

ELECTRICAL EARTHING AND ELECTROSTATIC PROTECTION AT ANTARCTICA

R.N. Sarwade and P.K. Dey

Research & Development Establishment (Engineers)

Background

Indian Antarctic Station, Maitri, is situated at 70° 45' south latitude and 11°40' east longitude on a small ice-free region of Antarctica, called Schirmacher Oasis. The term Oasis is used because this region is endowed with surrounding lakes. These lakes are frozen during winter and for major part of the summer, on the surface. Construction of Maitri is on jacked up steel foundation columns. The water supply to the station, which houses scientists, labs is taken from Priyadarshini lake through a 200 m long heated copper pipeline. The station is powered by three phase diesel generators. This power is used for operating boilers for heating water supply, lighting, communication, computers, workshop and instrumentation of various conducted experiments.

Problem

Electrical power distribution over a wide area necessitates electrical earthing for the purpose of protection against lightning and shock. Next more important purpose is protection of electronic instrumentation used for various measurements from Electro-Magnetic Interference and static charge nuisance, commonly observed in cold and dry environment.

It was observed that ground to neutral electrical potential-difference was varying at alarmingly high levels of the order of 100V. Investigations conducted showed very low soil conductivity due to existence of permafrost. Power ground at each of the genset was thus ineffective. Equipment ground at various locations were equally ineffective. In addition, balancing of the loading in all three phases was doubtful.

Steps taken to achieve effective grounding, methodology used, analysis carried out to establish data effect of weather parameters are discussed.

Methodology

An electrical cage was fabricated from 65 mm x 12 mm x 1000 copper flats, eight in numbers. It was lowered in 3 m deep water of Priyadarshini lake with the help of the helicopter. This grid was in turn connected by laying of 300 m long cable upto the foundation columns of Maitri.

One more cage was fabricated in the same manner as above and was lowered in the waste water ditch. This in turn was connected to the foundation columns, (**Fig.1**). The electrical potential difference measured successively after each of the above steps, gradually decreased from 80 V to 45 V to 25 V, and finally to 1.5 V. It was continuously monitored even during winter.

Winter Observations and Analysis

The cage dropped in kitchen waste water ditch was nearer to the boundary of the ditch. In winter, the freezing of water starts from boundary. Soon after the time when water in the vicinity of the cage was completely frozen, increase in potential difference between ground to neutral was noticed. Further inspection lead to the following findings:

- Braided copper used for connecting the cage to main ground was corroded due to sulphadising.
- Many joints on the way were found to be corroded.
- Ground connection to Bhaskara power block was found to be broken.

The difference in ground and neutral potential was measured regularly. **Chart-1** shows its variation over the year. It is clearly seen that till Feb 96, the difference was 100 V plus. The earthing was provided in Feb 96, as described. The chart shows rise during July-Aug 96. It is seen, (**Charts-2,3,4**), the minimum temperature is - 42°C around 21st July 96, due to which water around the cage was totally frozen and the result was increased potential difference during July and August, of the order of 40 V. The rise in ground potential during Oct-Nov 96 is due to mechanical failure of the laid cable.

Rectification

- Copper cage was shifted from boundary to the centre of the ditch and after excavation of ice, the cage was lowered to the bed of the ditch and was covered with a mixture of coal, salt, sand.

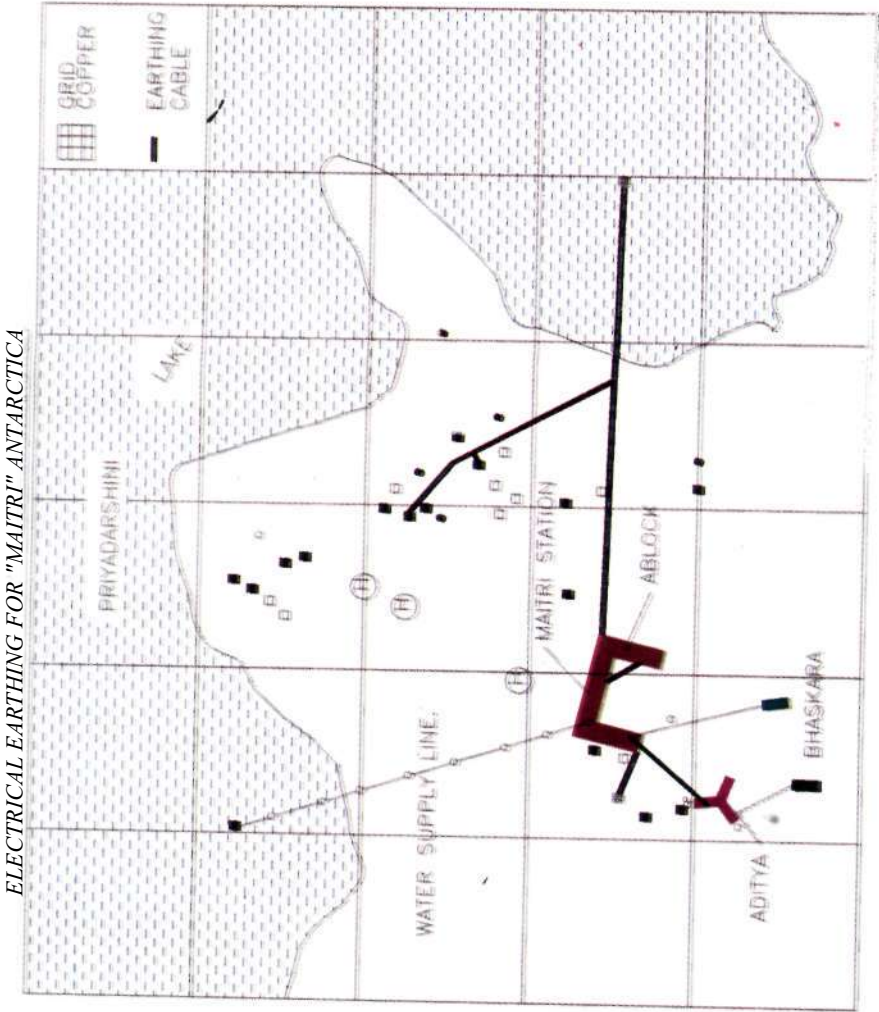


Fig.1

- The buried cage was connected to main ground (foundation columns of the station) with a thick copper strip, instead of braided copper as earlier.
- All the joints were cleaned and properly connected.
- New earthing cable was laid, connecting Bhaskara power block with the main ground.

EARTHING LAY-OUT AT ANTARCTICA

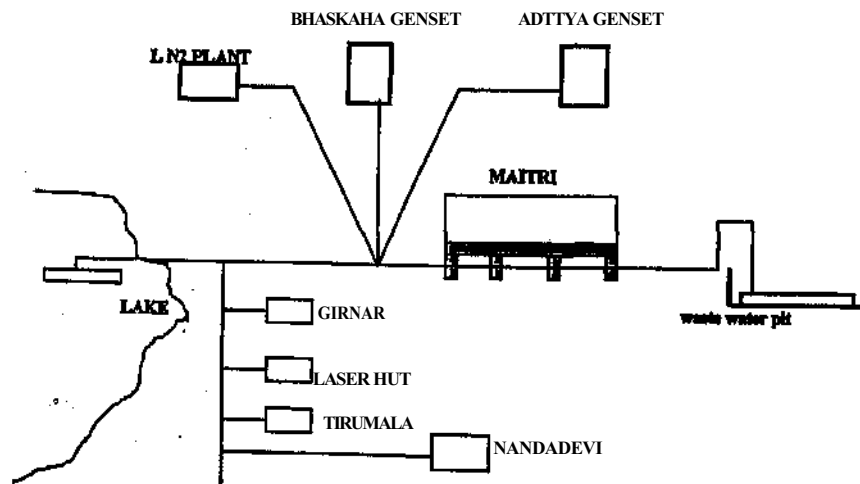
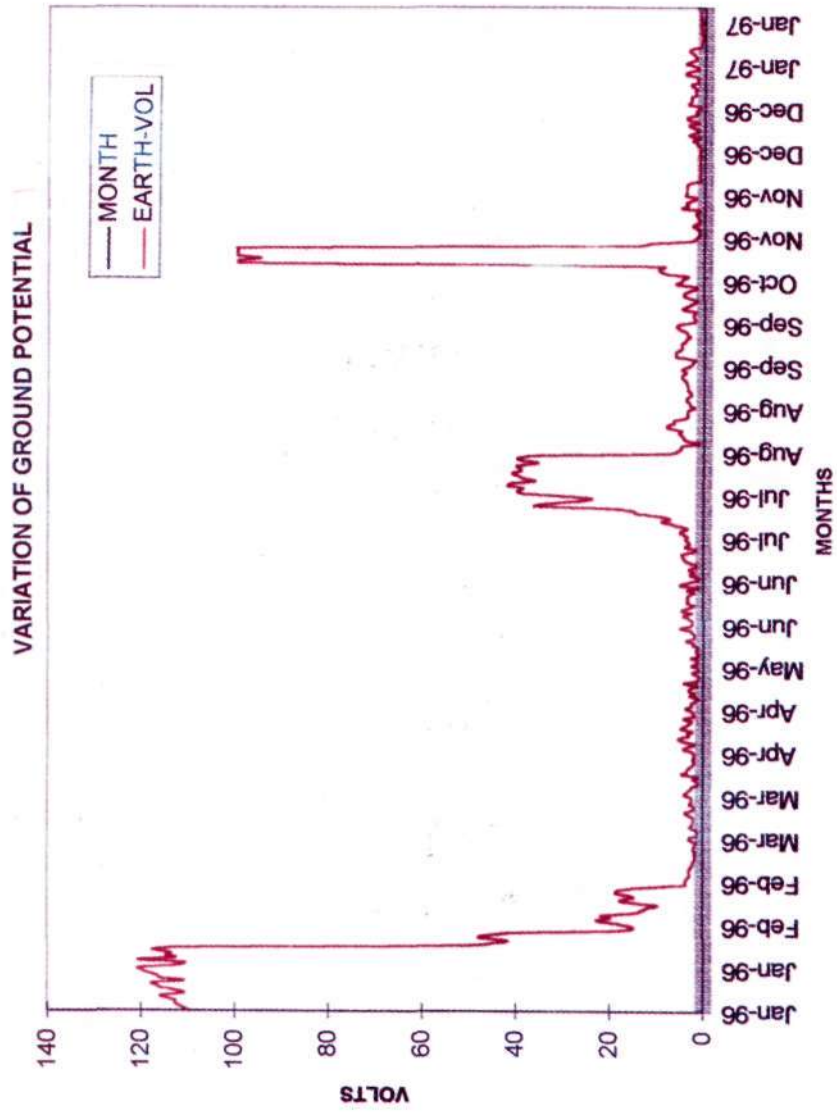


Fig. 2



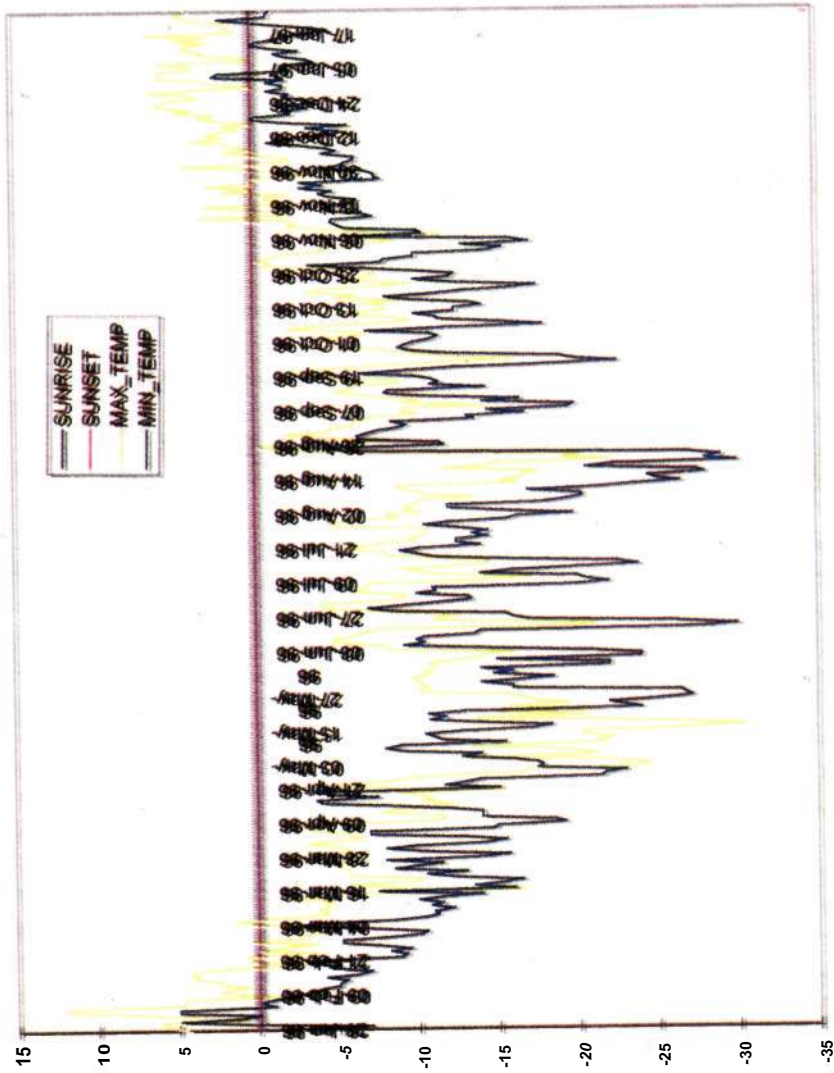


CHART 2

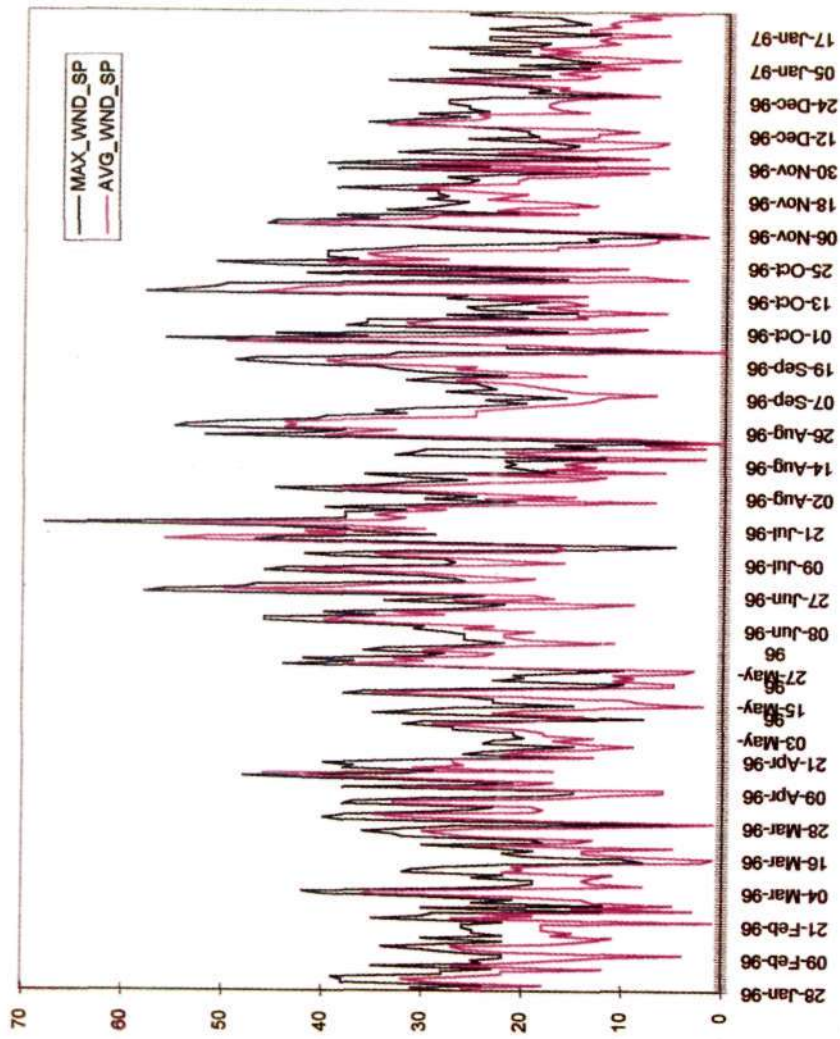


CHART 3

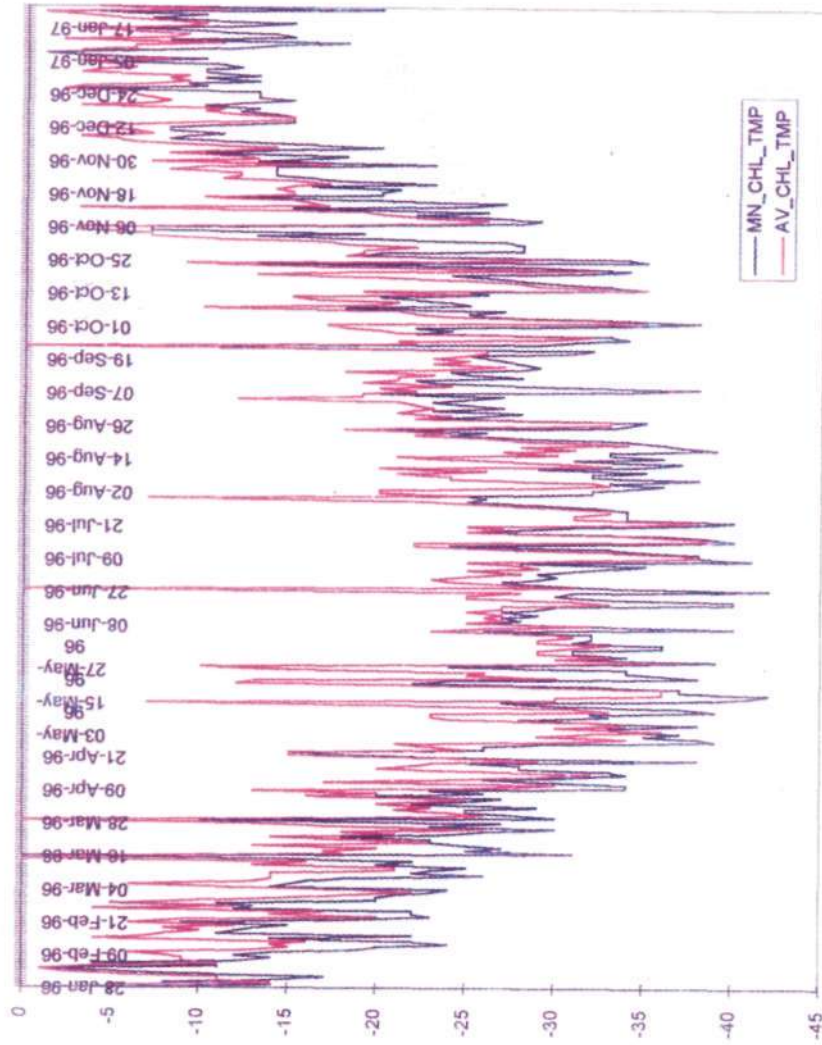


CHART 4