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New Indian Research Base at Larsemann Hills (Antarctica)

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ABSTRACT

The site for the proposed research base at Larsemann Hills, East Antarctica was visited and first hand evaluation of the topography, landing approach, water sources, wind pattern, construction/maintenance logistics, etc., has been completed. The exact location and alignment of the proposed station could be concluded in consultation with the Architects. An aerial survey and video photography of the total area has also been completed. Observations/ Recommendations on the proposed site for the new station are enclosed as Annexure.

INTRODUCTION

This Report has been prepared for the National Centre for Antarctic and Ocean Research, Goa as part of process for establishing the 3rd permanent Indian Research Base at Larsemann Hills in Antarctica.

The design of the new Indian Station is at a conceptual stage and the expedition to Larsemann Hills was primarily to make an in-depth assessment of the site and associated factors. This would be of immense help to NCAOR to evaluate and examine various proposals submitted by firms across the globe for the proposed research base before finalizing the best suited conceptual design.

The design is expected to meet the requirements of the Antarctica Treaty Protocol and the NCAOR would be able to demonstrate at the next ATCM in New Delhi with plans of their new station and India's continued commitment to working responsibly and cleanly in Antarctica.

Site Information

The location selected for the new Indian Research Base in the Larsemann Hills region is at: 69° 24' 28" South Latitude and 76° 11' 14"

East Longitude. The Larsemann Hills is an ice free area of 40 square kilometers located approximately halfway between the Vestfold Hills and the Amery Ice shelf on the south eastern coast of Prydz Bay, Princess Elizabeth Land, East Antarctica. The basic inputs about the site conditions of the Larsemann Hills region are as below:

Approach

The bathymetric surveys in the approach passage to the proposed site (an unknown promontory in between Stornes and Broknes peninsula, surrounded by Thala Fjord and Quilty Bay) has established that the average depth to the bedrock was 200 metres. Though no beach landing is available, the north eastern part shows a favourable gradient that can be developed into an offloading point. The proposed location of the new research base is at a distance of around 7 km from the nearest airstrip which could be made approachable through a well marked land route on the south eastern side of the promontory. Aerial view of the proposed site (Fig. 1) (an unknown promontory in between Stornes and Broknes peninsula, surrounded by Thala Fjord (on left) and Quilty Bay (on right).

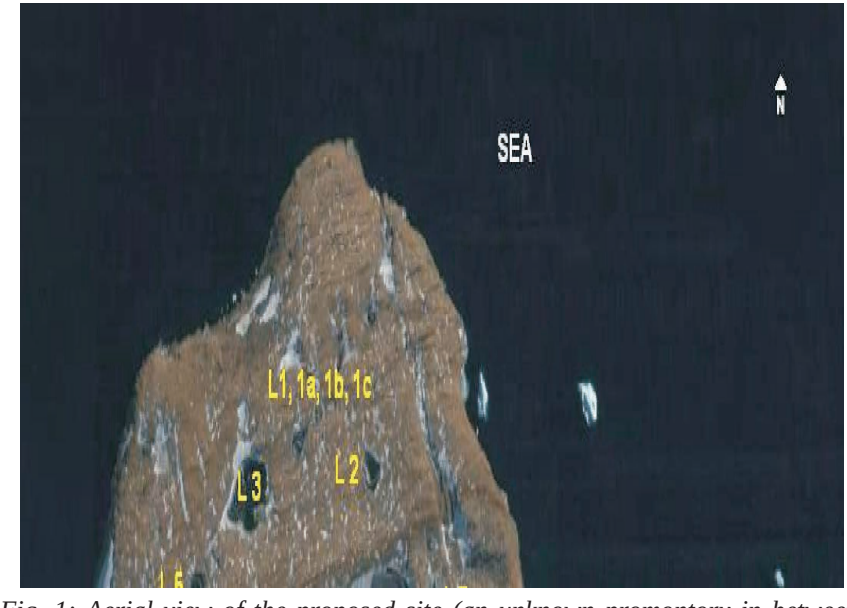

Fig. 1: Aerial view of the proposed site (an unknown promontory in between Stornes and Broknes peninsula, surrounded by Thala Fjord (on left) and Quilty Bay (on right)

Climate

The area witnesses persistent, strong katabatic winds that blow from the North-East. Minimum daily temperature recorded is - 39 degrees Celsius, whereas maximum daily temperature recorded is + 8 degrees Celsius. Precipitation occurs as snow and is unlikely to exceed 250 mm water equivalent annually. Direction of wind is mostly from East and South-East direction.

Hydrology

The promontory in the Larsemann Hills has 7 lakes ranging in salinity from fresh water to slightly saline, and in size from shallow ponds to large ice-deepened basins, although most are small and shallow (2-5m). The surfaces of all the lakes freeze during winter and most thaw for up to 2 months in summer allowing them to be well-mixed by the regular katabatic winds. Most lakes are fed by snow melt and some have entrance and exit streams that flow persistently during summer. Fresh (potable) water supply will have to be generated from the group of lakes located in the northern part of the promontory. The sea water (using RO) could be utilized for other non-potable purposes.

Refer Annexure showing the promontory

Proposed Structure and Materials (conceptual)

The proposed structure is a load carrying system that not only maximizes prefabrication but at the same time minimizes expensive and time consuming operations.

Fig. 2: View from jetty side of approach to the promontory

The concept for the new station is the use of standardized container modules in the load carrying system designed as a steel structure enhancing the stability of the overall building. The system is planned and designed taking long term needs into account.

The anticipated costs of operating, maintaining and servicing the systems are given top priority. The elements of the platform structure designed is to be fabricated from deformed rolled steel sections of ordinary structural steel while only elements exposed to higher stresses and extreme weather conditions steel with high ductility will be used. All steel members will be protected against corrosion by robust galvanizing. Welding at site is not planned. The foundation of the building will be designed on firm rock. The height of the modules above grade will be determined in consultation with NCAOR taking into account prevailing snow conditions. (Detailed design and material components for the building will be approved by NCAOR at every stage of work).

Around the containers an additional exterior jacket will be erected to protect the internal space from wind, precipitation and irradiation. The façade system is to be constructed of sandwich elements comprising of a PUR-core between steel sheet cover and will have a high shear resistance to withstand wind forces.

Construction and Logistics (conceptual)

The new Indian Research station is proposed to be constructed in 1-2 austral summers. Prefabrication of all elements shall be resorted to ensure the best quality which will also considerably reduce the construction time. Prefabrication will also reduce the size of construction crew and save substantially on transport costs and site resources. Most of the work will be done in India. The sequence of the site construction will have to be phased out to optimize time.

Presuming a construction season of 3-4 months coupled with uncertainty of doing work during certain days on account of vagaries of nature, and that the initial tasks involve setting out basic infrastructure, site development, approach jetty, erection of cranes, services, stores, etc. the project may take 2 austral summers for completion. This will allow for comprehensive testing and commissioning of the system before the station is left to the first over-wintering team at Larsemann Hills.

ENVIRONMENT

The new Indian Research Station shall conform to the Protocol on Environmental Protection. It is crucial that NCAOR identifies and mitigates all the potential impacts before, during and after construction of the station. It is understood that NCAOR has undertaken a full Environmental Impact Assessment in accordance with the articles of the Antarctic Treaty. The impacts can either be reduced or to some extent in some cases avoided. The adoption of green and other technologies that challenge current best practice is also expected to be promoted by NCAOR. The waste hierarchy of the 3 R's (Reduce, Reuse and Recycle) should be adopted with additional objectives to treat and dispose waste judiciously.

It is proposed that eco-friendly materials and executions will be strictly adhered to while setting up of the new station. The design team and selected contractors will have to develop a Construction Environmental Management Plan to ensure that the impacts are under control.

OBSERVATIONS AT LARSEMANN HILLS

Period of Inspection: 7th, 8th, 9th, 11th and 16th March 2007

1. The terrain for sitting the new station at Larsemann is fairly level with contour level at + 26.9m.
2. The approach to the station from the sea route shall be in the NE coast of the peninsula with contour level at + 1.7m.
3. The water depths as seen visually for a distance of 15 m from the shore line range from 1 to 3m approximately.
4. There are a lot of rock outcrops within 100 m length of the proposed approach to the station and a steep slope of 1 in 4 for a length of 20 m thereafter.
5. Site development from the material landing point to the station will be required to facilitate easy movement of vehicles.
6. Lake L-3 or L1-C could be used as the primary source of water supply to the station if the water is potable.
7. Wind direction is in S-E, E and N-E directions.
8. The navigation of the ship to the promontory may not be possible on account of icebergs being in close proximity to each other.

9. The use of helicopters for effective management of logistics will be required before, during and after construction of the station.

10. There are around 15 lakes and shallow basins within the promontory area (frozen at present) and average water depths estimated from 0.5 to 5 m.

Refer Annexure for other technical details

RECOMMENDATIONS

1. The footprint of the proposed station shall be restricted to 42 x 28m with frontage in SE direction.

2. The orientation of the station shall be in NW to SE direction (Maximum angle of inclination available is approximately 290 degrees).

3. The construction of two mooring dolphins very close to the coast may be required for anchoring a specially designed self propelled feeder vessel from ship to shore.

4. Two shore cranes with a swing of approximately 20 m may be required on shore for unloading and handling of materials.

5. Special tractor/crawler mounted units will be required for transportation of materials stored near the jetty to the station 330 m away.

6. Lakes L-1A, L-1B, L-1C, L-2 and L-3 could be dammed/ interconnected as a long term plan for conservation and supply of water to the station. RO using sea water may not be required as it also involves high maintenance costs.

7. The areas for earmarking other facilities like helipad, fuel storage, independent field laboratories/huts, etc. could be finalized concurrently during the construction stage of the main station.

8. Waste management education to be imparted to expedition members from time to time.

9. Familiarization by NCAOR staff with the technical systems before delivery to Antarctica.

10. Construction of a small scale model of the station and subject the same to wind tunnel effect.

11. Logistics management will be a critical activity before, during and after construction of the station.

ACKNOWLEDGEMENTS

1. Ministry of Earth Sciences, Government of India
2. Chairman, Mormugao Port Trust
3. Director, NCAOR
4. Technical Committee, NCAOR
5. Leader & Expedition Members XXVI ISEA (Summer Team)
6. Staff of NCAOR, Goa.

ANNEXURE

1.	Distance from proposed jetty landing to station	330 m
2.	Distance from proposed station to lake L-3	400 m
3.	Distance from proposed station to lake L1-C	183 m
4.	Distance from proposed station to lake L1-B	93 m
5.	Distance from proposed station to lake L-2	126 m
6.	Appx. area of largest Lake L-7	46000 m^2
7.	Appx. area of Lake L-3	11000 m^2
8.	Appx. area available for setting station (fairly level)	1500 m^2

9. GPS co-ordinates and Contour from MSL of:
   a) Apple hut installed by XXVI ISEA 69° 24’ 20.91” South Latitude and 76° 11’ 35.91” East Longitude 28.80 m
   b) Proposed jetty point 69° 24’ 17.91” South Latitude and 76° 12’ 00.22” East Longitude 1.70 m
   c) Proposed crane position near jetty 69° 24’ 17.85” South Latitude and 76° 11’ 58.42” East Longitude 9.60 m
   d) Proposed position for loading of piston bulley 69° 242’ 18.203” South Latitude and 76° 11’ 57.39” East Longitude13.70 m

(Contd.)

Annexure Contd.

e) Proposed new Indian research station 69° 24’ 20.31” South Latitude and 76° 11’ 30.68” East Longitude 26.90 m

f) Lake L-1 A69° 24’ 19.67” South Latitude and 76° 11’ 30.04” East Longitude 26.70 m

g) Lake L-1 B 69° 24’ 18.57” South Latitude and 76’ 11’ 38.99” East Longitude 19.10 m

h) Lake L-1 C 69° 24’ 24.70” South Latitude and 76° 11’ 17.26” East Longitude 34.70 m

i) Lake L-2 69° 24’ 23.11” South Latitude and 76° 11’ 24.94” East Longitude 33.90 m

j) Lake L-369° 24’ 27.37” South Latitude and 76° 11’ 01.95” East Longitude 37.00 m

k) Highest point in the are 69° 24’ 38.81” South Latitude and 76° 11’ 02.66” East Longitude 100.00 m

Note: Technical and scientific data shall be submitted by NCAOR, SOI, NHO and Shriram Institute for Industrial Research.