antenna matching was cumbersome.

(b) The sets were inconvenient to carry around clue to their size and weight.

(c) The range obtained was not enough due to poor ground conductivity.

APPENDIX 1

The following defects were observed and rectified in 1.5 kW transmitter supplied by MACE:

1. Transmitter was not switching on :- This fault was existing because of the wrong wiring at the relay coil of RLI in HT unit. One of the mains phase was grounded. The fault was rectified by correcting a wrong wiring.
2. Instead of 220V A.C., 440V A.C. was fed at various points. The load distribution in different A.C. phase was not correct. This fault was rectified by distributing the load evenly on all the phases. To do this the following wiring changes were made:-

H.T. Unit

(*i*) Blower: Disconnected point no. 10 of SK1 and grounded point no. 1 of TS4 (Load on phase S).

(*ii*) Relay RL2: Disconnected point number (a) of RL2 from point number 11 of SKI and grounded point no. (a) (Load on phase R).

(*iii*) Relay RL1: Disconnected point no. (a) from point no. 44 and connected to ground (Load on phase R).

L.T. power supply

(*i*) Relay RL2: Disconnected point no. 6 of PL2 and 12 of OFF switch and ground point no. 12 (Load on phase R).

(*ii*) Transformer T1: Point no. 1 of transformer Tl was removed from point no. 40 of PL2 and point no. 1 was grounded.

(iii) Neon Lamp: One end of neon lamp was grounded.

Exciter

(1) Disconnected R phase going to exciter and one end of fuse F2 was grounded.

Following components were changed to make the transmitter serviceable.

L.T. power supply

Transistor TR11 in -60/95 V bias circuit was found bad and was changed with BEL 100 P transistor since the same transistor was not available.

P. 1. unit

Bias adjustment potentiometer V2 was open so it was replaced to make the circuit working.

APPENDIX 2

Faults observed in 400 watts transmitter supplied by BEL:

This transmitter worked for one day after the installation but subsequently developed the following faults which were rectified:

Driver Unit: Transistor TR1 2N 5070 was faulty (C to E leaky) which was causing the low gain. The transistor was replaced.

Choke Dr. 2 in HT: Unit had become open. This fault was eliminated by shorting the choke since the replacement was not available. Air pressure switch was not making contact preventing safety loop operation. This fault was rectified by eliminating air pressure switch from the circuit.