
ENGINEERING AND
LOGISTICS

Technical Report on Antarctic Communication

Narendra Singh and Ajay Sharma

Defense Electronics Applications Laboratory, Dehradun

Communication is a vital need of human being in modern society. The significance of communication is enhanced further in Antarctica due to its hostile weather conditions and isolation from rest of the world. DEAL Dehradun has been responsible for providing total communication facilities viz.; convey communication, HF/VHF communication to the field parties, flight operations, communication with ship and communication between Maitri Antarctica and India. The DEAL team is also responsible for maintaining the satellite terminals for telephone, telex, fax and E-mail services from 15th expedition onwards. Since then the communication scenario has changed drastically and state of the art equipment have been introduced for providing HF/VHF and satellite communication. A high gain log periodic antenna was installed for better performance of HF link. Experimental HF voice/data communication trials have been conducted to get the new communication window for data transfer between India (DEAL) and Maitri. In continuation of this specific program, the following tasks were carried out during the 25th ISEA.

Communication during Voyage

The 25th (Silver Jubilee) Antarctic expedition comprising 52 members sailed on 29th Dec, 2005 from Cape Town port, South Africa, under the leadership of Sh L. Prem Kishore of NGRI Hyderabad. Every Antarctic expedition is very significant and unique. Expedition team comprised scientists, engineers, communication team, doctors and logistic support personnel. Role of the communication team started from the day of sailing. During voyage phone, fax and e-mail facility were provided to the members by using the system available on board the ship. Calling time and e-mail size were kept to a minimum to restrict the expenditure on communication. Throughout the journey regular HF contact was maintained with India and Maitri Station. The first courtesy sortie reached Maitri on 9th January 2006. The VHF communication was installed the next day at ship for flight operation.

Installation of VHF Repeater

VHF communication is highly reliable and dependable due to line of sight communication. The peak of Vitehia hill 300 meter above Maitri level was selected for the purpose. The repeater and battery were housed in a separate wooden box. Ground plane antennae were installed with proper guy wires. No charging facility was available and so every time before convoy we had to replace the battery for convoy communication.

VHF Communication

Very High Frequency (VHF) is used to describe the 30 MHz to 300 MHz portion of the radio spectrum. This range of frequency provides short range line of site communication. The range for VHF communication can be from several hundred meters to several miles depending on equipment used, RF power level, antenna height, and terrain etc. VHF is the best choice to use when communication is needed to tie all personnel together in a localized area. Routine life cycle of Maitri Station depends on VHF Communication. It is necessary to execute several activities. VHF Radio Sets are used to be in touch with the field parties. Communication Officer quite frequently exchange information including location update, weather update with the scientists in field. It is mandatory to carry the VHF Set while leaving the station for any outside activity. VHF is used for route information, weather update to Convoy team. The VHF communication is also used to contact with summer huts, as well as in daily activities like generator operation and power change over, operating the pump house, to contact with the maintenance and support personal etc. VHF is also useful to keep regular touch with the neighboring Russian station 'Novolazarevskaya'. Some in-field scientific activities require conversation at regular intervals with team members dispersed in few hundred meters and they interact with each other by switching to VHF Radio set to different channel assigned to them for in-field operation. VHF repeater is very useful to extend the range of communication especially in the hilly and uneven terrain. Line of sight (LOS) is one of the prime requirements for VHF communication. The 165 km long convoy route from Maitri to the sea shore (India Bay) is covered by undulated snow surfaces. To provide VHF communication between Maitri and the mobile Convoy, the height of the transmitting antenna is very important to maintain LOS. By using the DC operated repeater station

at the top of 'Veteheia Hill', sited behind the Maitri station, there was a remarkable enhancement in the VHF Communication range.

Aviation band communication with helicopters was also done on VHF frequencies. It is very necessary during takeoff and landing of helicopter at Antarctic surface. Communication Officer and helicopter pilots are always in touch to update about visibility, clouds, wind factors, person on board (POB), under slung load and other information for the safe flight operations.

Also maintained periodic VHF contact with the nearby Russian station Novolazarevskaya.

HF Communication

High Frequency (HF) signal is extensively used for medium and long range radio communication. In the most basic sense, it is a radio capable of communication over land and sea for very long distances. In radio spectrum HF lies between 3 and 30 MHz. HF waves propagate over long distances due to reflection from the ionized layers in the upper atmosphere. Due to variations in height and intensities of the ionized regions, different frequencies must be used at different times of day and night and for different paths. Propagation may also be disturbed and enhanced during periods of intense solar activity. HF propagation has considerable vagaries and is far less predictable than propagation at VHF. HF frequencies are open to everyone with those frequencies. In an emergency situation it is of vital importance because as many people as possible can hear, which is something the satellite phones can never do. Another advantage of high frequency radio is that they are Free to Air, meaning they cost nothing for the time on-air. HF Radio equipments were used to establish connection between DEAL (Dehradun, India) and Maitri (Antarctica) as well as between Maitri and ship.

Long haul HF communication can reach any corner of the world depending upon the propagation conditions. Regular HF communication was maintained with India using 125 watts HF Codan Radio. The broad band log periodic antenna (6.2 to 30 MHz) was used for this purpose. The communication window in HF band is available during 1900 hrs to 2200 hrs IST.

There was no communication for couple of days during high magnetic storms. Lot of fading has been observed at Maitri which sustained even up to 03 minutes, due to sudden ionospheric changes.

Weather Fax on HF

Weather Fax was received by HF weather Fax machine twice a day. It is very important for the expedition member to know the weather condition while leaving the station for the field work like drilling, convoy, field sampling, etc. During the winter time it is very important to avoid getting stuck in the blizzard.

The weather fax data is transmitted by Pretoria South Africa. The fax quality depends on the ionospheric, magnetic conditions as well as HF antenna, which is frequently damaged by the blizzards.

Satellite Communication

In Antarctica, satellite communication is the only means of reliable communication over long distances. It can be initiated instantaneously and weather conditions do not affect too much as compared to HF. With the advancement in satellite communication technologies, satellites have emerged as the nodal communication means in remote areas like Antarctica and most of the communication activity in Antarctica including voice, email, fax and data are based on satellite.

There are five satellite terminals at Maitri Two are Inmarsat-M terminals, one of which is installed inside Maitri communication room. It is being used as the main terminal for telephone/fax. The second terminal is installed in the summer camp hut and is being used by leader for dedicated Fax and phone facility.

The third is the Inmarsat-B terminal which is installed in Radio Room. This is being used exclusively for E-Mail services twice a day. Being a 9.6 KBPS, all the technical data of IIG, NGRI and SASE are being transmitted time to time with using this terminal. To avoid large mails size, filter is being used time to time as per requirement.

Telex which was being used for synoptic data transmission by Inmarsat-A terminal (back loaded) was replaced by the fourth terminal i.e. Inmarsat-C terminal. This terminal provides EGC mail and is being used for the 06 hourly synoptic data transmission. Inmarsat-C provides the **GSM SMS functionality** and was tested and implemented.

The fifth terminal is the mini-M suitcase Inmarsat terminal. This is being used by the field parties like drilling team and convoy team while they are out of communication due to damaged VHF antennae in the blizzard.

Inmarsat-mM terminal can be used from inside of Banzara window if location is as per satellite location. Using EPABX port of terminal it was used during blizzard successfully. With this field party is never out of communication.

Convoy Communication

Indian station Maitri is 120 km away from ice shelf. The convoy is being sent to bring the scientific equipments, fuel, construction material and food etc from Indian bay to Maitri. The communication between convoy and Maitri is the backbone for a successful convoy. Therefore VHF static/mobile communication round the clock was provided for this purpose. The inter-vehicular communication is also of the same importance, which was maintained by using 25W VHF radios of Motorola and spare 5W Motorola walkie-talkies. The best possible communication was provided with the available resources.

Technical Problems Experienced at Antarctica

During our stay at Antarctica, the following technical problems had been experienced.

Installation and Operation of VHF Repeater

1. Due to improper strength and sealing, the wooden box which was used for housing the VHF Repeater could not withstand the Antarctic conditions. Therefore proper housing of the Repeater and charging facility of batteries on site is recommended.
2. The VHF Repeater unit should be ruggedised as per mil standard. The unit should be protected from static charge, which is one of the causes for repeated failure of repeater unit.
3. The VHF communication is the cheapest and reliable communication for convoy and major repair cannot be undertaken at Antarctica, sufficient spare units are required to be carried for the purpose.
4. High rating lead acid batteries of the order of the 180 Ah is of prime importance, as the low rating battery gets discharged faster due to low temperature.

The equipment's and battery should go under environmental test at the laboratory before dispatch to Antarctica.

5. VHF repeater of around 50 watt is required for extending the range and quality of communication.
6. Efficient VHF antennae are not available in sufficient quantity.

HF Communication

The HF wide band antenna had gone bad a number times and either the complete antenna was damaged or some of the elements were broken due to high wind.

So the number of wide band HF antenna should be required and low loss feeder cable should be connected.

Satellite Communication

Spot repair at component level is not possible at Antarctica, so spare satellite terminal is required inside Maitri. However, the test and measuring equipments at L band and sufficient spares at card level are required.

ACKNOWLEDGEMENTS

We are grateful to Directors of DEAL and NCAOR for giving the opportunity to participate in the expedition. DEAL Team received all out support from the leader of the team, other team members and logistic team, without that it would not have been possible to execute the task successfully.