

Fire Protection — Indian Stations at Antarctica: Maitri and Dakshin Gangotri Hangar Accommodation

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Abstract

Fire is the greatest safety hazard at Antarctica because of its dry climate. The fire protection system at Indian Antarctic Stations - Maitri and Dakshin Gangotri- has been evaluated and the weak points identified. Recommendations have been made for safety of men and material and fire drills proposed.

Introduction

During past nine expeditions various problems on "fire safety" of men and property have been experienced by Indian Expeditions to Antarctica. The basic reasons for the various problems on fire and safety faced at Antarctica are due to the hostile weather conditions as this continent is the coldest, windiest and driest in the world. Besides these, its rich oxygen content further aggravates the hostile nature of environment from fire safety point of view.

Defence Institute of Fire Research was assigned the job to study the adequacy, possible improvement and efficient support of "fire safe" condition for men and property at Antarctica - Maitri and Dakshin Gangotri hangar accommodation.

Indian Stations

Dakshin Gangotri: The first Indian permanent station at Antarctica was constructed on ice-shelf in 1983 to provide necessary accommodation and facilities to the Indian expedition. The complete construction was made of marine ply with PUF insulation in between the ply. For the purpose of maintenance and shelter of various vehicles being used at Antarctica, a hangar accommodation was built in 1985. This has, like the main station, got burried under the snow but is still in use by extending the entry chute of the hangar. Presently it is being used only for temporary accommodation for the winter team who have to undertake convoys for transporting fuel from DG to Maitri station.

Maitri: This permanent station, presently in use, is in Schirmacher Oasis. It is mainly constructed as one compact unit. However, the noise pollution due to generators, a separate accommodation for housing the generators was built this year. The main block of the station which is centrally heated using radiators of 1000 K cal/h capacity each, consists of standard modules of 10' X 8' made of marine ply sandwiched by PU foam as thermal insulation material and interconnected by connectors. The modules have been lined internally by a fire retardant material namely gypsum board and externally by plastisol coated G.I. sheets, 34 such modules have been connected to accommodate 25 members. The remaining space is used as office, clinic, transmitter room and meteorological laboratory. Lofts have been provided on top of these living modules which are used for storage purposes. On the eastern side the main block is extended to house the greenhouse. The block 'A' provides accommodation for workshop, laboratory, cold storage and power supply. At present 4 no. of 62.5 kVA generators are housed in this block. The block 'B' accommodates central heating system, the kitchen, bathing cubicles and chemical toilets (not in use). The block 'C' provides accommodation for 5 no. of incinerator type toilets.

Fire Hazards

(a) Dakshin Gangotri hangar accommodation

On 6th Feb '91, a fire took place in the link block of hangar accommodation at Dakshin Gangotri burning down the service facilities. Because of these reasons, it is recommended that this accommodation may not be used in future.

(b) Maitri station

The main fire hazard in Maitri station are in the following areas:

- i) Boiler room
- ii) Power generation room
- iii) Drying room
- iv) Electrical heaters
- v) Incinerator toilets

The possible causes of fire accidents in Maitri station could be the following:

- i) Electrical short circuiting
- ii) Poor house keeping
- iii) Failure of thermostat of the central heating system

- iv) Human delay response especially due to reduced reflexes in Antarctic conditions
- y) High wind and dry condition with oxygen rich environment helping to aggravate the fire
- vi) Toilet incinerator system

Fire Protection System

Smoke detector. The complete Maitri station has been provided with ionization type smoke detectors. They are spot type, self contained with alarm. They were found to be quite sensitive and effective. They have been well arranged and distributed throughout the station. The smoke detectors installed in the lofts have been divided into two zones for alarm purposes. However, some of these were non-operational due to nonavailability of batteries.

Heat detector. They have been used as additional protection in generator room and boiler room. These too have been found working satisfactorily.

Portable fire extinguisher: Halon 1211, CO₂, DCP and soda acid extinguishers are available in sufficient quantity and are well distributed. However, due to lack of knowledge and non-availability of spares and refills, many were found inoperative. All of them have now been made functional.

Modular type fire suppression extinguishers: The generators and boilers have been protected by a modular type of fire suppression extinguishers containing Halon 1211.

Fire blankets: Living rooms and working places inside the Maitri station are provided with a 2' × 2' fire blanket each.

Trolley mounted 50 kg extinguishers: These were found in inoperative condition. Three such extinguishers, out of total ten available at Maitri, were made operational.

Installed during Tenth Expedition: The 25 kg Halon 1211 has been installed at generator room which is accommodating two cold storage units installed during the present expedition.

Recommendations

Compartmentalisation

In case of any fire internally i.e. inside the station, tremendous amount of smoke will be generated. This can lead to a difficult situation as it reduces the visibility, causes suffocation and creates panic as a result of which people lose their power of reasoning and thinking. This can lead to uncontrolled fire and a possible loss of

life. Keeping this in mind, the station should be compartmentalised by providing smoke check doors at suitable places with magnetic door closers operated centrally.

Fire escape respirators

It is a protective emergency respirator which in case of fire or accident makes possible a rapid escape from areas invaded by harmful smoke or gases. A suitable number of such fire escape respirators be made available specially in generator room, boiler room and individual living rooms.

First aid hose reels

Since most of the items belong to class A fire, the best method available for extinguishment is water. Hence it is suggested that first air hose reel system be installed inside the station. It requires very less quantity of water as compared to hydrant system and can be operated by any person without any training. On the rear of the chemical toilet, the space available is sufficient for making a fire water tank for operating the hose reel system or the 4500 litre oil tanks of the boiler room may be converted to be used for this purpose since the oil storage inside the boiler room is dangerous and must be placed outside the station.

Static water tanks

Till now there has been no provisioning for combating fire from outside the station. The need for this has been felt specially after the major fire at Dakshin Gangotri link block hangar accommodation. To combat such a situation, a static water tank of 50,000 litres using anti-freeze be used. This tank be connected with remotely operated 1800 LPM at 7 kg/cm² fire pump through permanently laid pipe lines terminating to fixed monitors at strategic points for giving full coverage at Maitri station with anti-frost valves at each joint.

Summer hut fire protection

At present, the summer huts have not been provided with any fire protection system. It is recommended that each hut be provided with 2.5 kg portable Halon 1211 extinguisher. It is recommended that the positioning of each hut should be such that in case of any major fire the smoke and the radiation should not affect the neighbouring huts. Externally, all huts be treated with minimum 2 coats of fire resistant paints.

Emergency exits

The emergency exits provided on the north side of Maitri building be provided with the stairs which are not there at present.

Local heating device

The local heating devices such as electrical coil type heaters have been found to be in use, especially during winters, for heating the living rooms, the communication dome, radio room, workshop, drying room and other places too. The radiators are dangerous as they focus the entire heat at one place and may become a source of ignition. To avoid this, it is suggested that these heaters be immediately replaced by heat convectors/hot air blowers which would help in convecting the heat rather than radiating.

Fuel storage

The storage tank of 4500 litres fuel inside the boiler room be relocated outside as in case of a major fire this tank would add fuel to fire.

The individual fuel tanks of 350 litres each of the generator be placed outside the generator room and be provided with float valves for prevention of overflow.

No fuel drum be kept inside the station.

A centralised fuel storage tank which can meet at least 15 days requirement of the station be located outside the station and be positioned in such a way that it could supply fuel to respective areas by gravity feed. At present it has been provided for meeting the requirements for present generation room partially.

No fuel drum be stacked alongside the helipads.

Electric wiring

No electric wiring without proper conduit be used. This is essential for preventing the accidental chaffing/cutting of the wires due to any reason whatsoever.

Wiring of proper rating should be used. The external temperature of the insulation of the wire should never exceed the ambient temperature.

As far as possible, joints should be avoided.

Humidifiers

To minimise the generation of static electricity, it is suggested that industrial type humidifiers mixed with salt be used. This could also help in preventing the drying of the skin and joint pains as informed by doctors. The mixing of salt is essential to make the water more conducting since it has been observed that Antarctic water being snow-melt is non conducting.

Toilet incinerators

There should be only one toilet incinerator inside the 8' × 8' toilet cubicle. This would help as follows:

- reasonably comfortable space for carrying out maintenance/repair.

- easy dissipation of heat at the time of firing the incinerators.
- reasonably safe fabrication of the toilet at Antarctica.

Further the walls of the module be made of 'plastisol' coated G.I. sheets instead of marine ply with PUF insulation. This would reduce the chances of catching a fire.

Spark arrestors

The exhaust pipe of generators, boilers and toilet incinerators be provided with spark arrestors.

Fire resistant coating/cladding

The generator and boiler rooms may be cladded with gypsum board followed by a coating of fire resistant paint. The inside as well as the bottom of Maitri station be painted with fire resistant paint.

Spark proof motors

The electrical motors being used at Maitri be of non-sparking type.

Storage of hazardous cylinders

Hydrogen cylinders are being used by IMD scientists. Besides, few cylinders of acetylene and oxygen are used in welding. Other hazardous cylinders used are LPG. The quantity of hydrogen cylinders required is more than 150 per year. In view of this it is suggested that hydrogen generators be used instead to reduce the fire/explosion risk. No hazardous cylinder except two LPG cylinders be kept in the main building.

Convoys

Each vehicle be provided with a 2.5 kg Halon 1211 extinguisher with 2 nos of fire blankets 2' x 2' size.

Site camps

Whenever a site camp is set up, a 2.5 kg Halon 1211 extinguisher should be provided per tent.

Extinguishers

For the purpose of ease in identification and operation of portable extinguishers, the following types alone be used.

- 9 litre water CO2 extinguisher
- 2.5 kg Halon 1211 extinguisher

All other types of extinguishers be removed/retrieved.

Stock position of fire equipments

A minimum of 50% spare parts of all fire protection equipments be kept which are required for normal maintenance work. A minimum of 200% reserve be kept for extinguishant refills/consumables. This has to be worked out after getting the actual stock position.

Training

A person trained in the operation and maintenance of all types of fire fighting equipment installed in the station should be available. For this, any person from the wintering team be nominated well in advance to take a minimum of 15 days crash course in fire fighting before the commencement of the expedition. He will be responsible to train other members of the expedition subsequently.

Good housekeeping

It is needless to emphasize on good housekeeping. It is a known fact that cleaner the area/equipment the better is the fire prevention. This also helps in developing the sense of discipline which is utmost required in Antarctica.

The safety of personnel and station should at no time be compromised for achieving the goal especially in Antarctica where resources are very limited.

Fire standing order and drill

A draft fire standing order and fire drill for Maitri station is given here. These should be amended from time to time depending on the modifications/alterations in the building/systems. These should be properly displayed and periodically briefed. The fire drill practice should be carried out at least once a month during winters and twice a month during summers.

Fire Standing Order at Maitri

- 1 Every member living in the station must get himself acquainted with the use, operation, limitation and location of each fire detector, fire alarm and fire extinguishers in and around the whole Maitri complex including summer camp area.
2. Smoking of cigarettes is permitted in lounge only. All other areas in and around Maitri station should be no-smoking zones.
3. In the summer camp, members can smoke inside their huts but not in the loft accommodation.
4. All ash trays must contain at least 2-3 mm layer of water.
5. Only hot air blowers/convectors be used where local heating is required.

6. Any repair work which causes flame, heat or sparks must be carried out in station workshop. In unavoidable circumstances, with prior permission of the leader, can it be carried in other places, making sure of safety precautions and keeping a person ready with a hand held extinguisher.
7. In case of any fire being detected, attempt should be made to extinguish it immediately with the nearest available correct type of extinguisher and simultaneously shout "FIRE" till some one comes for assistance.
8. On receipt of fire call, the leader or the senior most person available in the station and the member-in-charge of fire fighting operation must rush to fire spot and supervise fire fighting operations.
9. Care should always be taken of the following while combating fire.
 - a) There should be no opening from wind ward direction as it would aggravate the fire since the air in Antarctica is dry and oxygen rich.
 - b) All efforts should be made to stop the spread of fire to unaffected items/areas. If needed, salvage operation must start.
 - c) Due to smoke, the visibility becomes poor and breathing becomes difficult. In such a case, the person must enter lying low with a wet cloth covering his nose and mouth.
 - d) After the fire has been extinguished, the member-in-charge of fire fighting must ensure that there is no hidden heat left even if it requires removing of complete sheets, panel or opening of a system.
 - e) Once a month, fire drill practice to be conducted by the leader.
 - f) The operation readiness of all fire fighting equipments will be the responsibility of the member-in-charge fire fighting operations.
 - g) Tampering with any system/equipment should immediately be brought to the notice of the leader since it may be you who may fall victim due to non-functional system/equipment in an emergency.
 - h) Clean your room and area of work daily. It will go a long way in giving you a fire safe atmosphere to live and work.
 - i) Member-in-charge of fire fighting must check each and every equipment once a month and maintain records.

Fire Drill

The importance of fire drill is to train the personnel to overcome the mob psychology. It helps the individuals to maintain and use their power of rational thinking and reasoning even in an emergency which may threaten their existence. It enables to contribute the efforts of every individual in combating the situation

effectively without compromising the safety requirements for self and others. It also helps in maintaining the fire equipments operational readiness. Following are the details of the drill:

1. This drill is to be conducted once a month.
2. It has to be conducted by the leader, who will simulate fire emergency and give fire call.
3. There should not be any prior information i.e. element of surprise be present.
4. The drill timings should not have any consideration for importance of any work, time or comfort of members.
5. Duties and responsibilities of each member should be spelt out in detail. This should include the method of communication with each other, method of attack and reaching ultimate place of safety with essential life saving items.
6. After every drill, the leader should check the following:
 - a) that all the fire equipments have been replaced
 - b) that all the life saving items have been restored
 - c) that all members had been clothed properly
 - d) that no one got injured during the drill or that first aid was administered to the injured.
7. After the check, the leader must conduct assessment of the drill conducted with all the station members and call for suggestions for removing the drawbacks if any.