

Surface Transport over Snow & Ice Terrain in Antarctica

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Haulage of fuel and cargo from shelf and Dakshin Gangotri to India's new permanent station, Maitri, involved surface transport over 130 km long crevasse laden terrain of snow and ice. The wilderness of Antarctica, lack of landmarks and cruel cold, call for extreme caution, meticulous planning and a sound sense of navigation while negotiating the icy continent.

During the austral winter of 1990, the 7th wintering team had the distinction of running 9 convoys, 7 to DG and 2 to Wohlthat mountains. The convoys were significant in the sense that no assistance was sought for from the neighbouring German or Russian stations. The convoys to Wohlthat were a great feat as these have opened new areas for geological exploration during the winters.

Convoys to Dakshin Gangotri

The major objective of these convoys was to transport fuel and other heavy stores to Maitri. The team undertook 7 convoys to DG during the period from 25th Feb '90 to 14th Nov '90. A joint convoy with members of new team was also undertaken in February 1991 to acquaint them with terrain and route. Every convoy consisted of 6 vehicles (Fig.1) and 7 to 8 persons. Due to constraints of manpower, it was not possible to have a driver and a co-driver in all the vehicles. However, the leading and the last vehicle generally had two persons each, to guide and monitor the progress of vehicles. The details of different convoys to DG and the cargo handled are given below in Table 1.

Each convoy had a scientific component attached to it, increasing the value of effort. Significant glaciological, geomorphological and geophysical data were collected during the convoys by members from Geological Survey of India.

An effective communication between convoy and Base — as also among the different vehicles was maintained. Two 100W Tx/Rx sets and six PWSL Walkie-Talkie sets were provided to every convoy leaving Maitri.

Convoys to Wohlthat Mountains

Attempts by earlier expeditions to approach mountains south of Maitri did not materialise owing to the limited capabilities of then available snow vehicles. During DC Expedition two new Piston Bullys (DS-270) were obtained and a geological programme envisaged for Wohlthat mountains during winters.

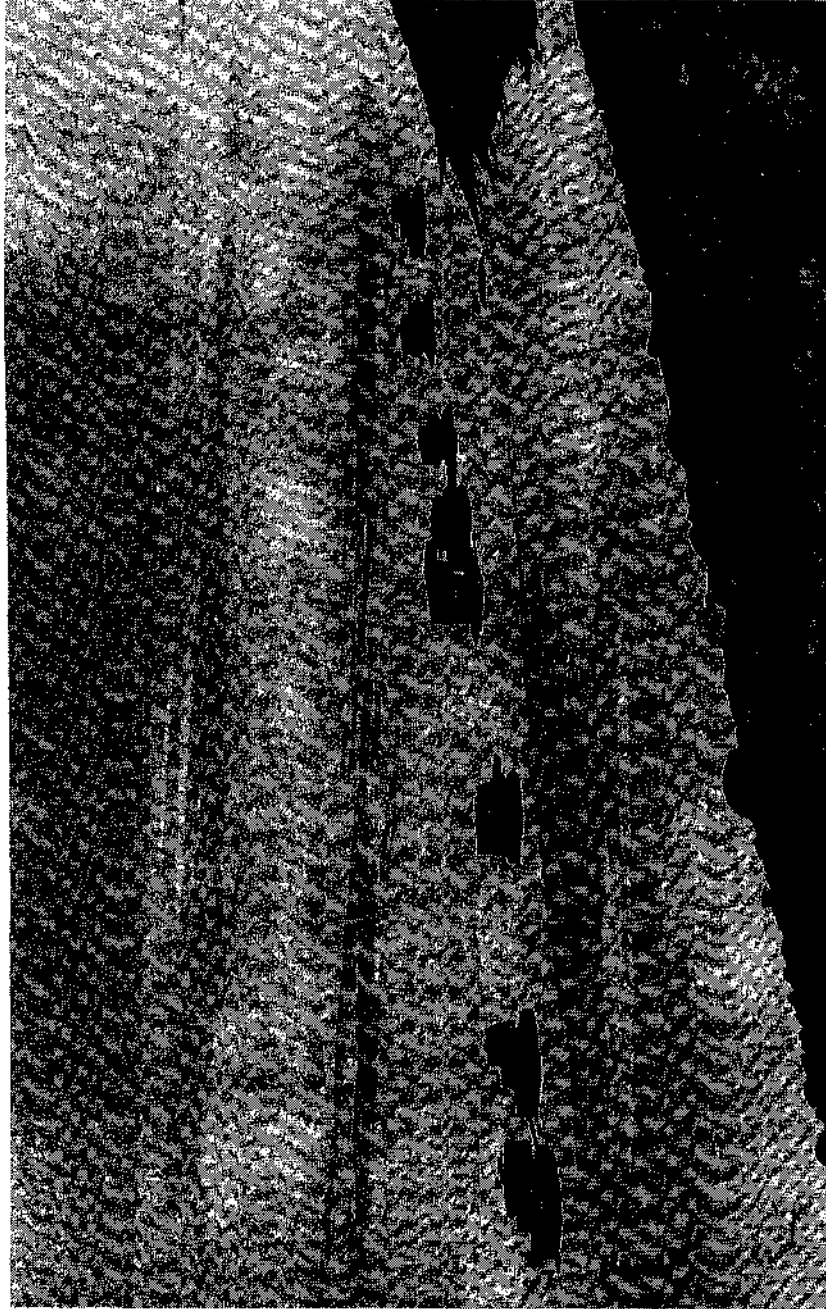


Fig. 1. One of the winter convoys on move from Mairi.

Table 1: The Convoy Details

SI. No.	From	To	Tasks accomplished (Transportation of)
(a)	25 Feb'90	27 Feb'90	27,000 Ltrs of fuel
(b)	15 Mar'90	25 Mar'90	50,000 Ltrs fuel
(c)	12 May'90	20 May'90	53,000 Ltrs fuel, Dobson Hut Workshop container and Engine assembly of 62.5 KVA genset shifted to Maitri.
(d)	30 Jul'90	10 Aug'90	48,000 Ltrs of fuel
(e)	07 Aug '90	10 Aug '90	Recovery of vehicle
(f)	11 Sep '90	19 Sep '90	5000 Ltrs of fuel. Hial Tech construction stores of 8 contrainers load buried in snow at shelf retrieved and brought to Maitri. 30 KVA genset with container shifted to Maitri.
(g)	05 Nov '90	14 Nov '90	56,000 ltrs of fuel.



Fig. 2. Pisten Bully 270DS making its way to Nordvestoya, northern Humboldt mountains.

A reconnaissance convoy was run between 9th to 12th April 1990 with three vehicles and six personnel. The convoy covered 65 km one way and returned successfully after establishing 65 route markers and collecting base data for geophysical and glaciological studies. The convoy established suitability and trafficability of different snow vehicles being used

at Indian station apart from gaining the confidence and having the 'feel' of the continental ice terrain.

The main Wohlthat convoy was planned and executed successfully between 5th October to 28th October 1990. Three vehicles, two geologists, including the leader, and four Army contingent members joined the detachment of wintering team which camped at Nordvestoya and completed detailed geological studies as assigned to the VII Wintering team.

The two new Pisten Bullys, PB 270 DS, were extensively used to cover interior areas (Fig. 2), facilitating collection of data and optimum utilization of good weather days. The success of Wohlthat convoy has paved the way for future exploration of interior areas during austral winters and thus has rightly been claimed as new feat in the annals of Indian Expeditions to Antarctica. The party faced three severe blizzards while at Nordvestoya and one blizzard during the return journey. The vehicle performance, power generation and communication systems functioned satisfactorily.

Vehicles

A variety of snow vehicles are held at Maitri and DG stations. All the vehicles have been used extensively during the winter of 1990. Vehicles available in Antarctica with VII wintering were:-

a.	Pisten Bully - 270DS	-	VITASTA
b.	-do-	-	SATLUJ
c.	Pisten Bully-170CS	-	GANGA
d.	-do-	-	BRAHAMPUTRA
e.	-do-	-	NARMADA
f.	Canadian Foremost Nodwe 110 C (Crane)	-	PANCHALI
g.	Sno Cat	-	KRISHNA
h.	-do-	-	KAVERI
i.	APCTopas,	-	—
j.	Dozer D-31	-	ANGAD
k.	Dozer D-50 A	-	GHATOTKACH
l.	Liebherr 902 R Crane	-	HANUMAN
m.	Snow Cutter	-	BHIM
n.	Snow Scotters	-	---

The performance report of different types of vehicles is given in the succeeding paragraphs.

Pisten Bully

Pisten Bully is one of the most important vehicles available at Maitri/Dakshin Gangotri. Its utility is enhanced because of attachments like blade and bucket. The blade is a very effective tool for removing the heavy accumulation of snow, especially at Dakshin Gangotri.

Bucket is used to ferry small loads from one place to another. Crane, when fitted, is used to handle small loads. Some of the advantages of this vehicle are:-

- (a) It is a well balanced vehicle with wide tracks and low ground pressure.
- (b) Due to low ground pressure and non-skid tracks it can be plied on all types of icy terrain.
- (c) This vehicle has very little turning radius. Infact, it can be turned complete 360 degrees standing at a place. This feature is very advantageous when towing a sledge.
- (d) Blade, bucket and crane are utility attachments.
- (e) A Pisten Bully can be started with the help of another Pisten Bully using the 24 V lead connected between the sockets provided.
- (f) Because this vehicle is being overhauled in 512 Army Base Workshop and the EME members of winter team coming to Antarctica are associated with repairs and given training on these vehicles, they are to some extent exposed to this machine.

There are two versions/models of Pisten Bullys available at Maitri, PB 170 CS and PB 270 DS. Out of two PB 170 CS, one "GANGA" was overhauled in 1987 and other, "NARMADA", was overhauled in 1989 and brought to Antarctica by IX Expedition. The third PB 170 vehicle "BRAHAMPUTRA" was recommended for back loading to India for base overhaul. Two new PB 270 DS, which were procured and brought to Antarctica in 1989, have higher horse power engines, wider tracks and are basically towing vehicles. These have single speed forward and reverse gears. It has performed very well in all the convoys including the two convoys to Wohlthat. However, some disadvantages also have come to light. These are:

- (a) Limited fuel storage capacity of 90 litres of PB 170 CS and 155 litres for PB 270 DS, puts a severe restriction when the vehicles have to be taken on long convoys. Additional fuel has to be carried for refuelling enroute. Refuelling causes wastage of time and fatigue on the operators under severe cold and adverse weather conditions.
- (b) The internal heating system (driver cabin heating and body heating) of PB 170 CS is less effective during winter, when it is required the most.
- (c) The ground clearance is far too less making wroking under the vehicle an extremely difficult task, more so when the vehicle is immobile.
- (d) Non-availability of passenger cabin on PB 270 DS, limits the use of this vehicle for haulage task only.
- (e) The vehicle, in spite of having been fitted with non-skid tracks, does have the tendency to skid on blue ice with little steep gradients.

Performance of Pisten Bullys

PB-170 CS: It has been used as a passenger carrier as well as for haulage of sledge mounted bins. The vehicle can haul approx 6 to 8 tonne load, depending upon the trailer/sledge being towed, on the summer route between Maitri and DG. One of this vehicle

carrying living module Sankalp on a German sledge was taken to Wohlthat mountains. It developed some problems due to low temperature. The vehicle had also starting trouble at temperatures below -10°C . Other drawbacks with this vehicle from maintenance point of view are :-

- (a) Due to less ground clearance, getting under the vehicle is difficult.
- (b) Accessibility to servo valves etc from the sides is also difficult.
- (c) Skirt plates provided on the sides of engine compartment allow accumulation of snow, resulting in the engine getting fully covered by snow.
- (d) Internal heating system is less effective during winter.

PB 270 DS : These vehicles fitted with higher HP engines, have been used extensively during all the convoys, including two to Wohlthat. The vehicles have been taken to heights of 5000-6000 ft above m.s. l without loads, during geological mapping in Wohlthat area. PB 270 DS has the capacity to haul upto 15 tonnes load on summer route between Maitri & DG depending upon the sledge being towed and time of convoy. The performance of vehicles has been satisfactory during all the convoys. However, the vehicle has some drawbacks, which have been mentioned in the preceding pages.

Though these vehicles have performed well during the expedition, these are basically ski-slope maintenance vehicles and not meant for haulage of heavy loads over long distances. Vehicles capable of hauling higher loads with power pack of 500 HP or more should be preferred to minimise administrative backing and number of convoys.

Sno Cat

Two Sno-Cats, 1700 are held Both have served in Antarctica for the last four years or so. These vehicles are basically passenger carriers with limited haulage capacity. The performance of these vehicles during the First four convoys to DG had been very satisfactory in hauling approximately 6 tonne load on German sledges but during the successive convoys undertaken in September and November 90, the vehicles started giving troubles.

Both the vehicles, though are 'on road' but their reliability is poor. The vehicle's performance over soft snow is good but it skids on blue ice with frequent shedding and breaking of track. Therefore, both the vehicles have been brought to India for base overhaul.

Canadian Foremost Nodwell 110 C

Canadian Foremost Nodwell 110 C mounted with TICO 1585 Wt crane, was procured and brought to Antarctica in 1988. The vehicle could not be exploited during the first year of its induction due to non-availability of spares required to undertake the repair of engine. However, during last year improvised repair was carried out and vehicle performed very well hauling over 15 tonne load in each convoy and handling fuel barrels and other small compact loads. The vehicle is a combination of very sophisticated system, hence, it requires extra care and better handling to get optimum and trouble-free output.

During the end of wintering period, this vehicle developed some snags in its engine. The new engine assembly was requisitioned and the repair was undertaken after cannibalising

some parts *viz* governor assembly, air compressor, stop solenoid etc. Two severe blizzards hit DG when the assemblies and other minor components were opened up. After assembling all the components new engine assembly was fitted and vehicle started. The starting of engine was smooth and initial running for about ten hours was carried out. The performance of engine under idle conditions was satisfactory and all the gauges on the instrument panel were reading normal but when the vehicle was put in gear the hydraulic pressure of the torque converter dropped down to 35 psi (Minimum pressure required is 55 psi and for normal running it should be 75 to 125 psi). All the hydraulic hoses and their connections, and other related components were checked. No abnormality was noticed anywhere. All the probable causes (as given in the repair manual) were checked and all the adjustments/remedies carried out, but the pressure did not build up to the required level.

Finally the torque converter was removed from vehicle and opened up. We found very fine metallic particles lying at the bottom of the sump. This indicated that abnormal wear of some of the components, which were not visible from outside, must have taken place. Further opening up of the torque converter was not possible due to, firstly, heavy blizzard struck again at DG which lasted more than four days that could have led to ingress of blowing snow into the opened up components damaging them further. Secondly, the date for sailing of ship did not permit us to undertake a long repair at this stage.

Liebherr 902 R Crane

Liebherr 902 R crane called "HANUMAN" is an excavator presently kept at Dakshin Gangotri and used as a crane. It has given a good performance though its lifting capacity of about three tonne or so puts some restriction on its utility.

Hanuman is an important vehicle with us at DG and its use was restricted to handling of heavy, bulky and voluminous loads. Other smaller loads were handled with Canadian crane. This crane was mainly used for following tasks:-

- (a) Lifting of all types of empty containers including fuel containers from sledges on to the ground and vice-versa.
- (b) Removing the sledges and containers buried under snow.
- (c) Repositioning the fuel and other containers depending upon the snow accumulation at DG.
- (d) Loading of heavy machines like generators, etc. on the sledges for transportation purpose.
- (e) For heavy repair jobs like engine fitting of a vehicle, etc.
- (f) Stacking of fuel barrels on to the platforms and putting the same into the containers for transportation to Maitri.

Performance

Hanuman is basically a summer vehicle and its performance below - 20°C becomes sluggish. It gives lot of starting trouble during winter. Some of the defects which have occurred during the last winter are as follows:

- (a) Breaking of accelerator lever from the root due to low temperature.
- (b) Sluggish operation of the booms. The hydraulic fluid gets thickened due to low temperature.
- (c) Cabin stopped rotating. The operating solenoid started behaving erratically due to low temperature.

Liebherr 902 R Crane is a very effective tool in handling bulky and voluminous loads. It can be of tremendous use at Maitri but the shifting of one available at DG is neither advisable nor possible at this stage.

APC Topas

New engine assembly was fitted on to this vehicle but during trial run the hydraulic and coolant hoses gave way and started leaking due to their inability to withstand low temperature. The new hoses were fitted along with the association of new team and the leakages were stopped. Engine was started but the trial run could not be carried out due to the shifting of Seventh Wintering team to ship. Following limitations have come to light in respect of this vehicle:-

- (a) Cabin heating system is not adequately effective.
- (b) Due to the restricted field of view through the periscopes, the driver has to run the vehicle with the opened hatch which is difficult in the cold environment of Antarctica. The blowing snow gets frosted on the periscopes and blinds the view within a short span of time.
- (c) The vehicle skids on blue ice due to flat metallic tracks and also gets dug in soft snow due to narrow tracks.

Dozers

There are two dozers, D31 and D50A, held at Maitri. They are basically used for dozing purposes. A small carrier is fitted on dozer D31 to carry fuel barrels and other manually unmanageable loads within Maitri Station. Both the dozers, fitted with necessary attachments, have been handed over in running condition to the new wintering teams.

Snow Scooters

The two snow scooters shifted to Maitri during winter were not in use as the ice free and rocky terrain at Maitri forbids use of these vehicles. However, during the austral summer of 1991, these scooters were extensively used by advanced field parties of G. S. I. and N. G. R. I. at Humboldt and Petermann Mountains.

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