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WIND ENERGY UTILIZATION AT MAITRI AND ENVIRONS AT ANTARCTICA DURING XVII ISAE

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Introduction

Wind Energy Group of National Aerospace Laboratories had initiated the Wind Energy Activities during XVI Indian Antarctica Expedition. The main objective of the programme was to determine the wind energy potential in Antarctica and to formulate an overall Wind Energy Utilization plan for Indian Antarctic Scientific Programme. During XVI expedition the wind monitoring station was installed and commissioned. Wind data has been collected in three levels. Further a study of terrain features, energy loading patterns and infrastructure available at Maitri was carried out.

Based on the above studies a two pronged strategy to effectively implement a Wind Energy Program for Indian Station at Antarctica was initiated. In the continuation of this programme Shri I.Rajashekar from National Aerospace Laboratories was deputed to Antarctica during XVII expedition to carry out the following activities:

1. Installation of Wind Powered Battery Chargers
2. Trial pile foundation test for large windmills to be installed in future
3. Recommissioning of wind monitoring station at Maitri

Installation of Wind Powered Battery Chargers

Two small wind powered battery chargers were to be tested in this expedition to gain operational experience and study the applicability of wind power in areas such as communication and logistics as well as to provide standby power to scientific equipment.

In Antarctica communication between Maitri, Ship and Helicopter is carried out by VHF communication. A VHF repeater station located at Vittiah Peak requires 12V Battery power supply. Due to low temperatures and active use of the repeater, the batteries have excessive self discharge. During blizzards and other critical periods when communication is very important, a discharged battery powering the repeater station can cause considerable difficulties.

To over come this, discharged batteries were replaced very often resulting in loss of many hours of work and effort as this had to be carried out nearly every day.

Therefore a 12V,72 W rated wind battery charger was installed at the Vittiah peak. Subsequent to that, the need to bring discharged batteries to Maitri was reduced to bare minimum. Photograph in Figure 1 shows the installation at Vittiah peak.

The Automotive Workshop is at considerable distance from the Maitri generators. Therefore, there is a separate 30 KVA alternator installed at the workshop. The workshop generator is kept working for shorter intervals of time and is used to charge batteries of snow vehicles apart from other loads. Due to low temperatures and intermittent use, the batteries used to start the generator itself needs to be charged frequently. A portable generator had to be kept in readiness for this work. It was then decided that one wind powered battery charger should be installed at the automotive workshop and the output be used for charging diesel generator starter battery. The machine would also charge the batteries of snow vehicles as and when required. This results in a great saving of fuel as even for this purpose the generator had to be kept working.

The installation was accordingly carried out. The need to

charge the batteries for diesel engine starter was no longer an additional burden. Further there was no need to keep the 30 kW generator working when only electrical power requirement for charging batteries of snow vehicles. Fig. 2 shows the installation next to the automotive workshop.

Both installations have proved beyond doubt the usefulness of the machines. The machine at Vittiah peak was dismantled at the end of summer season. The machine at Automotive workshop was kept functional.

Trial Foundation

NAL is presently discussing with the Dept. of Ocean Development the possibilities of installing a 10 to 20 kW wind electric generator at Maitri. Wind turbines require a very sound foundation. Towards this end, a number of alternatives were considered. The soil conditions in the Shirmacher hill range is such that casting of normal foundations can be an expensive and difficult exercise. In order to keep this under control a version of pile foundation was to be tested.

The idea is to drill a series of holes in an array on a fairly big sized rock close by to the station. In these holes a snugly fitting rod would be inserted and fixed. The rods are to be integrated by channels or other structural members. This would then be used for supporting the wind mill tower.

Two methods for fixing foundation bolts were proposed. First one was to drill 34 mm diameter hole to a depth of 2 m. Into the hole steel rod is inserted after filling the hole with a low temperature setting epoxy resin. The resin is then allowed to cure for ten days (normal setting any time at $<0^{o}$ c is atleast 6 days)

This would form the basic unit of a pile foundation.

Another method tested was to drill a hole of required size. In this method conical shaped insert is first placed at the bottom of the hole(fig 3). A pipe with edge suitably prepared is driven into the pit and hammered over the conical expander. The pipe would then be

used as one of the foundation bolts. In both cases the free end of the pile would be suitably designed to permit integration of each of the pile by suitable structural members (fig 4).

Both methods were tested The rods fixed in this manner were pulled out using mobile crane with a tension type Load cell (figure 5). The bolt with epoxy resin fixing gave a pull out tension of about 4 tons. The pipe type of foundation withstood 2.8 tons before getting dislodged.

Therefore, Epoxy resin method appears to be more useful even though it may be somewhat more expensive.

Recommissioning of Wind Monitoring Station

The anemometer fixed at nineteen meter height was damaged while it was being removed for servicing. The main shaft was bent due to the fall. The anemometer was opened and the shaft was dismantled. It was straightened using the high speed lathe and a dial gauge. After balancing the vanes with the repaired shaft the anemometer was fitted back on the mast and recommissioned.

Conclusions

From the experiments with Wind Electric Generators it is evident that the machines can be very useful for the purposes of battery charging and energizing stand alone data acquisition and analyzing instruments. It was felt that a slightly larger system could be even more useful. It was also suggested by the user groups that the voltage control needs to be attended to. Attention is to be paid to connecting load to the generator.

The pile foundation idea has yielded positive results and it can be considered for future WEG installations and if necessary for other installations of similar nature.

Since there were some gaps in the wind speed records over 1996-97 monitoring was to be continued through 1997-98.

Acknowledgments

The successful implementation of this project has been the result of whole hearted cooperation of all the departments concerned with the expedition. The Enthusiastic support extended by the DOD, NCOAR, Army contingent, R & D E, SOI, user departments such as DEAL, IIGM and others was instrumental in making things work. The support extended by the Leader Shri K. R. Sivan of the XVII Expedition was exceptional. Chairman and the members of CSIR-SCAR Committee have given invaluable suggestions to improve the programme and it is gratefully acknowledged. The Director, NAL has been very positive and encouraging in this endeavor. Without this proactive support it would have been very difficult to meet the targets. At Wind Energy, NAL all the members have worked very hard at this program and it is gratefully acknowledged.

Fig 1. WEG at Vittiah Peak

Fig 2. WEG at Automotive Workshop

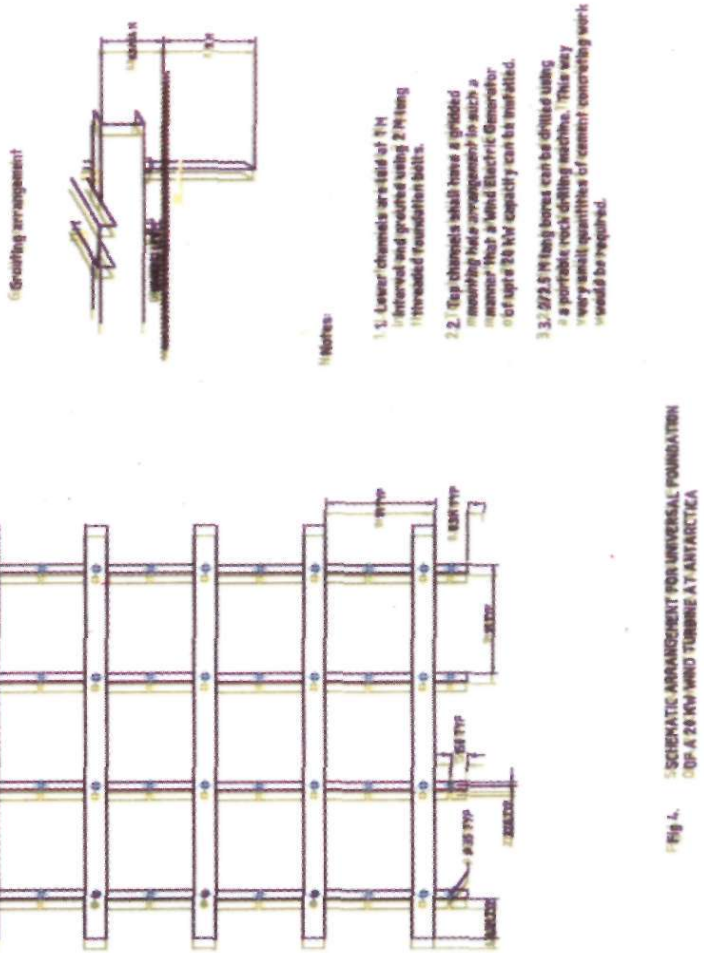


Fig 4. SCHEMATIC ARRANGEMENT FOR UNIVERSAL FOUNDATION OF A 20 KW WIND TURBINE AT ANTARCTICA

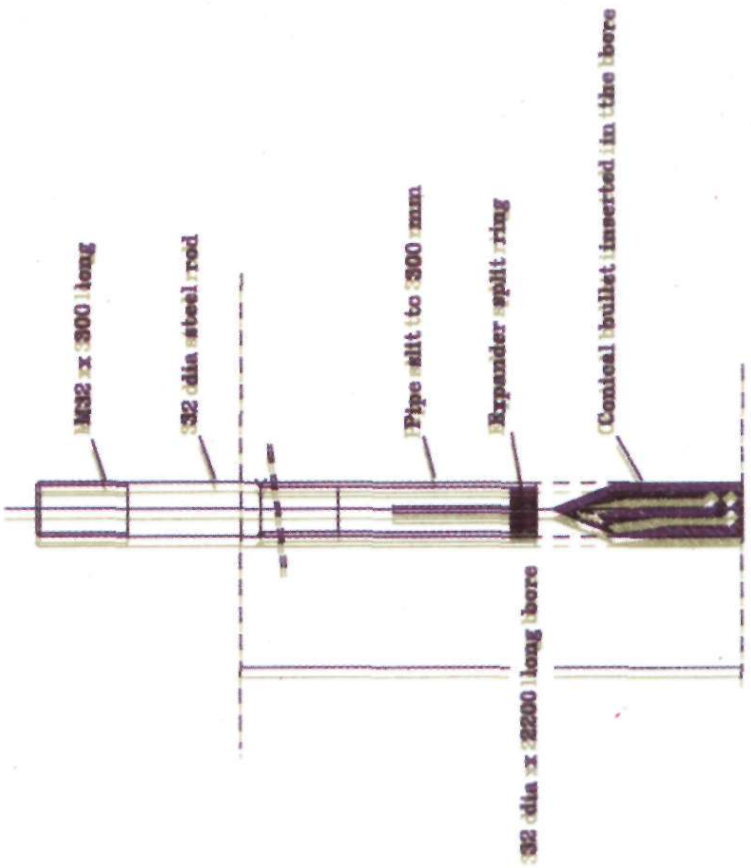
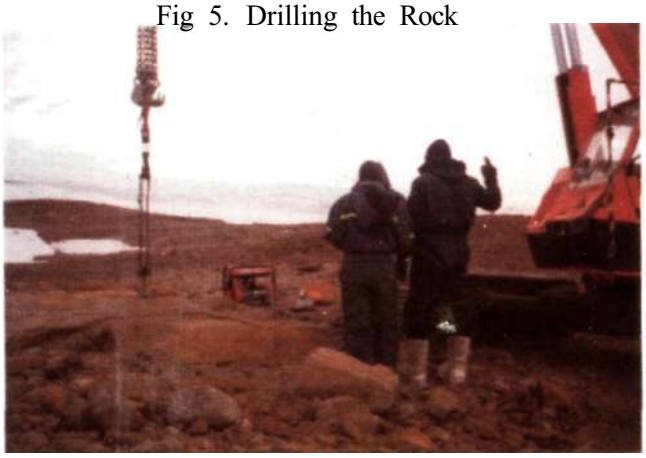


Figure 3: Foundation bolt expander arrangement

Fig 5. Drilling the Rock



Pull out test in progress