PRE-FEASIBILITY REPORT

Executive Summary

Raniganj CBM Block was awarded to ONGC-CIL on nomination basis in January 2002 and the PEL was granted by Govt. of West Bengal w.e.f. 09.06.04 (effective date). CIL has a Participating Interest of 26% and ONGC is the Operator of the Block. The total acreage of 350 sq. km. comprises a northern sector of 240 sq. km. (Sector-A) and a southern sector of 110 sq. km. (Sector-B).

The MWP of the Block entailed eight Coreholes and one Exploratory Well during the 3 years of Exploration Phase and two Pilot wells in the subsequent Pilot Phase of 4 years.

Prior to the award of Raniganj Block (jointly with CIL measuring 350 sq. km.), ONGC held PEL for the northern sector (240 sq.km.) w.e.f. 23.11.1999. During this pre-Policy regime, ONGC drilled 7 Coreholes to assess the CBM potential of Barakar coal seams of this area. Marginal to poor CBM prospect of the northern sector (Sector-A) and addition of new area led to focus the Exploration and Pilot Phase MWP in Sector-B.

Exploration Phase was completed with two extensions of six months each, while three extensions were sought and granted by GoI during Pilot Phase on account of LAQ issues in the area. One Exploratory and two Pilot Wells drilled during Phase-I and Phase-II respectively, are presently under dewatering and gas break has been recorded in all wells, although sustained flow of gas has not been achieved yet.

Pilot Phase of the Block ends on 8th December 2012, and in view of the encouraging results obtained in all the wells, a Development Plan for the Block was submitted, two months prior to expiry of Pilot Phase, as per the CBM Contract.

As Sector-A was inferred to be a poor to marginal prospect, CIIP estimation has been confined to the Panchet covered area of Sector-B where the Raniganj coal seams are targeted for CBM exploration. Total CIIP estimated for the Panchet covered area (~76 Km^2) of Sector B is 7.43 BCM. The entire volume is presently assigned to the PS category, in absence of sustained gas flow data in the Block, in accordance with ONGC's REC (Reserve Estimate Committee) guidelines on CIIP estimation of CBM acreages. The CIIP has been accepted for reporting to REC as on 01.10.12.

The present Development Plan covers all the prospective parts of Sector-B of the Raniganj Block. Some of the areas with marginal potential (largely on account of depth >1350m) have been planned for future assessment. Western part of Sector B has Raniganj Formation exposed, with coal seams at shallow/ near surface depths and being poor CBM prospects on this account, will be proposed for relinquishment. Such area is 34 sq. km. i.e. ~10% of the Contract area. Since Sector-A has uncertain CBM potential it is proposed to be probed by assessment wells, in tandem with the Development Plan.

The present Development Plan envisages drilling of 80 vertical, hydraulically fractured Development wells. An aggregate peak gas production of ~0.45 MMSCMD and a sustained average production of >0.4 MMSCMD may be attained over a plateau of six years on raw field basis. Project Economics has however, been worked out at an operating efficiency of 90% and further discounting the production profile for workover days and internal consumption. Volume that may be available for marketing after discounting these factors is 0.37 MMSCMD at peak and ~0.33 MMSCMD over a plateau of six years.

As the wells are spread over a long tract of inhabited/ industrialized area, four delivery points are provided for ease of marketing. Therefore, a handling capacity of 0.05 to 0.2 MMSCMD of gas at the respective mini GCS, and a total effluent handling of 1200 m^3/d have been provisioned to meet the peak production.

CBM sale would be at the fence of ONGC installation(s) either to an end user or to a Gas Marketer to supply to the end user as per CBM / Natural Gas utilization policy of the GoI. Presently, four custody transfer points are planned, although feasibility of interconnecting the production hubs, compression to suit the market and strategic tie-ups up with existing operators in the vicinity may also be examined in the future.

The total Development cost has been estimated to be INR 957 Crore with supply of gas at ONGC fence, the CAPEX component being INR 600 Crore and OPEX of INR 357 crore. The development activities include drilling of wells and commissioning surface facilities staggered over 4 years. Net cash flow after tax, Royalty and PLP is estimated to be INR 531Crore, at a gas price of US $ 6.0/MMBTU, escalated @ 5% alternate year over a 20-year span. IRR and NPV of the project work out to be 12.2% (US$ =INR 53) and INR 3.8 Crore (@ 12% discount) respectively.

1. Introduction/Background

The CBM exploration venture was initiated by ONGC in 1995-96 through drilling of two R&D Wells in Durgapur area of Raniganj Coalfield. Even though these wells (DU# 1 and 2) yielded lot of critical information pertaining to CBM exploration, they could not be tested due to technical complications and poor potential inferred from low/poor gas content and permeability of the coal reservoirs. This led ONGC to shift its focus to the northern part of Raniganj Coalfield covering an area of 240 sq. km (subsequently referred as Sector-A). During the Pre-CBM Policy regime, this area of 240 sq. km. in the northern part of Raniganj Coalfield was held solely by ONGC (23.11.98 - 22.11.02). In January 2002, an additional area of 110 sq. km. in the south/south central part of Raniganj Coalfield was jointly identified by ONGC-CIL for joint working.

With the onset of the CBM Policy era, the Raniganj CBM Block, spread over an area of 350 sq. km. which includes 240 sq. km. area in the northern part (termed as Sector-A) and the jointly identified 110 sq. km. area in the south/south central part (termed as Sector-B) of Raniganj Coalfield was awarded to the ONGC-CIL Consortium (ONGC-74%, CIL-26%) on Nomination basis by Government of India in January 2002 with ONGC as the Operator. The contract between Govt. of India (GoI) and ONGC-CIL Consortium was signed on 06.02.03 for the Raniganj CBM Block and the PEL for this area was subsequently granted by Govt. of West Bengal on 09.06.04 (effective date).

In the northern sector seven Coreholes were drilled in the PEL area by ONGC during pre-CBM Policy era (October 2000-March 2002) targeting the coal seams of Barakar Formation. Five to six major, regionally correlatable coal seams were encountered in most of these Coreholes. The CBM specific information, however, revealed a very erratic behavior, both laterally and vertically, with extensive pyrolitization due to intrusives. The task of delineating any prospective area in this sector was difficult due to this erratic behavior/variation.

Marginal to poor CBM prospect of the northern sector (Sector-A) and addition of new area, led to focus the Exploration and Pilot Phase MWP in Sector-B. The Phase-I and Phase-I MWP was therefore confined to Sector A.

2. General Information of Raniganj Block

2.1 Location & Accessibility

Raniganj Coalfield is located about 190 km. northwest of Kolkata and it falls mainly within the states of West Bengal with a very small part in Jharkhand. The greater part of the coalfield falls in the Burdwan district of West Bengal while a small portion falls in Birbhum, Bankura and Purulia districts. The most important town located in the central part of the coalfield is Asansol.

The Raniganj CBM Block of ONGC-CIL Consortium is confined only in the state of West Bengal. The block, measuring 350 sq. km. is spread over two sectors viz. Sector-A (240 sq. km.) along the northern margin of the Raniganj Coalfield and Sector-B (110 sq. km.) in the south central part of the coalfield.

The Kolkata-Delhi National Highway (NH2) as well as the Kolkata-Delhi Main/Grand Chord lines of Eastern Railway traverses through the middle of the coalfield. The surrounding areas are also well linked by a good network of roads and branch lines of Eastern Railways. Near Andal the railway network is so intricate it has forced the operator to increase the number of production hubs in order to avoid crossing of pipe lines across the railway tracks. Both the sectors are in close proximity to the industrial belt of Durgapur-Raniganj-Asansol. This area is very densely populated due to the rapid urbanization in the recent years.

2.2 Phased Development

From the G&G work carried out in the Exploration and Pilot Phase it has been observed that the coal seams occur at depths shallower than 600m along the northern margin of the block and below 1350m along the southern periphery. While the shallow areas have shown poor saturation, the deeper parts are constrained by reduced permeability and poor deliverability. Hence, CIIP has not been estimated for seams above 600m and below 1350m for this block.

For assessing the area below 1350m and also for CBM specific data generation, five assessment locations are proposed of which three are in the eastern and two

in the south western part of the Development area. These locations are expected to further add to the Producing area.

The assessment wells in Sector B are planned to be drilled in the 2nd/ 3rd year of the Development Phase and if encouraging results are obtained, the production from these identified assessment areas may be added to the present Development area. The drilling of wells in these areas and the adjoining areas may be considered in next Development Phase at a later stage. Neither the cost of these 5 assessment wells, nor the production, if any, has been included in the present Development Plan.

Four Assessment wells have also been planned in Sector A of the block which was inferred to have a poor to marginal prospect on the basis of Corehole data generated in the pre-Policy regime. As the gas content in Sector A is erratic on account of widespread igneous activity, the large area of Sector A needs to be optimistically re assessed through G&G studies and conventional well testing. Positive results will open up a new play and large area for another phase of the Development in the Raniganj Block. The assessment wells of Sector A are also planned to be drilled in tandem with the Development wells of Sector B. Location of Development and assessment wells is given in (Fig. 1).

2.3 Physiographic Features and Drainage Pattern

The topography of Raniganj Coalfield is represented by a gently undulating area with a few linear hills marked by the intrusives. Two prominent elevations namely Panchet (643m) and Biharinath (451m) are conspicuous in the southern part of the coalfield otherwise covered by the Younger Gondwana sediments.

Three perennial rivers Ajay, Barakar and Damodar along with their tributaries drain the northern, eastern and southern parts of the coalfield. River Barakar marks the boundary between Burdwan district in West Bengal and Dhanbad district in Jharkhand. The general slope of the terrain is towards southeast (Fig.2 & 3).

2.4 Climate and Vegetation

The area experiences mild to semi-extreme climate with temperatures varying between 40^{o}C to 45^{o}C in summer and between 6^{o}C to 10^{o}C during the winter months. The average annual rainfall is between 120cm and 135cm most of which precipitates during the months of July to September.

Vegetation in the area mostly comprises of shrubs, however, some forest cover is seen in the north-eastern part of Sector-B near Ajay River.

2.5 Stratigraphy of Raniganj Coalfield

Raniganj Basin is one of the few coalfields of peninsular India where both the Lower Gondwana and Upper Gondwana sediments are present. Raniganj coalfield in addition to being the oldest coal mining area of the country is also the only coalfield (except Singrauli) to house commercial coal deposits in both Barakar and Raniganj formations. The generalized stratigraphic succession of Raniganj Coalfield is given in Table-1.

Basement of Raniganj coalfield is represented by Archean metamorphic rocks consisting of Granite gneiss, migmatite gneiss, hornblende schist, hornblende gneiss, metabasic rocks, pegmatite and quartz veins etc.

Basement rocks are unconformably overlain by Talchir Formation of Upper Carboniferous age. Talchir sediments are exposed along narrow irregular strip along the northern edge of the western half of the basin. Talchir sediments are represented by medium to coarse-grained khaki feldspathic sandstones with silty shale and needle shales.

Talchir Formation is conformably overlain by Barakar Formation, which is exposed as an irregular belt roughly parallel to the northern boundary of the coalfield. The Formation covers an area of about 155 sq. km. and a maximum thickness of about 650 m. is reported. Barakar Formation shows maximum development in the western and northern parts and gradually thins towards east and south. Barakar sediments are represented by coarse to gritty arkosic sandstones, grey and carbonaceous shale. Eight regional coal seams have been identified within the Barakar Formation.

The Barren Measures conformably overlies the Barakar Formation, is exposed as an irregular belt in the northern, northeastern and western part covering an area of 113 sq. km. in between Barakar and Ajay River and a thickness of around 365m is reported. Barren Measure sediments are characterized by dark-grey to black carbonaceous, fissile shales with ferruginous laminae and thin bands or nodules of hard clay ironstone. Sector-A lies mainly in this Barren Measure covered area and Coreholes were drilled by ONGC in the pre-CBM Policy regime to assess the CBM potential of the underlying Barakar coal seams.

Raniganj Coalfield is the Type Area of Raniganj Formation, which conformably overlies the Barren Measures. Raniganj Formation crops out along the southern half of the coalfield, east of Barakar River, is nearly 1050 m thick in the coalfield area, and spreads over a major part of the basin. Raniganj Formation shows maximum development in the western part of the basin and gradually attenuates towards east and north. Raniganj sediments are represented by grey, medium to fine grained micaceous feldspathic sandtone, siltstone and shale. A total of ten regionally corelatable coal seams have been reported in Raniganj Formation in addition to the topmost Andal Local seam.

Panchet Formation conformably overlying Raniganj is exposed in patches in the eastern, south-central and western part of the basin covering an area of 240 sq. km. Panchet sediments comprise coarse grained, micaceous, green sandstone alternating with silty shale.

Geological map of Raniganj Coalfield (Fig. 4) clearly depicts that Sector-B is subdivided into two segments, the eastern part covered by the Panchet Formation (east of Andal) and the smaller western part with exposed Raniganj Formation. Raniganj Coal seams are the objective in this sector.

The Supra Panchet strata unconformably cap the Panchet Formation at isolated outcrops in top of Panchet, Gaurandih and Biharinath hills, the three prominent topographic expressions in the coalfield. Pebbly to coarse, quartzose sandstone and dark red silty shale bands represent Supra Panchet sediments.

Post-Gondowana igneous intrusives in the form of dykes and sills of dolerite, mica-peridotite and lamprophyres cut across the coal seams of Barakar and Raniganj Formation and resulted in pyrolitisation of the coal seams.

Laterite and alluvium predominate in the eastern and southeastern part of the basin and conceal the eastward boundary of the basin.

3. Meteorological Status

The micrometeorological condition regulates the transport and diffusion of air pollutants released into the atmosphere. While the principal meteorological variables affecting horizontal convective transport are average wind speed and directions, the vertical convective transport is a function of atmospheric stability. The transport of pollutants is also governed by topography of the region. The air monitoring is to be carried out during the year other than monsoon. The study area of 350 sq. km. consists of parts of Durgapur, Raniganj and Asansol. The meteorological status of the study region is to be obtained from Kolkata Patna and Pune Office of IMD. A battery operated continuous monitoring of mechanical weather monitoring equipment is to be installed at suitable location on a flat terrace so as to correlate the collected meteorological information with the available data. Meteorological data consists of wind speed, wind direction, humidity and temperature. Climatological table of observation is to be collected from IMD to obtain the historical data of the region.

Annual temperature for this region varies between 10° C to 45° C. The relative humidity varies between 39 to 69%. The region receives a rainfall of about 36mm in the month of May and 176mm in the month of June (Fig.5). The average wind speed during the month of May is 5.5 kmph and 7.8 kmph during the month of June. The annual and 24 hour wind rose are depicted Fig.6 & 7.

3.1 Temperature

The monthly variation of maximum temperature for five years has been depicted in Fig. 8. There is a sharp rise in temperature from January to April where as there is not much difference in temperature in October as compared to July.

3.2 Wind Direction

Predominant wind direction for four seasons over the study area is depicted in Fig. 9. It may be observed from the figure that in January, the predominant winds

are Westerlies and North-Westerlies in major part of the study area. In April, winds are in different directions in different parts of the study area. However, the predominant directions in the month of May and June are North West and South East respectively. In July, the most predominant direction is South-Easterly. Only in the extreme South-West area of the study area, the initial direction of wind is observed to be South-Westerly which later changes to South-Easterly ultimately, as in the other part of the study area. In October, again the winds are in different directions, particularly in the extreme east and extreme west of the whole Raniganj CBM block.

3.3 Wind Speed

The wind speed at different heights has been represented in Fig. 10. The figure shows the leading wind speed along with their directions.

3.4 Mixing Heights

The mixing height of the region is one of the most important parameters studied on the basis of available radio-sonde data. However, the study of mixing heights was also carried out for various months using Doppler sodar system.

It has been reported based on the previous studies that the variation of maximum mixing heights are ranging between 1200-1600 m and the variation of minimum mixing heights are ranging from 200 to 400 m in January. Western parts and to some extent Central parts have low mixing height values as compared to the other part of the basin. The mixing height observed in the western part of the region in our recent studies shows that in the month of January, it is as low as 100 m while the maximum is as high as 650 m. Fig. 11 shows the mixing heights observed in the month of February. In April, the values are higher as compared to all other seasons. Again the maximum and minimum values of mixing heights observed in the month of July decrease. And furthermore, these values decrease in the month of October. The diurnal and nocturnal variations of mixing heights were studied through Doppler sodar.

3.5 Ventilation Coefficient

The maximum VC is observed to be as high as 9000 m^2/s in winter season. The lowest VC was seen in the winter much below 1000 m^2/s. Lower VCs were observed in extreme northern parts of the region.

4. Technological aspects (drilling with layout, Cementing, Logging, Stimulation & Testing)

4.1 Drilling methodology

Development of the Raniganj Block has been envisaged presently through vertical hydro-fractured well in view of their proven track record. Reservoir modeling of the block has been performed using vertical hydro-fractured wells on 80-acre spacing in view of good permeability of the seams. However, the possibility of drilling inclined wells after examining their techno-commercial feasibility is not ruled out to further improve the economics and mitigate LAQ issues.

The design of vertical hydro-fractured wells planned for development of Raniganj Block is described below.

Drilling

Drilling will be carried out by deploying mobile rig using rotary drilling / Air drilling method.

The overall drilling plan and well architecture are systematically described below:

i. Drilling of 12¼" section above the top most coal seam (~300m)

ii. Setting of surface casing (9 $^5/_8$") accordingly

iii. Drilling of 8 ½" hole vertically down to the Target Depth (T.D.), depending on the targeted seams. (A weighted average of 1200m TD per well has been considered in the economics).

iv. Setting of $5^1/_2$" production casing up to desired depth, depending upon the target seams and considering a sump of 100m below the bottom most object seam

v. Water based mud to be used. Bentonite suspension will be used while drilling the 12¼" section. Low solid polymer mud (PHPA) with 2-3% bentonite suspension will be used as drilling fluid during drilling of the 8½" section.

vi. The $5^1/_2$" production casing is to be cemented in single stage with the use of low weight cement slurry with sufficient compressive strength.

Depth of drilling : Average 1200m

Diameter of wells : 12¼″ and 8½″ as explained above

Drill cuttings etc. : Sandstone, Silt, Shale (chemically inert, stable), Coal

4.2 Drilling Fluids & their Composition

During the course of drilling a vertical well an approximate volume of 127 m3 of Water based low solid polymer mud will be used (for well of 1200m depth).

Name & quantity of chemical to be used:

Sl No.	Name of Chemical	Consumption(MT) / well
1.	Bentonite	12.0
2.	Caustic Soda	2.0
3.	Soda Ash	0.4
4.	PHPA	1.2
Total Tonnage		15.6

4.3 Type & quantity of water consumption and source of supply

a) **Drilling:** Approximately 800 m^3 of water is required for drilling of each well (Approx. 1200m well depth). The source of water is to brought by tanker from nearby testing well/ or bore well at site

b) **Work over:** Average 3-5 m^3 of water is consumed per day for operational purpose. The source of water is same as above.

c) **Stimulation:** During stimulation of each object around 300 m^3 of water is pumped into the well. Water tankers are hired for transporting water from nearby testing wells/ In case of transporting of water are not feasible then from other sources.

d) **Testing:** During prolonged testing phase, well produces water and produces water is consumed in drilling well / or simulation job.

4.4 Fuel (MT) and energy (MW) consumption

a) **Drilling:**

Fuel: 36 KL per month during drilling

Energy consumption: Approximately 50 MWH per month

b) **Work Over**

Fuel: Around 3 KL per month

Energy consumption: 430 HP Rig engine + 33 KV Gen set

c) **Stimulation:**

3 Pumpers of 2250 HP each

Fuel consumption: Average 3 KL per Job

d) **Testing :**

Fuel: Around 5 KL per month

Energy consumption: 100 KVA DG sets

4.5 Emission from combustion of fossil fuels, production processes, material handling, plant & equipment (quality & quantity)

a) **Stimulation & Testing**

During drilling and production operation (Stimulation & Testing) some Emission from combustion of fossil fuels is envisaged as follows:

Generator set, emission within limit and

Occasional gas flaring is carried out following all statutory norms viz OMR 1984, OISD guidelines. It should be mentioned that complete combustion of the flared gas is ensured.

4.6 Cement type, additives and quantity to be used

Type of Cement**:** Oil well cement-Class-G

Quantity of Cement**:** 40 Metric Ton/per well

Cement Additives**:** PVC resin, Silica Flour, Retarder (R-53), Friction reducers (FR-22), Defoamer

4.7 Details of hazardous wastes (drilling fluid, cutting, deck wash, waste oil, spent acid, municipal wastes & produce water), generated and their management.

Drill cuttings of sand, shale, siltstone and coal will be generated, the quantity will be about 50-55 m3 by volume per well. The earth cuttings generated at drill site will be mostly inorganic in nature and can be used either for land filling or road making. These solids could be collected and transported to the identified sites.

Production of water during the life of the well varies considerably, the rate reduces with time. However, average water production per day may vary from 10-12 m3/d. The produced water will be utilized for simulation job/ drilling operation or allowed to evaporate naturally from the evaporation pit. The available water analysis data show the water to be fit for agriculture/ livestock with limited treatment. It is expected that over a period of time, and from different locations within the Block, chemical composition of the water is likely to alter. Some values may increase whilst others may decrease.

4.8 Brief on well logging

Following logging operation will normally be carried out in all these wells:

Open Hole:

- DLL-MSFL-GR-CAL
- LDL-CNL-GR
- DSI-FMI

Cased Hole:

- CBL-VDL-GR for and Perforation of object coal seams with GR correlation

4.9 Casing details, well design and well construction details

As discussed above the casing details to be used in Pilot wells are as follows:

Surface to ~300 m: Hole size 12¼“& 9 ⅝ “Casing

Beyond ~300 m : Hole size 8½ “& 5½“Casing

4.10 Perforation

After casing and cementation the well bore to formation communication is made by perforating the casing with help of explosives.

4.11 Well activation and stimulation details

For only vertical wells each object coal seam is stimulated by hydro fracturing and thereafter the well is dewatered for making it active.

4.12 Details of transportation of personnel & materials

For transportation of personnel from well site to their accommodation, vehicles (ambassador/sumo) are provided.

For transportation of material trucks/ trailers are used.

4.13 Details of noise, vibration and emission of light & heat from equipments, engine, ventilation and operation

All safety precautions regarding noise, vibration level are taken as per guidelines and standards**.**

4.14 Total Duration of Project (Drilling and Testing)

Development of the Block during years 1 & 2 will mainly concentrate on the completion of assessment of the existing wells and for obtaining ML, statutory clearances and acquisition of requisite land. Development well drilling is scheduled to start from year 2 along with work for creation of GCS and associated surface facilities, which will be completed by year 3 to start regular production. However, small scale gas sale may start from year 2 through EPS mainly targeting small and marginal customers, in the line of incidental gas sale from the Jharia CBM Block.

5. Risk, Disaster and Environmental damage/oil spill associated with project:

CBM Wells do not produce any oil or condensate. Hence, the question of oil spillage does not arise. Moreover, the formation pressure of CBM wells in Damodar Valley coalfields is sub-hydrostatic to hydrostatic. Therefore, risk

involved during drilling of CBM wells is minimal. However, all necessary precautions as per OMR and OISD norms and guidelines will be strictly followed.

5.1 Risk Analysis

Risk involves the potential occurrence of some accident consisting of an event or sequence of events. Accidental release of gas to the atmosphere from the well is studied by visualizing scenarios on the basis of the properties of gas and the impacts are computed in terms of damage distances. A disaster situation is the outcome of the fire or explosion of released gas in addition to other natural causes which eventually leads to loss of life, damage to property and ecological imbalance. Depending upon the effective hazardous attributes and their impact the maximum effect to the surrounding are assessed.

5.2 Disaster Management

Disaster Management Plan (DMP) for the CBM Exploration in Raniganj CBM Block is already developed as per the recommendation and guidelines issued by the NEERI during the Risk Assessment Studies of the Block covering the need, the objectives, the management plan, the accident prevention methods, fire prevention measures, Emergency response actions, warning system, public information system, fire fighting system, support services system and relief to the victims for situations before, during and after the crisis. Accordingly DMP is prepared and ratified by the Competent Authority for each project and periodically reviewed as per OMR 1984.

a) Safety Provision, Emergency Response Plan, Fire fighting facility and accident reporting details on rig:

Emergency Response Plan (ERP) as per regulation No. 51 (A) of OMR-1984 is prepared at each Work Centre by the concerned Installation Mangers duly approved by the Competent Authority ahead of the date of commissioning of the project specifying:

- Actions to be taken in case of emergency as well as when and how such actions are taken
- Duties and responsibilities of each key personals
- Alarm and communication system
- Equipment specifications

- Plan for raining/mock drills

b) Accident Report:

In case of any type of accident as detailed in regulation-7 of OMR-1984, the owner/agent /manager inform the same to the regional inspector Chief Inspector and district magistrate within 24 hr. of such incidents. All type of accidents including major, minor and near miss are properly documented and reported every day. There is a well-developed / implemented and maintained reporting system for all type of accidents. All data related to accidents and near miss is analysed and corrective/preventive actions are to be taken appropriate to the incidents.

c) Accident Investigation:

Accident Investigation is to be carried out by proper enquiry committee at the appropriate level.

6. **Safety provision, Emergency Response Plan, Fire Fighting facility and accident reporting details on rig**

These are maintained as per different regulations in chapter IX of the OMR-1984 and Mines Act.

Provisions are made for:

- House keeping
- General lighting
- Electric lighting
- Supply and use of PPE
- Communication
- Safety belts and life line
- Safety warning signs
- Protection against pollution of environment
- Proper fencing

Adequate provisions are made for ensuring safety of the working personnel though written procedures in compliance with the Mines Act and OHSAS – 18,001

specifications. The various provisions for personal protection include the following gadgets at company cost:

- Safety shoe
- Safety Helmet
- Cotton Dungaree
- Safety Goggles
- Ear Plugs
- Cotton Hand Gloves etc.

There exists detailed well developed/implemented/maintained compliance system for the above through daily check lists, various internal safety audits and 3rd party audits.

6.1 Fire Fighting

Provisions are made as per OISD Standard-189 for proper firefighting arrangements. We ensure the observance of the provisions of the Act, regulations and orders concerning the fire detection and firefighting system; ensure proper layout, installation and maintenance of firefighting equipment.

Contingency plans for likely fire situation are prepared. Mock fire drills are conducted every month and the observations are recorded and analyzed. All firefighting equipments are properly maintained and are made of adequate capacity. Adequate training is provided to all employees in firefighting. There exist detailed written procedures and specifications with respect to the capacity/firefighting equipment / equipment maintenance for all installations as per OISD norms. They include foam type extinguishers, dry chemical powder type extinguishers, Carbon-dioxide type extinguishers, fire tenders. There is also a provision for fire water system, foam system and fire alarm and communication system. All facilities are monitored and maintained through daily checklists and internal/external audits.

6.2 Details of Noise, Vibration and emission from equipment

These factors are taken care at the time of procurement of equipment by inducting equipment satisfying accepted international oilfield standards. Apart from this Noise survey, Vibration monitoring, stack monitoring studies are conducted as per ISO-14001 specifications, periodically and they are maintained at acceptable levels. The check lists are prepared and environmental audits conducted in observance of statutory legislations like

- National Ambient air quality standards
- Ambient noise standards
- Noise pollution rules
- CPCB guidelines
- OISD standards

6.3 Environmental Damage in onshore exploration

The onshore exploration activities generate two major and minor waste streams. The major waste streams are:

A. Drilling Fluids
B. Drill cuttings

The minor waste streams are:

C. Deck Drainage
D. Sanitary Waste
E. Domestic waste

A. Drilling Fluids (Mud): Water based drilling fluids having no toxicity would be used without any significant environmental damage.

B. Drill cuttings: The drill cuttings removed from the well are rock debris and mineral particles generated by drilling into the underground formation. The discharge or rock cuttings and mud may have minor adverse environmental effect in case of spillage.

C. ***Deck Drainage:*** Deck drainage is either collected and treated separately for oil removal by gravity separation before discharge

D. ***Domestic Waste:*** These wastes originate from kitchen, laundries and galleys located on drilling facilities. These wastes comprise of metal cans, glass or plastic bottles, paper boxes and biodegradable waste etc.

ONGC is composting all biodegradable solid waste. The other solid wastes are collected, compacted and stored in confined places and transported for treatment to the treatment facility.

7. Well Abandonment Procedure

All procedures as per OMR shall be followed while abandoning a CBM well. However, it may be mentioned that normal life of a CBM wells may extend up to a period of 25-30 years.

8. Details of site restoration / decommissioning and demolition of wastes

All procedures as per OMR / OISD guidelines, any other statutory requirement shall be strictly followed in site restoration / decommissioning and demolition of wastes if any.

9. Expected Project Cost / Technoeconomics

The project cost which includes drilling, completion, testing of 80 development wells has been worked out to be about 957 Crore.

"I hereby given undertaking that the data and information given in the application and enclosures are true to the best of my knowledge and belief and I am aware that if any part of the data and information submitted is found to be false or misleading at any stage, the project will be rejected and clearance given, if any to the project will be revoked at our risk and cost".

DATE :_____ ED – NATIONAL HEAD

PLACE : BOKARO COAL BED METHANE

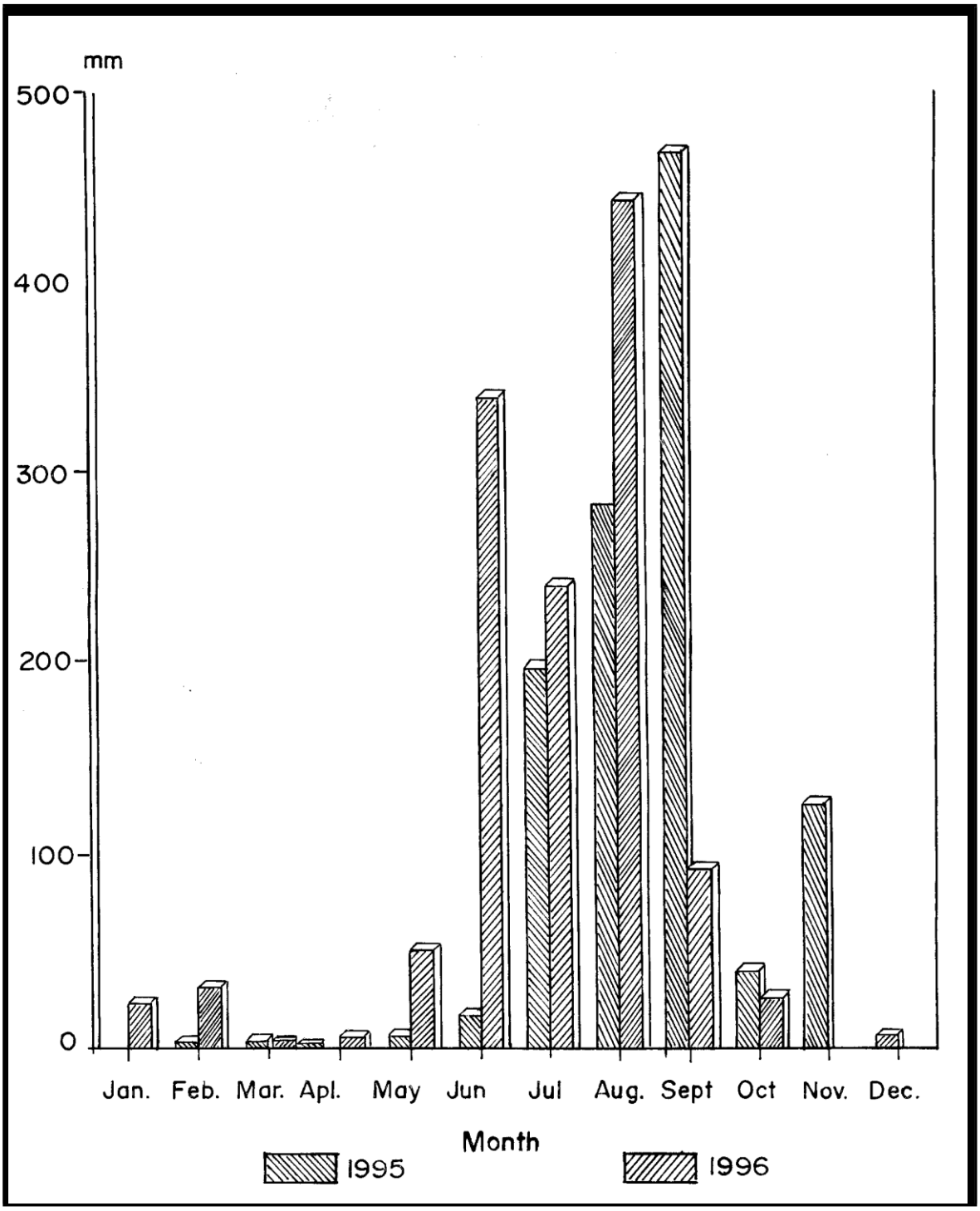

Fig.5: Monthly Rainfall

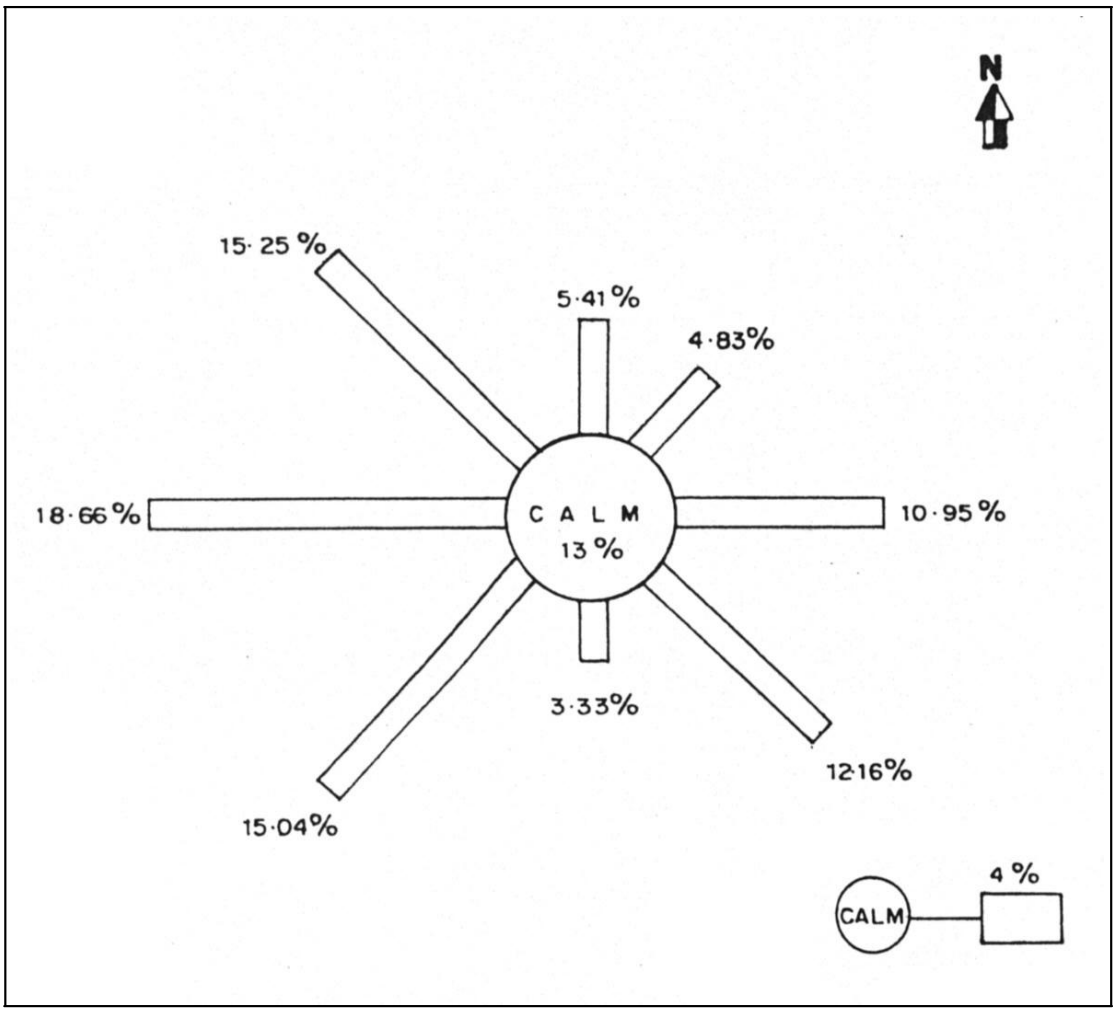

Fig.6: Annual Wind Rose Diagram

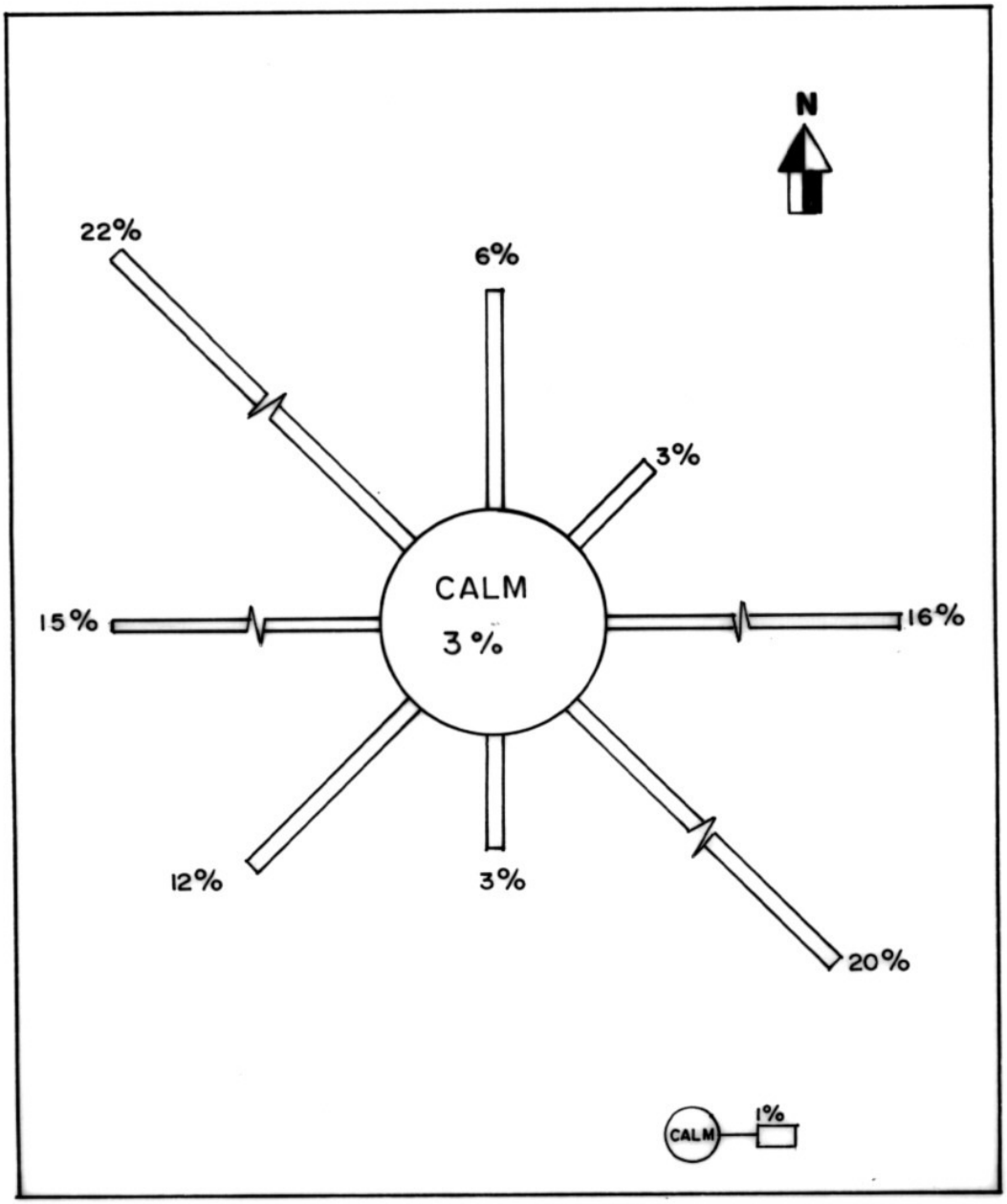

Fig. 2·1·3 : Windrose–24 hourly

Fig. 7: Wind Rose Pattern 24 Hourly

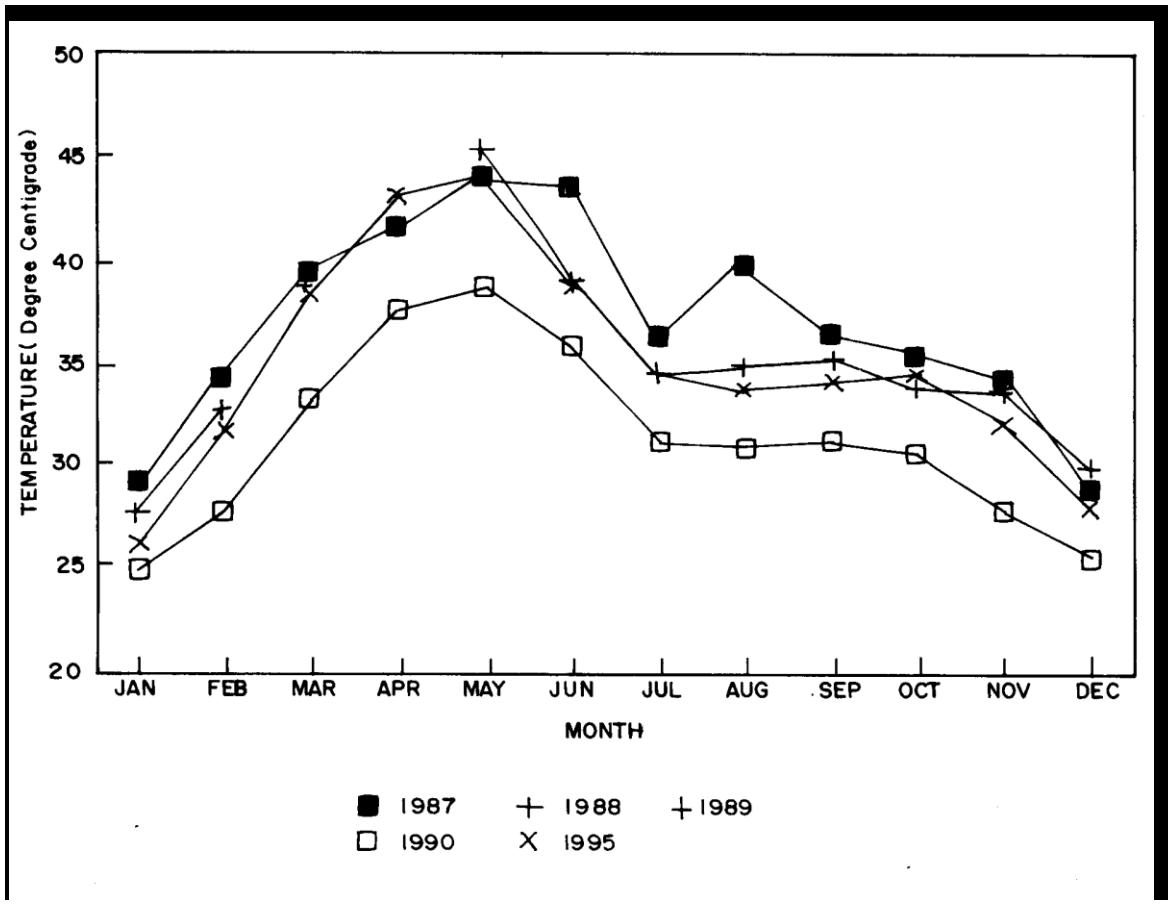

Fig. 8: Variation in Maximum Temperature

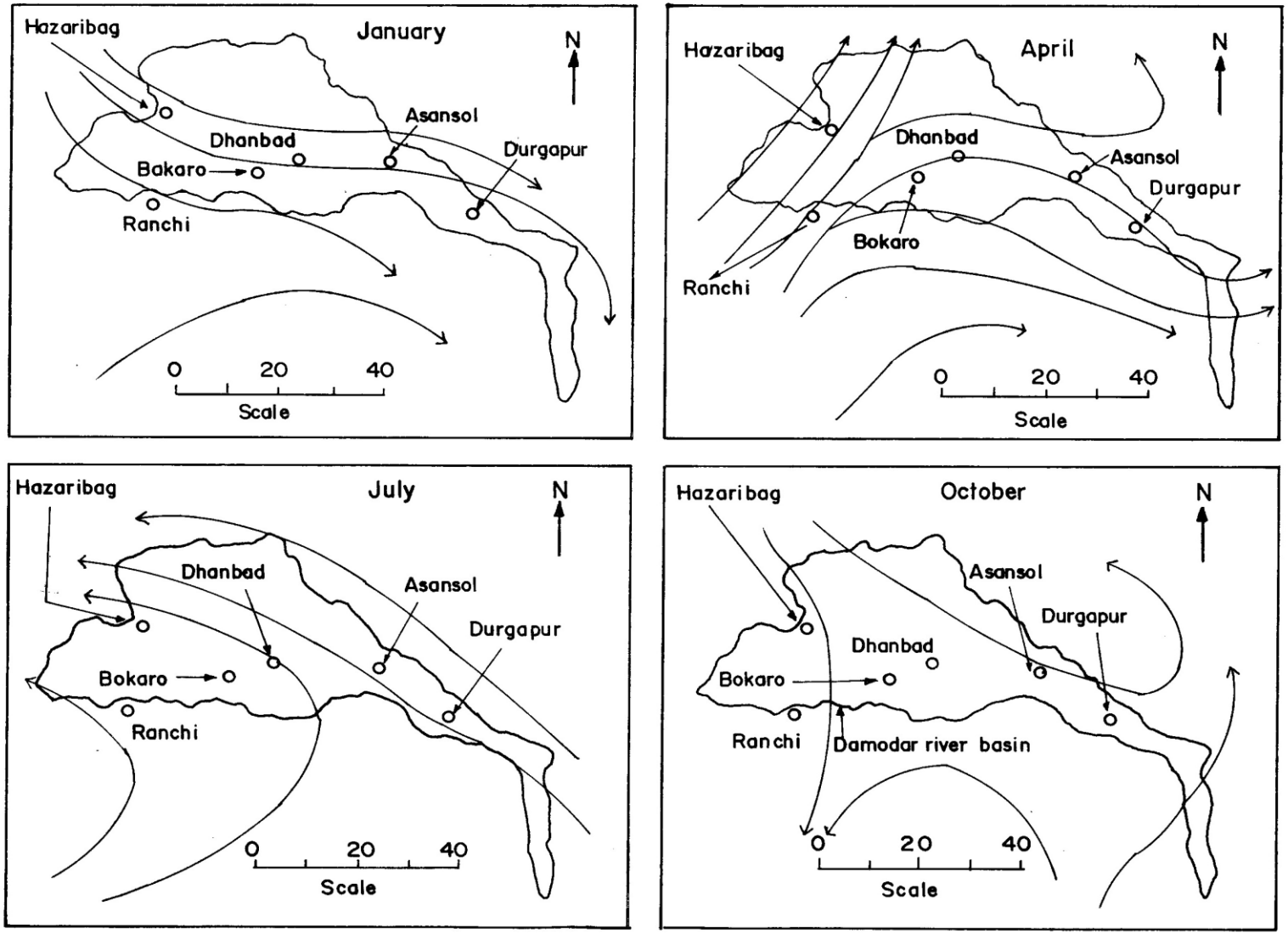

Fig. 9: Seasonal Variation in Wind Direction

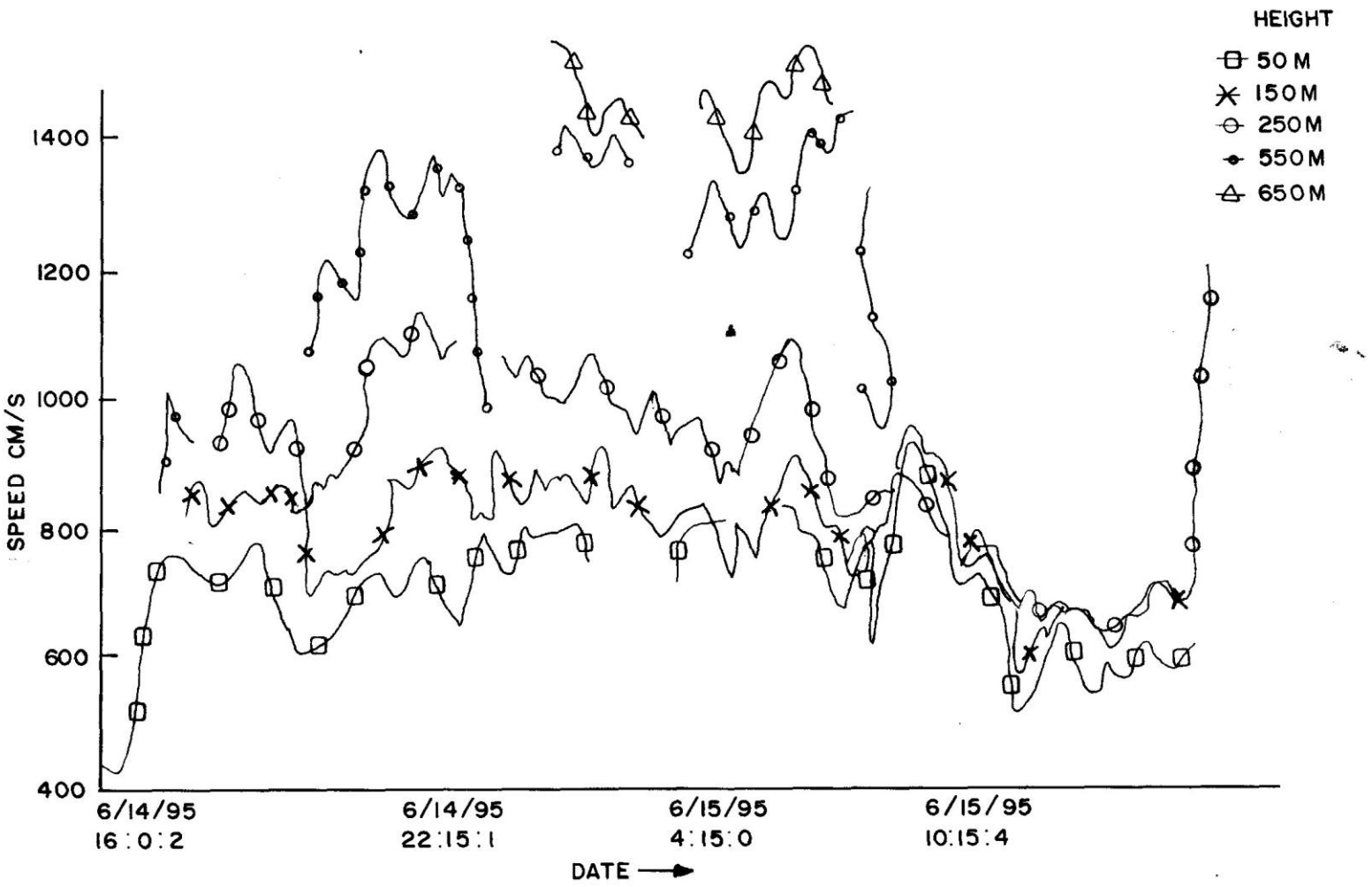

Fig. 10: Series Plot of Wind Speed at Different Heights

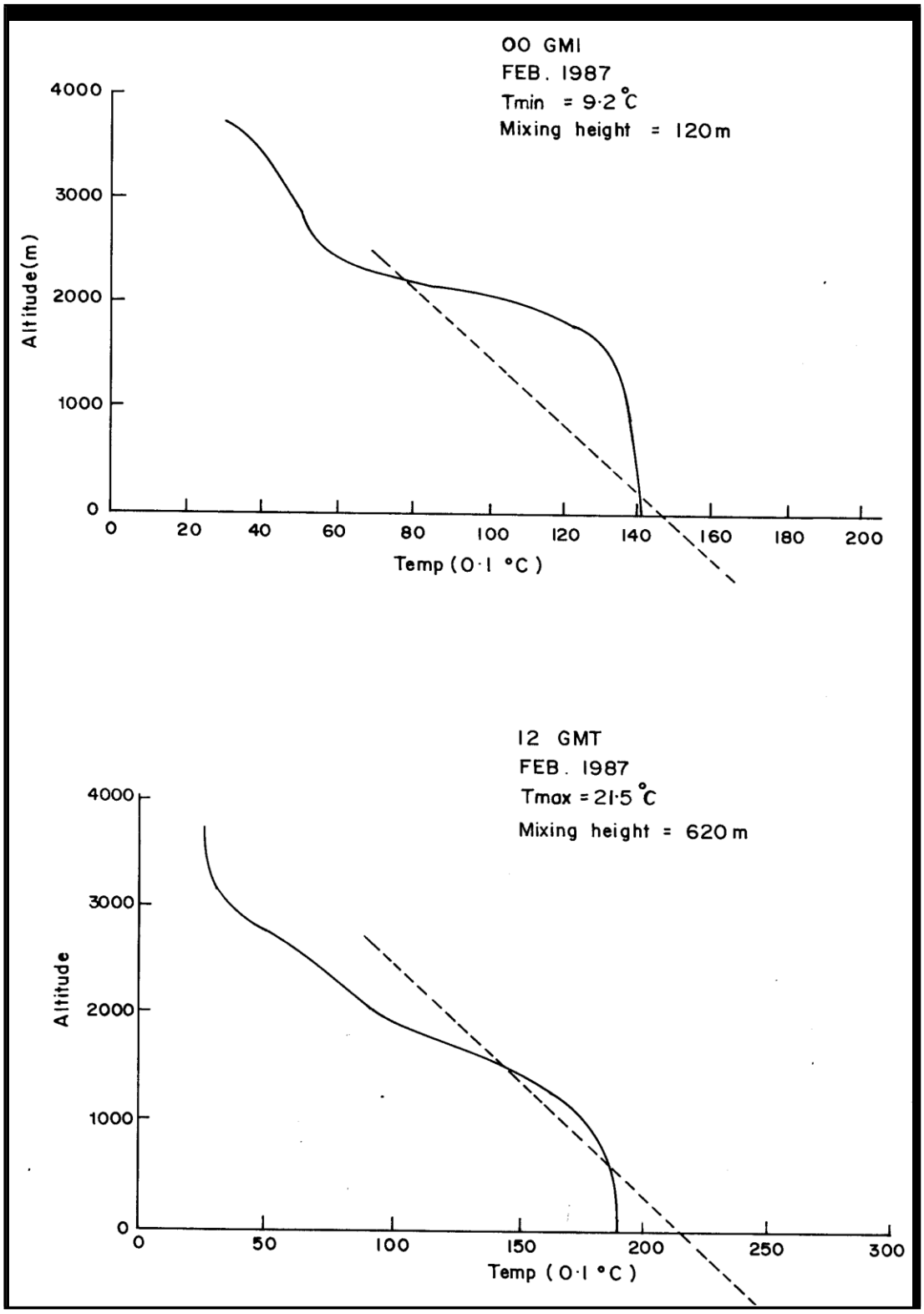

Fig. 11: Mixing Height