



Ref: WBPDCCL/Director(Mining)/

Date: 29.11.2024

To  
The Divisional Forest Officer  
Bankura (North) Division  
Machantala, Bankura, PIN-722101

**Subject: Point wise compliance/ reply of EDS regarding Diversion of 338.74 ha of forest land for Coal Mining in Barjora North Coal Mine Block in favour of The West Bengal Power Development Corporation Limited, Bankura District, West Bengal (Online Proposal No. FP/WB/MIN/43000/2019).**

**Ref:** (i) Query raised by DFO Bankura (North) Division vide Memo No.2502/8 on dated 25.11.2024

(ii) Ministry of Environment Forest and Climate Change, Forest Conservation Division, Government of India letter No. I/85056/2024 dated 21<sup>st</sup> October, 2024.

Sir,

In reference to the above-mentioned subject, this is to inform that Point wise compliance /reply is given below for your kind perusal.

Sl. No.	EDS Raised by DFO	Point Wise Compliance Report
i.	Why the diversion of nala is essential?	<p>Tartora Nala, which is a seasonal Nala (3 km in length &amp; avg. 20m in width within Mining Lease area) flows from west to east through the southern part of the proposed Forest Diversion area. Up to 10<sup>th</sup> year Nala will remain in its original course and only after 10<sup>th</sup> year of mining operations it will be diverted as per Approved Mine Plan &amp; Mine Closure Plan.</p> <p>It is essential to divert the Nala as because beneath the Nala approx. 2.5 million tonne Coal reserve is there and as per the approved Mine Plan &amp; Mine Closure Plan, coal reserve cannot be left out without mining.</p> <p>As per Approved Mine Plan &amp; Mine Closure Plan the detail diversion Plan of Tartora Nala and its Design &amp; Section are attached as <b>Annexure-I</b></p>
ii.	Why it is not possible to retain the nala within the mining lease with a safety zone along the nala?	<p>If WBPDCCL retain the Nala as it is, with a safety zone of both side from the Nala, approx. 2.5 million tonne of coal reserve will be blocked under the Nala. As per Approved Mine Plan &amp; Mine Closure Plan, reserve cannot be left out without mining as this already taken within total extractable Coal reserve considering conservation point of natural resource and safe working of the mine.</p>
iii.	Justification for the diversion of the "Tartora Nala".	<p><u>Justification for the diversion of the "Tartora Nala".</u></p> <p>There are mainly three reasons for diversion of Tartora Nala.</p> <p><u>Approved Mine Plan:</u> As per approved Mine Plan &amp; Mine Closure Plan, the entire Nala falling within Core Mining Zone, therefore diversion is essential. Stage Plan of 10<sup>th</sup> to 15<sup>th</sup> year is Attached as <b>Annexure-II</b></p>

Director (Mining)  
Corporate Office,  
WBPDCCL



	<p><u>Coal Reserve:</u> Beneath the Nala approx. 2.5 million tonne coal reserve is there, which cannot be left out as per Approved Mine Plan &amp; Mine Closure Plan by Ministry of Coal (MoC), Govt. of India.</p> <p><u>DGMS Safety Guidelines:</u> As per DGMS circular No. DGMS/SOMA/(Tech)circular no. 02, dated 22<sup>nd</sup> May,2024 Precaution against the danger of inundation due to the surface water &amp; underground water have been provided under Regulations 149 &amp; 150 of CMR,2017, &amp; DGMS Circular no. DGMS/SOMA/(Tech)Circular No. 02, dated 22<sup>nd</sup> May,2024 attached as <b>Annexure-III</b></p> <p>Therefore, if Nala is not diverted there will be threat of inundation during rainy season due to overflow and inrush of water by breaking the embankment when Mining Operations approach towards Nala,</p>
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Thanking You,

Yours faithfully

*Chanchal Goswami*  
29/11/2024

(Chanchal Goswami)

Director (Mining), WBPDCCL

Director (Mining)  
Corporate Office,  
WBPDCCL

### Chapter-3-Location, Topography & Communication



#### 3.11 Need for Shifting of 220 KV Mejia-Barjora Power Line and Tartola nallah:

An existing 220 KV power line belonging to Damodar Valley Corporation (DVC) passes through the eastern and northern part of the Barjora North Coal Block. The same needs to be diverted to have smooth and safe mining operation in this planned period. WBPDCCL has already initiated for this diversion and placed work contract to DVC vide no. HQ/M & C/ 6050000965; dt. 26.2.2019 and subsequently paid the requisite amount of Rs. 8.93 crores for diversion of this 220 KV HT line. The copy of the payment confirmation letter is furnished in **Annexure-XVIII G**. The approved layout plan for shifting of this HT line is furnished in **Plate No. XX**.

An existing Tartora nallah which flows from west to east, needs to be diverted along the southern edge of the proposed mine boundary. The elevation difference between the entry and exit points of this discharge scheme is about 8 meter. Total length of the diverted nala will be 6.30 km. Based on the present day flow parameters as observed at site, the base width and depth of the nala has been considered as 3 meter and 2.5 meter respectively. A more detail design needs to be done including cutting and filling requirement and vertical drop considerations before diversion of this nala. Chainage wise details of conceptual nala diversion is furnished Plate **No XVIII**. A declaration in this regard from M/S WBPDCCL has been furnished in **Annexure-XVIII H**.

**RQP: Abhai Pratap Singh**  
**RQP. (No. 34011/(50)/2009-CPAM;**  
**Dt. 07.10.2009).**

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Director (Mining)  
 Corporate Office,  
 WBPDCCL

हिटलर सिंह / HITLAR SINGH  
 अवर सचिव / Under Secretary  
 कोयला मंत्रालय / Ministry of Coal  
 भारत सरकार / Govt. of India  
 शास्त्री भवन / Shastri Bhawan  
 नई दिल्ली / New Delhi



will be 187.85 ha of mined out areas. The stage plan at the end of 15<sup>th</sup> Year is furnished in **Plate No. XIII D.**

**15<sup>th</sup> Year of Mine Operation:**

The mine will progress towards more south and almost cover the central part of the block. The total disturbed area at the end of this stage will be around 335.83 ha. Floor of Seam-I will be continued to maintain as quarry floor and the deepest part of the quarry will be at (-) 10 m RL. Both the backfilled dumping areas will be merged together to form a single dumping ground. Total backfilled dump area will be around 109.30 ha. Central Haul road will be pushed towards southward direction and it will terminate near the Infrastructure area at the coal stock yard. Diversion of TartoraNala is expected to be completed between 10<sup>th</sup> to 15<sup>th</sup> Year. At the end of 15<sup>th</sup> Year stage, TartoraNala will be shifted completely. Almost all the seams partially will be intersected in this period. Top soil spreading will commence in the northern patch of the merged dump. A water sump covering an area of 5.14 ha will be formed in between the two dumps.

The stage plan at the end of 15<sup>th</sup> Year is furnished in **Plate No. XIII E.**

**20<sup>th</sup> Year of Mine Operation:**

The mining operation at this level will reach to its southernmost extension. The southern limit will be defined by the safety barrier of the diverted nala at a distance of 15 meter from the bank. Central haul road will be extended till the southernmost tip of the mine. The establishment section in the southern part of the proposed lease boundary needs to be vacated by this period. Depth of mining will follow the floor of Seam-I and will be limited to (-) 15 m RL. Besides the merged dump in the previous stage, two more dumps of 62.45 ha and 50.45 ha respectively will be created in either side of the central haul road. Height of both the dumps will remain below the base level, however will not raise above the average ground level. Water sump will remain intact at this level and will be utilized as mine water arrestor.

The stage plan at the end of 20<sup>th</sup> Year is furnished in **Plate No. XIII F.**

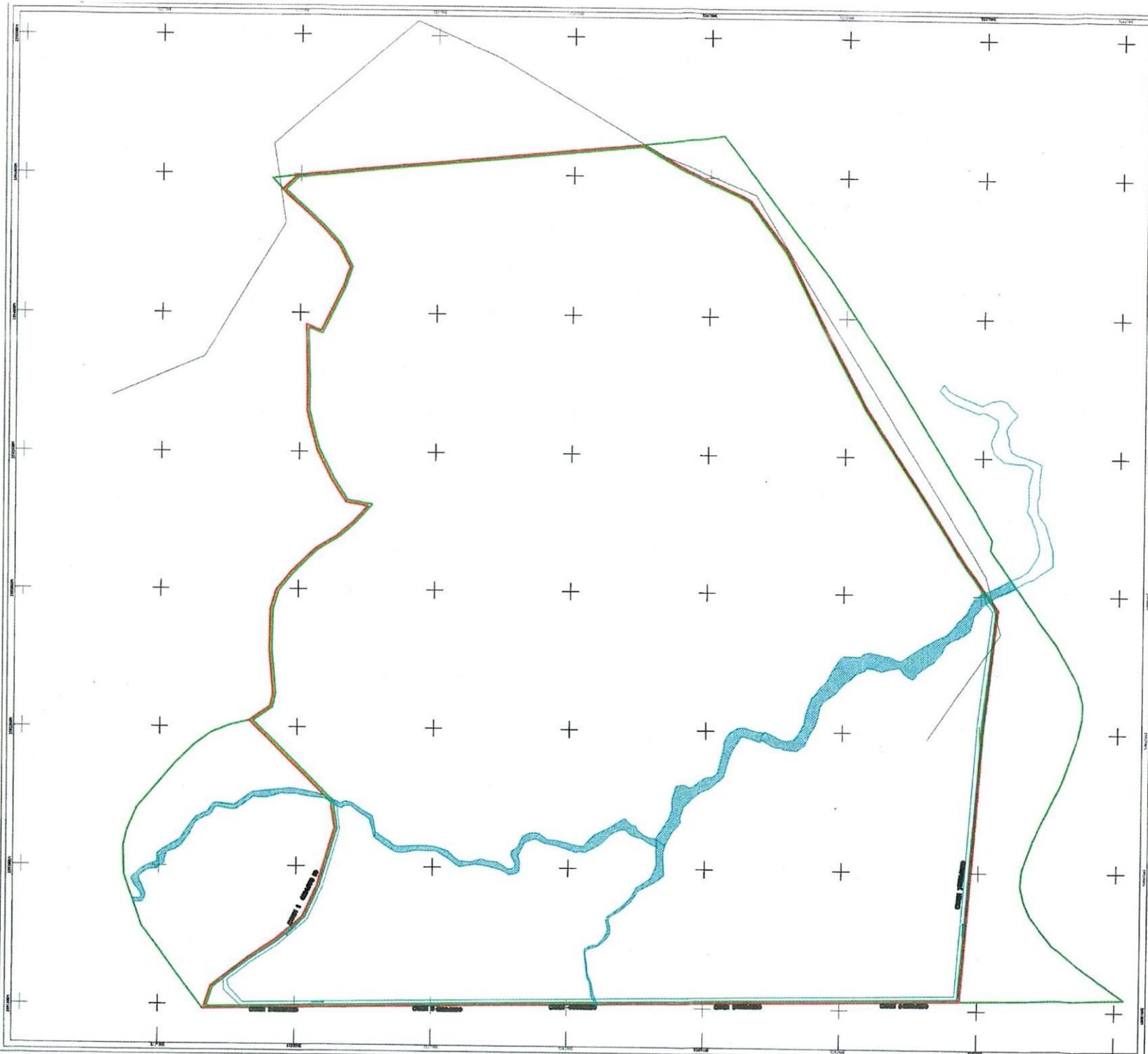
**RQP: Abhai Pratap Singh**  
**RQP. (No. 34011/(50)/2009-CPAM;**  
**Dt. 07.10.2009).**

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RQP: Abhai Pratap Singh  
Reg No. 34011/(50)/2009-CPAM.  
Dt. 07.10.2009

  
Director (Mining)  
Corporate Office,  
WBPDC

  
हिटलर सिंह / HITLAR SINGH  
अवर सचिव / Under Secretary  
नीयता मंत्रालय / Ministry of Coal  
भारत सरकार / Govt. of India  
शास्त्री भवन / Shastri Bhawan  
नई दिल्ली / New Delhi



  
**डिप्टर सिंग / HITLAR SINGH**  
 अवर सचिव / Under Secretary  
 कोयला मंत्रालय / Ministry of Coal  
 भारत सरकार / Govt. of India  
 नया रावली / Shastri Bhawan  
 नया दिल्ली / New Delhi

**INDEX**

Sl. No.	DESCRIPTION	SYM.
1.	BLOCK BOUNDARY	
2.	ML BOUNDARY (663.04 ha)	
3.	SAFETY ZONE	
4.	NALA	
6.	DIVERTED NALA	
7.	PROPOSED HT LINE	
8.	CHAIN START/END POINTS	

  
**Director (Mining)**  
 कोयला कार्यालय / Office,  
 नया रावली / New Delhi

**REFERENCES**

Sl.	NAME OF DRAWING	DRAWING NO
1	Surface Plan	Plate-4
2	Mine Working Plan	Plate-18 to Plate 22

- NOTE:**
- ALL DIMENSIONS ARE IN METER
  - BASIC DATA ARE TAKEN FROM G.R. ON Barjora North Block Prepared by CMPDI
  - PLAN IS SUBJECT TO SUIT ACTUAL SITE CONDITION.
  - ACTUAL POSITION OF RIVER MAY CHANGE, TAKEN FROM SURVEY OF INDIA TOPOSHEET.

RQP: **Abha Pratap Singh**  
 Reg No 34611/(50)/2009-CPAM  
 Dt 07 10 2009

**PLATE-XVIII**

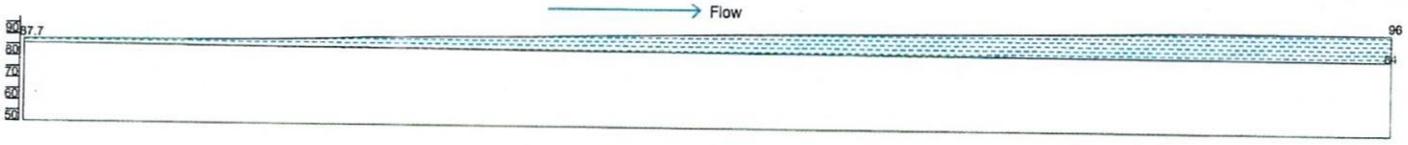
**West Bengal Power Development Corporation Limited**

**JOB TITLE:** MINING PLAN INCLUDING MINE CLOSURE PLAN (REVISION 1) FOR BARJORA NORTH COAL MINE, BARJORA, WEST BENGAL.

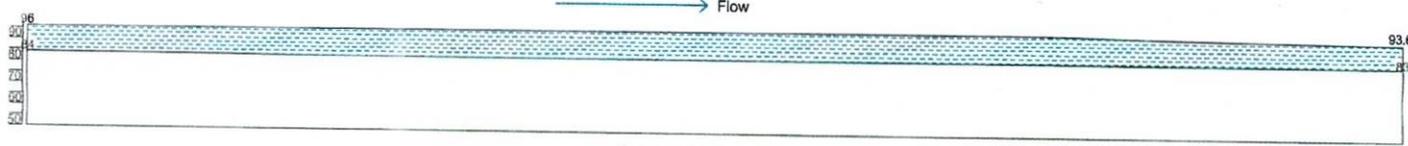
REVISION	Activity	Date	Signature	Draw
1	Approval	07/10/2009	Hitlar Singh	

Prepared by: **Abha Pratap Singh**  
 Checked by: **Hitlar Singh**  
 Scale: 1:5000  
 Date: 07/10/2009

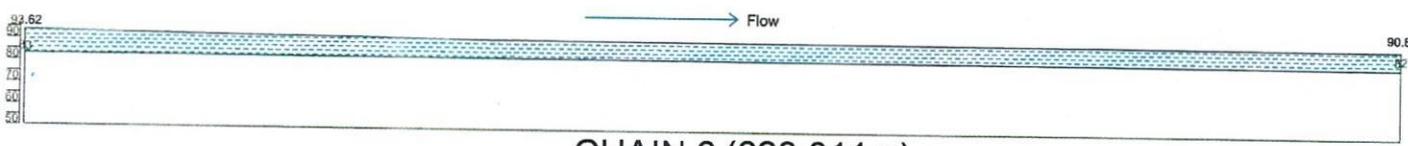
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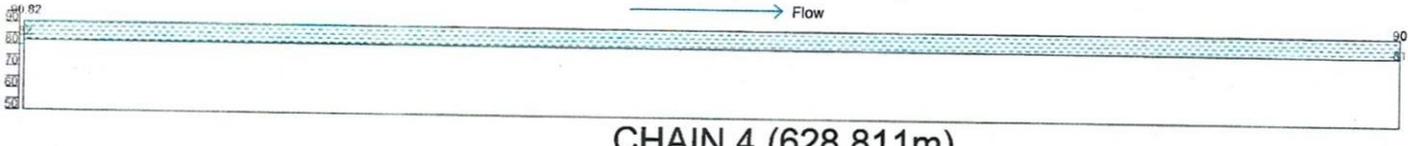
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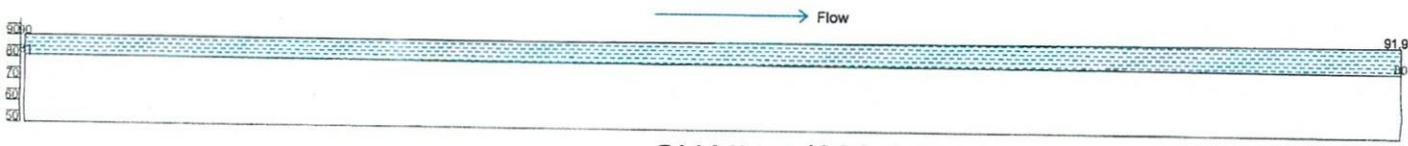
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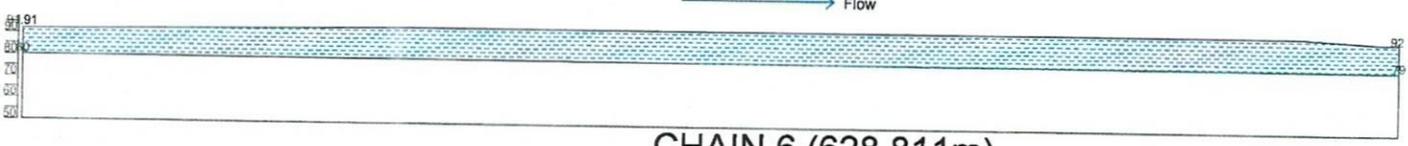
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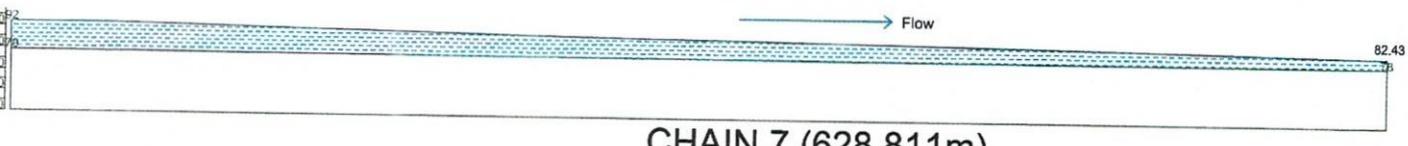
CHAIN 4 (628.811m)



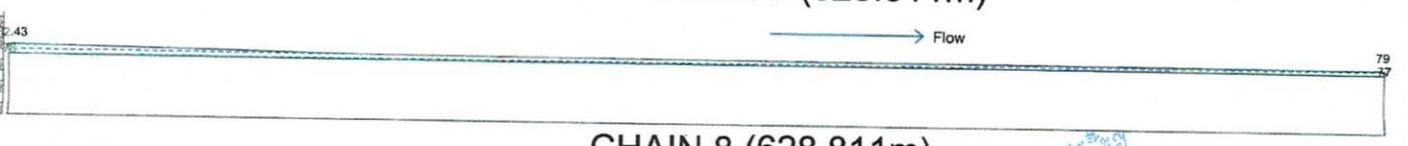
CHAIN 5 (628.811m)



CHAIN 6 (628.811m)



CHAIN 7 (628.811m)



CHAIN 8 (628.811m)

*Signature*  
 Director (Mining)  
 Corporate Office,  
 WBPDCCL

RQP: *Signature*  
 Reg No 84011/150/2009-CPAM  
 Dt 07 10 2009

Chief Engineer, Mining  
 West Bengal Power Development Corporation Limited  
 Kolkata

PLATE-XIXA			
West Bengal Power Development Corporation Limited			
JOB TITLE: MINING PLAN (INCLUDING SAFETY & ASSURE PLAN (REVISION 2) FOR BAKJORA NORTH (FYAL, MN) LA NALDA, WEST BENGAL.			
PROJECT:	Activity	Name	Date
NALA DIVERSION SECTION ALONG NALA	Approved by	Enr Akbar Princy Singh	
Prepared by:	Checked by:	Approved by:	Date:
<i>Signature</i>	Enr. P. Lal	Enr. P. Lal	
Scale: As Shown	Scale: As Shown	Scale: As Shown	Scale: As Shown
Sheet No. 10/100	Scale: 0 10 20 40 50	Scale: 0 10 20 40 50	Scale: 0 10 20 40 50



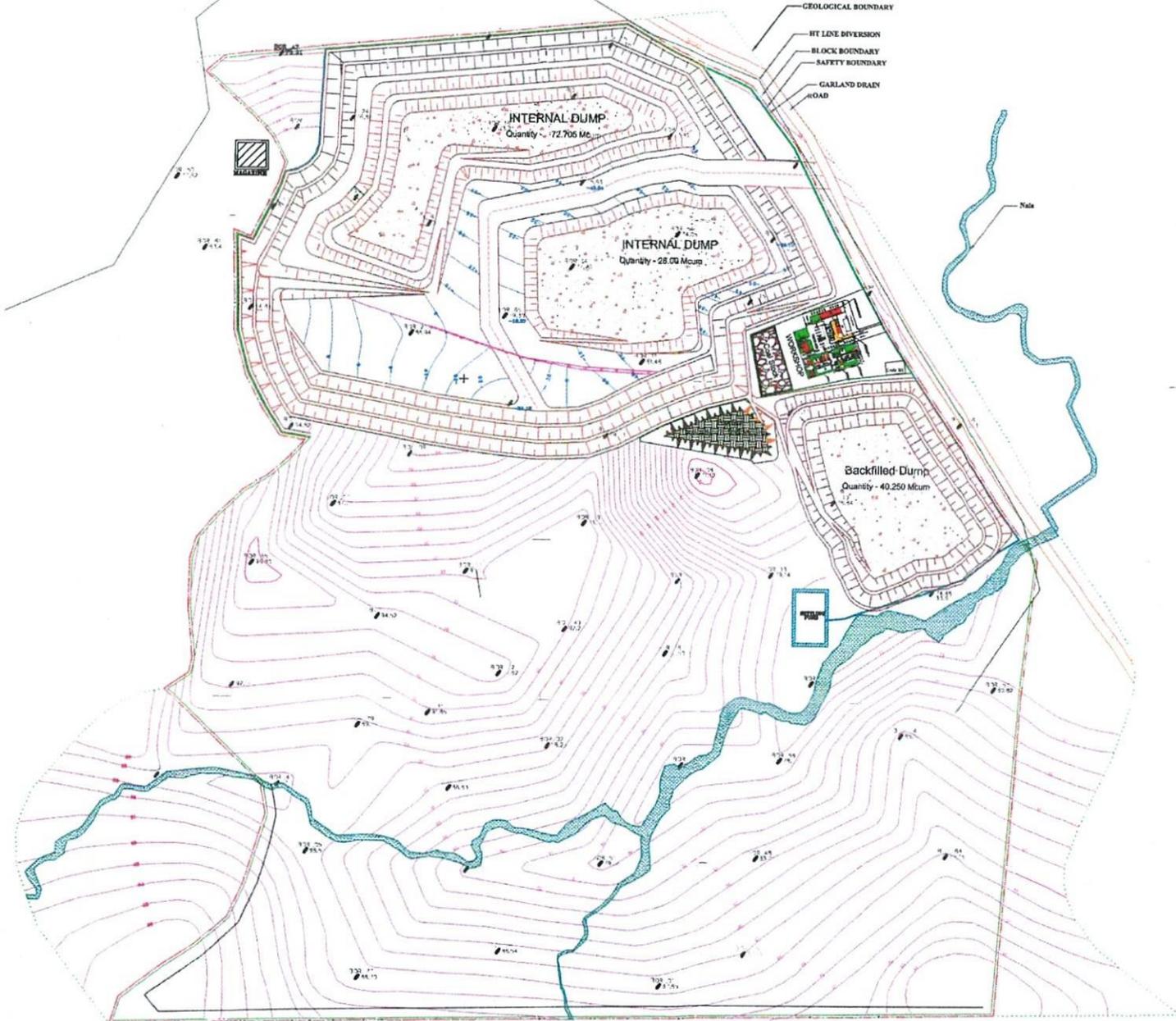
**ANNEXURE-II**



  
 HITLAR SINGH / HITLAR SINGH  
 और सचिव / Under Secretary  
 कोयला विभाग / Ministry of Coal  
 भारत सरकार / Govt. of India  
 शांति भवन / Shanti Bhawan  
 नई दिल्ली / New Delhi

*Handwritten signature*

Director (Mining)  
 Corporate Office,  
 WBPDCI



**INDEX**

Sl. No.	DESCRIPTION	SYM.
1.	BLOCK BOUNDARY	
2.	ML BOUNDARY (663.04 ha)	
3.	SAFETY ZONE	
4.	BORE HOLE LOCATION WITH RI	
6.	FLOOR CONTOUR	
7.	INTERNAL DUMP	
8.	HAUL ROAD	
9.	NALA	
10.	ROAD	
11.	PROPOSED HT LINE	
12.	SURFACE CONTOUR	
13.	SETTLING POND	
14.	GARLAND DRAIN	

**REFERENCES**

Sl.	NAME OF DRAWING	DRAWING NO
1	Floor contour Plans	Plate-6
2	Geological Plans	Plate-3
3	Surface Plan	Plate-4
4	Mine Working Plan	Plate-16 to Plate 22

- NOTE:**
- ALL DIMENSIONS ARE IN METER
  - BASIC DATA ARE TAKEN FROM G.R. ON Barjora North Block Prepared by CMPDI
  - PLAN IS SUBJECT TO SUIT ACTUAL SITE CONDITION.
  - ACTUAL POSITION OF RIVER MAY CHANGE, TAKEN FROM SURVEY OF INDIA TOPOSHEET.

ROP: *Handwritten name*  
 Reg No 3401/150/2009-CPAM  
 Dt 07 10 2609

**FLATE-XIIB**

West Bengal Power Development Corporation Limited

**JOB TITLE :** MINING PLAN ENCLUCING MINE CLOSURE PLAN (REVISION D) FOR BARJORA NORTH COAL MINE, BANKURA, WEST BENGAL.

Sl. No.	Activity	Name	Signature	Date
1.	Proposed by			
2.	Approved by	Dr. Anil Prasad Singh		

Prepared by: *Handwritten name*  
 Scale: 0 50 100 200 300 M  
 Date: 07.10.2009



HITLAR SINGH  
 Under Secretary  
 Ministry of Coal  
 Govt. of India  
 New Delhi

Director (Mining)  
 Corporate Office,  
 WBPDC

INDEX

Sl. No.	DESCRIPTION	SYM.
1.	BLOCK BOUNDARY	[Symbol]
2.	ML BOUNDARY (685.04 ha)	[Symbol]
3.	SAFETY ZONE	[Symbol]
4.	BORE HOLE LOCATION WITH RL	[Symbol]
6.	FLOOR CONTOUR	[Symbol]
7.	INTERNAL DUMP	[Symbol]
8.	HAUL ROAD	[Symbol]
9.	NALA	[Symbol]
10.	ROAD	[Symbol]
11.	PROPOSED HT LINE	[Symbol]
12.	SURFACE CONTOUR	[Symbol]
13.	SETTLING POND	[Symbol]
14.	GARLAND DRAIN	[Symbol]

REFERENCES

Sl.	NAME OF DRAWING	DRAWING NO
1	Floor contour Plans	Plate-6
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3	Surface Plan	Plate-4
4	Mine Working Plan	Plate-16 to Plate 22

NOTE:

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- BASIC DATA ARE TAKEN FROM G.R. ON Barjora North Block Prepared by CMPDI
- PLAN IS SUBJECT TO SUIT ACTUAL SITE CONDITION.
- ACTUAL POSITION OF RIVER MAY CHANGE, TAKEN FROM SURVEY OF INDIA TOPOSHEET.

ROP Anup Dasgupta Singh  
 Reg No 34011/1507/2009-CPAM  
 Dt 07 10 2009

PLATE-XIII

West Bengal Power Development Corporation Limited

JOB TITLE: MINING PLAN INCLUDING MINE CLOSURE PLAN (VERSION 2) FOR BARJORA NORTH COAL BLOCK, BARJORA DISTRICT, WEST BENGAL.

Sl. No.	Author	Issue	Revision	Date
1	XVII Year Start Plan			

Prepared by: [Signature]  
 Checked by: [Signature]  
 Approved by: [Signature]

Scale: 0 50 100 200 300 M  
 Date: 07-10-2009



भारत सरकार/Government of India

श्रम एवं रोजगार मंत्रालय/Ministry of Labour & Employment

खान सुरक्षा महानिदेशालय/Directorate General of Mines Safety



No. DGMS/SOMA/(Tech) Circular No. 02

Dhanbad Dated 22<sup>nd</sup> May 2024

To  
The Owners, Agents and Managers of All Mines

**Subject: Precautions against danger of inundation in mines.**

The sudden rise in water level in or around the catchments area due to rains during monsoon is a common phenomenon. The heavy current of water may cut across the bunds and barriers by deviating its normal course of water and also may result in flooding of low lying area including mine workings, if they are not adequately guarded.

Precautions against the danger of inundation due to the surface water and underground water have been provided under Regulations 149 & 150 of CMR, 2017, Regulations 127 & 128 of the MMR 1961 respectively. Also learning from the earlier inundation incidents/accidents including major disasters, DGMS guidelines/circulars have been issued for implementation to safeguard against the inundation in mines.

Identification of possible sources of danger due to surface water, remedial measures to avoid such danger, monsoon preparation and precaution against danger of inundation from surface water were emphasized and circulated through DGMS Tech. Circular No. 2 of 1978 and DGMS/SOMA/(Tech) Circular No. 6 of 2004.

However, in spite of above guide lines and caution letters issued from this Directorate from time to time, there have been cases of inundation in underground and opencast mines, mainly because adequate precautions were not taken.

The following instances have been recorded during the recent years

- (i) Instances of flooding of mines due to the sudden rise of water in the river/nallahs which have over flown above the known HFL, breaching the bund constructed for the protection of opencast workings against the river/nallah, resulting in flooding of the mine workings.
- (ii) The workmen going to the place of work near the sump have been washed away into the sump by the flowing water in the mine during heavy rain.
- (iii) Drowning of persons in the sumps/waterlogged workings for attempting to enter the sump for various reasons.

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*[Signature]*  
Director (Mining)  
Corporate Office,  
WBPDCL

- (iv) Rainwater entering the underground workings through the subsidence cracks of the shallow cover workings.
- (v) The Dumper operator driving the dumper on the haul road inadvertently entered the sump.

To prevent the occurrence of the incidents/accidents of inundation, all the mining companies shall prepare a principal hazard management plan specific to the mine and based on the risk assessed, prepare and implement the safety management plan which shall have bearing to and not limited to the following precautions:

1. Effective implementation of the provisions of the Regulations 149 & 150 of CMR, 2017, Regulations 127 & 128 of the MMR 1961, DGMS circulars issued on the subject and recommendations made by the courts of inquiry appointed on the disasters occurred in Indian mines due to inundation.
2. The pathways leading to the working places in the opencast mines shall be so situated that there is no danger to the passers thereby due to the water.
3. The rain water of the catchment area surrounding the mine shall be coursed away from the mine through a system of garland drains, so that even in heavy rains there is no danger to the persons working at the sump areas in the mine.
4. The bunds/retaining wall constructed against the river/ water courses shall be thoroughly examined and maintained according to the principles of engineering so that there occurs no breach during the incessant rains in the catchment area.
5. Proper fencing shall be maintained against the sump and the waterlogged old workings so that there is no unauthorized / inadvertent entry into such workings by any person.
6. Pontoon pumps shall be so maintained, that the necessity for the persons to go near the pumps for operation and all the repair/maintenance works is almost avoided. A proper safe operating procedure (SOP) to be framed and implemented for the repair and maintenance of the pumps near the sumps.
7. The travelling roads in the opencast mines shall be so designed that there is no danger to the persons from the water flowing into the sumps during the rains.
8. The haul roads passing by the side of waterlogged workings/sumps shall be suitably guarded by berm/ parapet wall against the vehicle drivers inadvertently driving into such workings.
9. A mechanism with adequate manpower to be established for inspection of surface area over the depillared panels and old workings for formation of cracks, if any, and the cracks shall be immediately filled up to prevent water entering into the underground workings.

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Director (Mining)  
Corporate Office,  
WBPDCL

10. A close liasoning and communication with local meteorological department, water dams, reservoir authorities shall be established to get alert of heavy rainfall, rise of water level and release of water from water dams etc.

I solicit your commitment in the effective implementation of the measures circulated, in the interest of safety of persons employed in the mines.

  
22/05/2024  
(Prabhat Kumar)  
Director General of Mines Safety

  
Director (Mining)  
Corporate Office,  
WBPDCI



Ref. No: WBPDCCL/Director (Mining)/1965

Date: 19.11.2024

**To**  
**Divisional Forest Officer**  
**Bankura (North) Division**  
**Machantala, P.O& District- Bankura**  
**PIN-722101 (West Bengal)**

**Subject:** Point wise compliance/ reply of EDS regarding Diversion of 338.74 ha of forest land for Coal Mining in Barjora North Coal Mine Block in favour of The West Bengal Power Development Corporation Limited, Bankura District, West Bengal (Online Proposal No. FP/WB/MIN/43000/2019).

**Ref:** Ministry of Environment Forest and Climate Change, Forest Conservation Division, Government of India letter No. I/85056/2024 dated 21<sup>st</sup> October,2024.

Sir,

In reference to the above-mentioned subject, it is for your information that after examination of the said proposal by MoEF & CC, Forest Conservation Division, Govt. of India, few essential details were sought to proceed for the forest diversion proposal. Accordingly, EDS has been raised vide letter No. I/85056/2024 dated 21<sup>st</sup> October,2024.

Point wise compliance /reply is given below for your kind perusal.

Sl. No.	EDS Raised by MoEF&CC	Point Wise Compliance of WBPDCCL
i.	The CWLW while recommending the proposal has mentioned that the impact of the proposed project could be kept at manageable level using extraction technology that does not require blasting. In this regard, the state shall intimate whether the mining is proposed to be done with the extraction technology without blasting or otherwise.	<p>As per Geological Report and Graphic Litholog Data of Boreholes of Barjora (North)Coal Mines, the top most strata is alluvium &amp; top soil of thickness varies from 6m-21m approximately. The Alluvium &amp; Top Soil are mostly soft material, may not require any blasting operation for removal/excavation and can be excavated without blasting. Geological Report mentioning alluvium &amp; top soil of thickness with Graphic Litholog of Boreholes is attached as <b>Annexure-I</b> for reference.</p> <p>Thereafter due to presence of hard strata (Sandstone/Shale etc.) blasting is required. Winning of Coal will be done through Surface Miner hence no Blasting will be required.</p> <p>CIMFR conducted Scientific Study for Controlled deep hole blasting at Barjora (North)Coal Mine on dated May, 2019.The Report by CIMFR is attached as <b>Annexure-II</b></p> <p>WBPDCCL has also obtained DGMS Permission to conduct controlled deep hole blasting under Regulation 196(3) of the Coal Mines Regulations, 2017 vide letter no: 010985 EZ Sitarampur Region No. I Perm 2024 264869 on dated 22.08.2024 as <b>Annexure-III</b></p> <p>Blasting in hard strata is necessary for removal of Over Burden. The Blasting will be done through advanced Technology i.e., by use of Electronic Detonator so there will be no adverse impacts of blasting on surrounding flora &amp; fauna. The Blasting Operation will be done</p>

**THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED**

Corporate Identity No. : U40104WB1985SGC039154

"Bidyut Unnayan Bhaban", Plot No. 3/C, LA-Block, Sector-III, Bidhannagar, Kolkata-700 106

Phone: No. (91) (33) 2335 0581/2339 3204/3294, Fax: (91) (33) 2335 0524 / 2339 3286, Mobile: 9425176555

E-mail : c.goswami@wbpdcl.co.in, Website : www.wbpdcl.co.in

  
Director (Mining)  
Corporate Office,  
WBPDCCL



		<p>following the recommendations of Scientific Study of CIMFR &amp; Guidelines of DGMS in order to keep the ground vibration &amp; Sound etc. within threshold limit value so that no harms will cause to flora &amp; fauna. Adequate numbers of blast induced ground vibration monitoring instruments &amp; Noise Level Monitoring instruments will be used to monitor the Vibration &amp; Noise for continuous check and balance mechanism to ensure that there is no harm to flora &amp; fauna.</p> <p>Further Control blasting technique will be adopted to eliminate the possibility generation of fly rocks as per Scientific Study Report by CIMFR.</p>
ii.	<p>A brief profile of the company/UA should be submitted giving details of their existing mining leases for coal in the State with their capacity of production, the present level of average annual production, location of these pits and the status of reclamation of forest land where mining is completed. Along with this, the State Government should also submit the details of all other coal mining leases with their capacity and average annual production and projected future requirements. They should fully justify the necessity of opening the proposed mining lease on forest land by giving details like total number of mines with mining lease, area, mineable, reserve life of mine, maximum production achieved in particular year against permission granted for production per year".</p>	<p>Brief profile of WBPDCCL, of their existing mining leases for coal in the State with their capacity of production, the present level of average annual production, location of these pits and the status of reclamation of forest land where mining is completed is herewith submitted as <b>Annexure-IV</b>.</p>
iii.	<p>The "Tartora Nala" flows from west to east of the proposed mine boundary and needs to be diverted as per the approved Mining Plan. A justification for the diversion of the Nala needs to be submitted. The state shall examine the matter and give a reasoned justification as to why the diversion of nala is essential and why it is not possible to retain the nala within the mining lease with a safety zone along the nala. The State Govt. shall submit no objection certificate from irrigation/water resource department with regard to the proposed diversion of the said nala.</p>	<p>As per Approved Mine Plan &amp; Mine Closure Plan, <b>Quote:</b> <i>"Diversion of Tartora Nala is expected to be completed between 10<sup>th</sup> to 15<sup>th</sup> year. At the end of 15<sup>th</sup> year stage Tartora Nala will be shifted completely".</i></p> <p><b>Unquote:</b> WBPDCCL will obtain all necessary permission/approvals from appropriate Authorities for diversion of the course of the Nala well in advance as per the progress of the mine.</p>
iv.	<p>The PCCF(HoFF) has recommended the proposal, however, keeping in view the fact that the area proposed is in high conservation zone and part of a landscape which is an elephant habitat, an in-depth analysis of the issue is needed, especially in view of the concerns raised by the Nodal Officer. The PCCF(HOFF) shall therefore submit his clear recommendations duly addressing the specific concerns raised by the Nodal Officer.</p>	<p>Total area of the Forest land proposed for diversion is 338.74 ha. Out of total area of the this only 10-13 % is Very Dense Forest whereas overall canopy density is 0.4 in entire forest area.</p> <p>In order to mitigate and balance the detrimental impact due to the mining activity, State Forest Department has Prepared the Comprehensive Wildlife Conservation Plan and Comprehensive Soil Moisture Conservation Plan with a financial outlay of Rs 90,13,54,162.00 &amp; of Rs. 16,23,65,280.00 respectively.</p> <p>Further Compensatory Afforestation (CA) Scheme with a</p>



		<p>financial outlay of of Rs. 22,27,54,343.00 has also been prepared for implementation. The entire implementation cost will be borne by the WBPDCCL.</p> <p>Further any additional plantation as compensatory measure, if directed by Forest Department, WBPDCCL commits to adhere the instruction in totality.</p> <p>In post closure of the mine, the used forest land will be reclaimed biologically &amp; technically and will be handed over to State Forest Department as per the prescribed norms.</p> <p>WBPDCCL, being a State PSU, is dedicated to compensate any impacts due to diversion of the Forest land as per directions/guidelines of Forest Department.</p> <p>In view of the above the proposal of Forest Diversion may kindly be considered as it is unavoidable in order to meet the Power requirement of the State of West Bengal.</p>
v.	<p>The compensatory afforestation has been proposed over non-forest land. The regional Office in the SIR has reported that about 169.41 ha area in Jalpaiguri district is in the riverine area of Teesta river. The suitability of the same has to be ensured. Further, it has been informed that during site inspection, only some of the areas proposed for CA in Bankura District were physically inspected. The Regional Office needs to inspect the remaining areas proposed for CA and ensure their suitability. A detailed report in this regard is required from the Regional Office.</p>	<p>Availability &amp; Suitability of 338.84 Ha Non-forest land has been obtained from Concerned Authority for Compensatory Afforestation (CA) against 338.74 Ha of Forest Land Proposed for Diversion, which has been already uploaded in Part-I, Parivesh Portal.</p>
vi.	<p>The State Government shall submit the information on the above-mentioned points to the Ministry along with a copy to the Regional Office. The Regional Office shall examine the same and keeping in view the recommendations of the Nodal Officer, West Bengal and the Regional Office shall submit its recommendations on the proposal to the Ministry.</p>	<p>This is related to State Forest Department and MoEF &amp; CC, Regional Office (RO), Bhubaneswar.</p>

Thanking you

Yours faithfully

(Chanchal Goswami)

Director (Mining)

*Chanchal Goswami* 19/11/2024

Director (Mining)  
Corporate Office,  
WBPDCCL

**Copy for kind information to:**

1. Addl. PCCF & Nodal Officer Govt. of West Bengal, Aranya Bhawan, Kolkata.
2. Chief Conservator of Forest, FCA, Govt. of West Bengal, Aranya Bhawan, Kolkata.
3. Chief Conservator of Forest, Central Circle, Durgapur, West Bengal.

**THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED**

Corporate Identity No. : U40104WB1985SGC039154

"Bidyut Unnayan Bhaban", Plot No. 3/C, LA-Block, Sector-III, Bidhannagar, Kolkata-700 106

Phone: No. (91) (33) 2335 0581/2339 3204/3294, Fax: (91) (33) 2335 0524 / 2339 3286, Mobile: 9425176555

E-mail : c.goswami@wbpdcl.co.in, Website : www.wbpdcl.co.in

comprising sedimentaries of Barakar formation with isolated occurrences of Talchirs above the (basement) metamorphics.

The stratigraphical sequence within the Barjora Coalfield is provided in table given below :

**Table No. 1**  
**Stratigraphic Sequence of Barjora Coalfield**

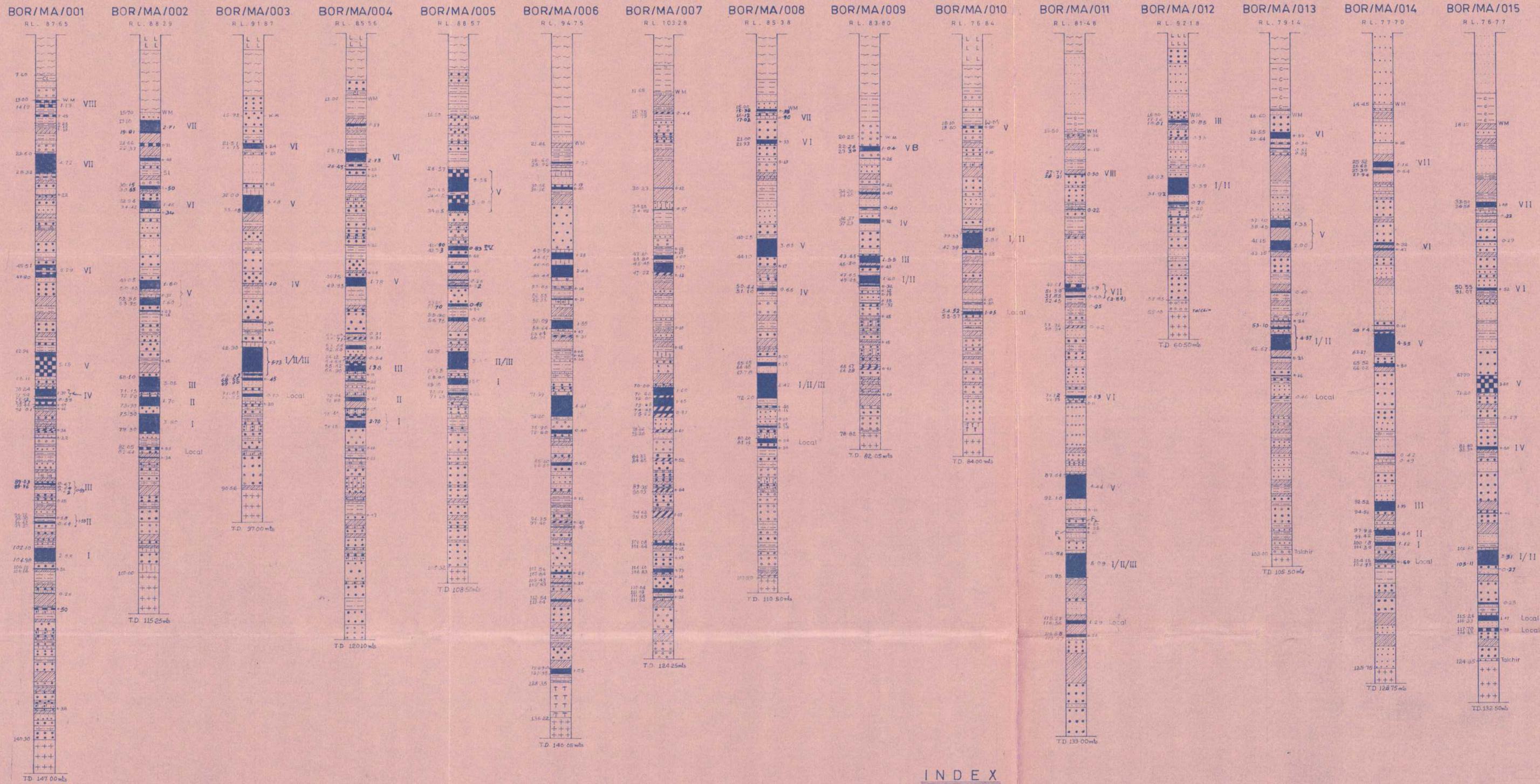
Age	Formation	Lithology
Recent	Alluvium/Soil	Loose to sub-consolidated, light to reddish brown soil and sandy soil
Quaternary	Laterite	Brown to dark brown, porous, heterogenous assemblage of iron and manganese rich materials
----- Unconformity -----		
Permian/ Lower Gondwana	Barren Measures	Dark grey/ Ironstone shale
	Barakar Formation	Sandstone, shale, carb. shale and coal seams
	Talchir Formation	Greenish shale and argillaceous sandstone, greenish in colour
----- Unconformity -----		
Pre-Cambrian	Archaeans	Granite, gneiss with mica schists, quartzite etc.

## 2.2 ALLUVIUM AND LATERITE:

Extensive lateritic cover in the form of thin capping associated with loose masses of sub-rounded quartz gravels and gritty sandstone occurs in Barjora Coalfield. These are fairly hard but crumble readily under pressure.

The alluvial cover along with the weathered/detrital mantle, which is extensive and thick at places, varies in thickness from 6m to 21m in Barjora North Block. It is characterised by loose sand/clay as well as oxidised (iron rich) reddish sandstone. The feldspathic content being largely removed, the formation appears soft and friable. This was observed in course of drilling operation when the alluvial/detrital cover was recovered as sludge. Ex-foliation is very commonly found on the eroded surface in the weathered zone, due to iron leaching from the iron-rich brownish sandstone.

  
Director (Mining)  
Corporate Office,  
WBDCL



\* - Borehole fall outside the block.

INDEX

	Alluvium		Alternating Shale & Sandstone
	Clay		Shaly Sandstone
	Laterite		Carb. Shale
	Fine Grained Sandstone		Sandy Carb. Shale
	Medium Grained Sandstone		Interbanded Coal
	Coarse Grained Sandstone		Coal
	Shale		Talchir
	Pebbles / Conglomerate		Metamorphics
	Sandy Shale		Shaly Coal

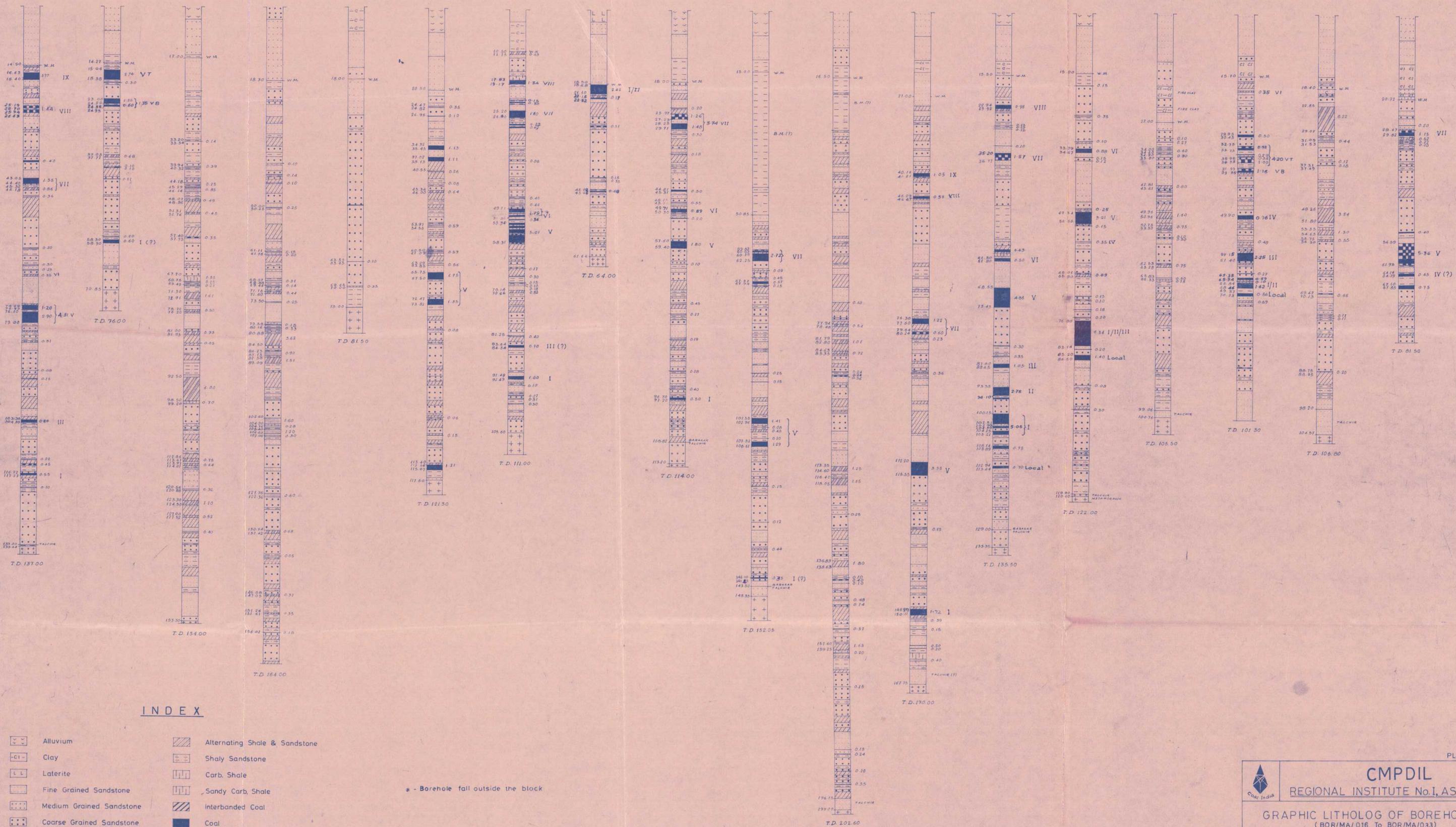
PLATE - IIIA

**CMPDIL**  
REGIONAL INSTITUTE NO.1, ASANSOL.

**GRAPHIC LITHOLOG OF BOREHOLES**  
(BOR/MA/001 To BOR/MA/015)  
**BARJORA NORTH BLOCK**  
**BARJORA COALFIELD**

Traced by:- D. Singh	R.F. - 1 : 400	Drg. No. RI-VG-2593
----------------------	----------------	---------------------

BOR/MA/016 R.L. 73.21    BOR/MA/017 R.L. 80.23    BOR/MA/018 R.L. 95.44    BOR/MA/019 R.L. 90.75    BOR/MA/020 R.L. 70.00    BOR/MA/021 R.L. 70.91    BOR/MA/022 R.L. 86.34    BOR/MA/023 R.L. 94.82    BOR/MA/024 R.L. 75.82    BOR/MA/025 R.L. 69.35    BOR/MA/026 R.L. 70.97    BOR/MA/027 R.L. 70.93    BOR/MA/028 R.L. 81.09    BOR/MA/029 R.L. 931.4    BOR/MA/030 R.L. 98.29    BOR/MA/031 R.L. 91.85    BOR/MA/032 R.L. 105.93    BOR/MA/033 R.L. 80.64



**INDEX**

- |  |                          |  |                               |
|--|--------------------------|--|-------------------------------|
|  | Alluvium                 |  | Alternating Shale & Sandstone |
|  | Clay                     |  | Shaly Sandstone               |
|  | Laterite                 |  | Carb. Shale                   |
|  | Fine Grained Sandstone   |  | Sandy Carb. Shale             |
|  | Medium Grained Sandstone |  | Interbanded Coal              |
|  | Coarse Grained Sandstone |  | Coal                          |
|  | Shale                    |  | Talchir                       |
|  | Pebbles / Conglomerate   |  | Metamorphics                  |
|  | Sandy Shale              |  | Shaly Coal                    |

\* - Borehole fall outside the block

	<b>CMPDIL</b> REGIONAL INSTITUTE No. I, ASANSOL	
	GRAPHIC LITHOLOG OF BOREHOLES (BOR/MA/016 To BOR/MA/033) <b>BARJORA NORTH BLOCK</b> <b>BARJORA COALFIELD</b>	
TRACED BY: A. Kabirol D. Singh	R.F. 1:400	DRG. NO. RI-I/G-2594

BOR/MA/034  
R.L. 107-61

BOR/MA/035  
R.L. 84-54

BOR/MA/036  
R.L. 84-50

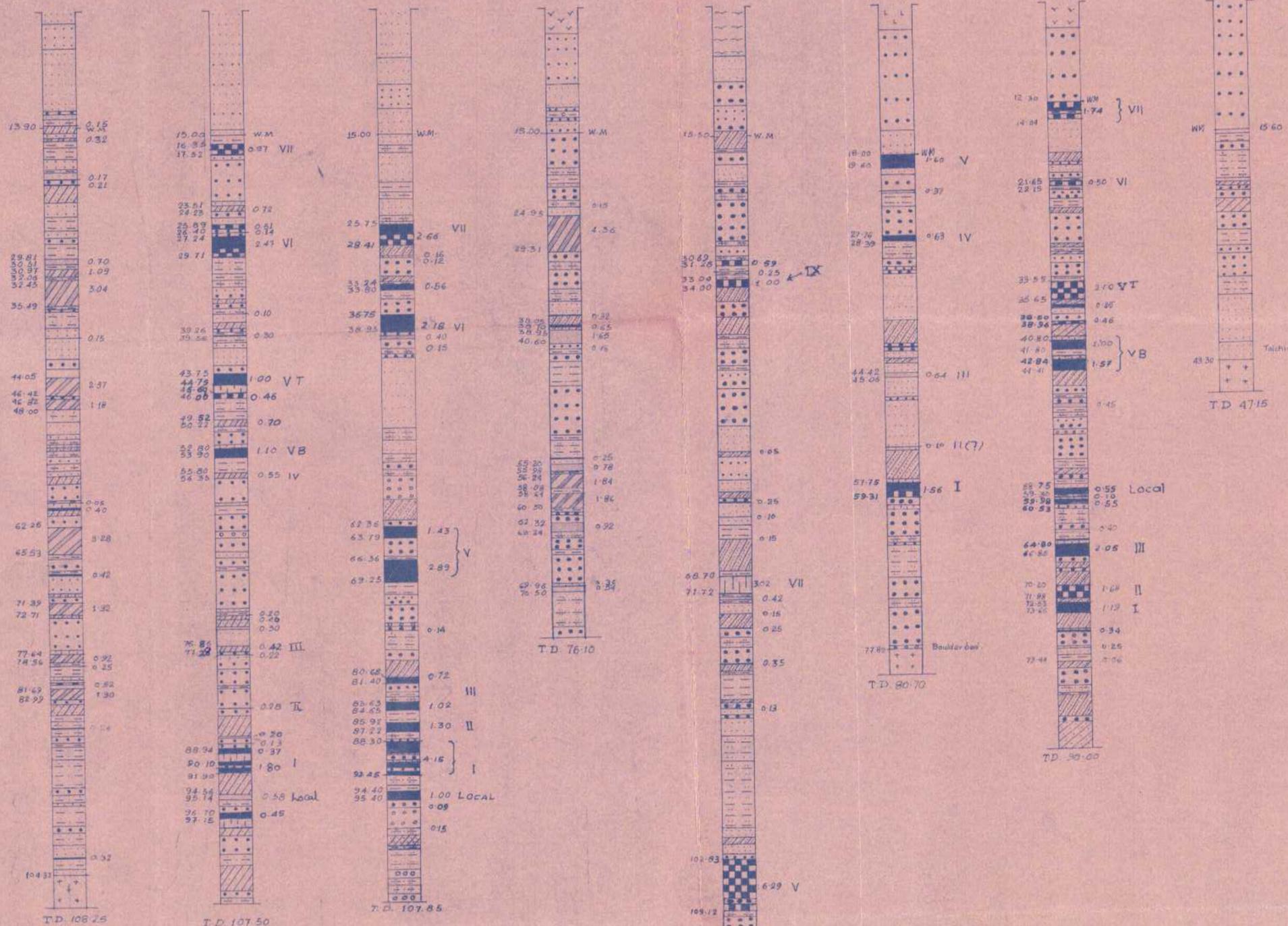
BOR/MA/037  
R.L. 94-38

BOR/MA/038  
R.L. 73-81

BOR/MA/039  
R.L. 80-17

BOR/MA/040  
R.L. 86-63

BOR/MA/041  
R.L. 111-58



\* - Borehole Fall outside the block

## INDEX

	Alluvium		Alternating Shale & Sandstone
	Clay		Shaly Sandstone
	Laterite		Carb Shale
	Fine Grained Sandstone		Sandy Carb. Shale
	Medium Grained Sandstone		Interbanded Coal
	Coarse Grained Sandstone		Coal
	Shale		Talchir
	Pebbles Conglomerate		Metamorphics
	Sandy Shale		Shaly Coal

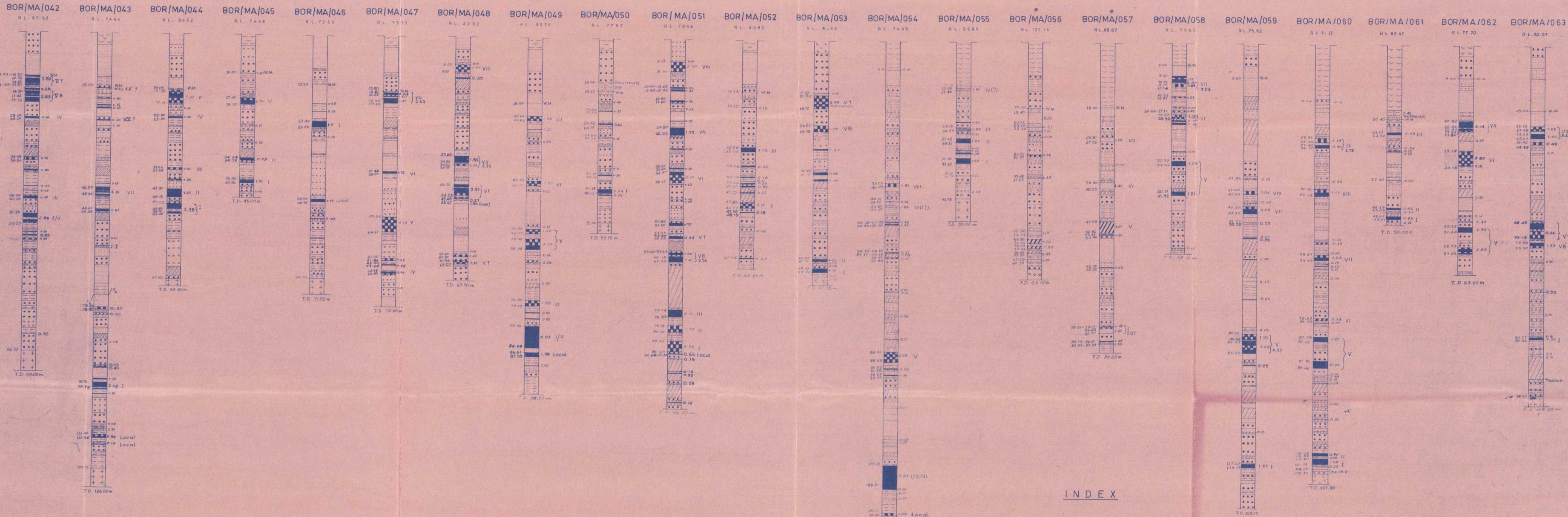
PLATE - III C



**CMPDIL**  
REGIONAL INSTITUTE NO.1, ASANSOL

GRAPHIC LITHOLOG OF BOREHOLES  
(BOR/MA/034 To BOR/MA/041)  
BARJORA NORTH BLOCK  
BARJORA COALFIELD

Traced by:- Ajoy Kabiraj      R.F.- 1:400      Drg. No. RI-1/G-2595



\* - Borehole Fall outside the block

INDEX

- |  |                          |  |                               |
|--|--------------------------|--|-------------------------------|
|  | Alluvium                 |  | Alternating Shale & Sandstone |
|  | Clay                     |  | Shaly Sandstone               |
|  | Laterite                 |  | Carb Shale                    |
|  | Fine Grained Sandstone   |  | Carb Shaly Sandstone          |
|  | Medium Grained Sandstone |  | Interbanded Coal              |
|  | Coarse Grained Sandstone |  | Coal                          |
|  | Shale                    |  | Talchir                       |
|  | Pebbles / Conglomerate   |  | Metamorphics                  |
|  | Sandy Shale              |  | Shaly Coal                    |

PLATE - III D

**CMPDIL**  
REGIONAL INSTITUTE NO. 1, ASANSOL.

**GRAPHIC LITHOLOG OF BOREHOLES**  
(BOR/MA/042 To BOR/MA/063)  
**BARJORA NORTH BLOCK**  
**BARJORA COALFIELD**

Traced by: Darshan Singh Swapan Mukherji	R.F.: 1: 400	Drg. No. RI-1/G- 2596
--	--------------	-----------------------

**Confidential**

**CSIR - CENTRAL INSTITUTE OF MINING AND FUEL RESEARCH  
(Council of Scientific and Industrial Research)  
Barwa Road, Dhanbad – 826 015**



**Report on**

**Scientific study to conduct controlled deep hole blasting  
at Barjora North Coal Mine and advice thereof**



**PROJECT NO.: CNP/4783/2018-19**

**MAY 2019**

*[Handwritten Signature]*  
**Director (Mining)  
Corporate Office,  
WBPDC**

**CSIR - CENTRAL INSTITUTE OF MINING AND FUEL RESEARCH  
(Council of Scientific and Industrial Research)  
Barwa Road, Dhanbad – 826 015**



**REPORT ON**

**Scientific study to conduct controlled deep hole blasting  
at Barjora North Coal Mine and advice thereof**

**BY**

<b>Dr. R. K. Paswan,</b>	<b>Scientist &amp; Project Leader</b>
<b>Mr. N. K. Bhagat</b>	<b>Senior Technical officer &amp; Project Leader</b>
<b>Dr. M. M. Singh,</b>	<b>Chief Scientist &amp; Head of Section</b>
<b>Mr. R. S. Yadav,</b>	<b>Senior Technical officer</b>
<b>Mr. Suraj Kumar,</b>	<b>Technical officer</b>
<b>Dr. P. K. Singh,</b>	<b>HORG &amp; Director</b>

**PROJECT NO.: CNP/4783/2018-19**

**MAY 2019**

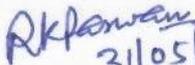
## NOTE

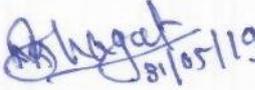
This report is meant for internal use of the sponsor of the study and it should not be published in full or part by the sponsor. It should not be communicated or circulated to outside parties except concern departments. However, CSIR-CIMFR reserves the right to publish the results of the investigation for the benefit of the mining industry.

The recommendations are based on the results of investigation carried out at Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDC) and MDO M/s Montecarlo Limited. It is hoped that the recommendations will be implemented to get the optimum results without hampering production, productivity and safety of the mine. The recommendations are guidelines, which should be implemented in letter and spirit.

Since the day-to-day blasting operations are not in the control of CSIR - CIMFR, the research team will not be held responsible for any untoward incident caused due to blasting.

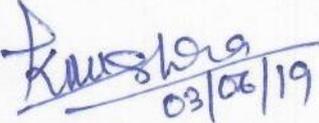
### SIGNATURE OF THE PROJECT PROPONENTS

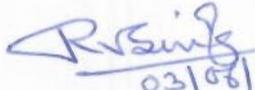
  
31/05/19  
(R. K. Paswan)  
Scientist &  
Project Leader

  
31/05/19  
(N. K. Bhagat)  
S.T. O &  
Project Leader

  
31/5/19  
(M. M. Singh)  
Chief Scientist &  
Project Coordinator

### CSIR-CIMFR AUTHORISED SIGNATORIES

  
03/06/19  
(Dr. P. K. Mishra)  
Principal Scientist & HOS  
Project Monitoring

  
03/06/2019  
(Dr. R. V. K. Singh)  
Chief Scientist & HORG  
Business Development & industrial Liaison

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## EXECUTIVE SUMMARY

This report relates to the study conducted by CSIR-Central Institute of Mining and Fuel Research, Dhanbad on Advice for optimization of blast design parameters at Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL) along with MDO Montecarlo Limited for scientific study to conduct controlled deep hole blasting at Barjora North coal mine and advice thereof. The results of investigation, analyses of data and recommendations, made thereof, are summarised below:

- ❖ Twelve (12) blasts including one signature hole blast were conducted at different benches of the Barjora North Coal Mine of M/s West Bengal Power Development Corporation Limited and forty-five (45) vibration data were recorded at different locations in the vicinity of inhabitant's area lying nearby.
- ❖ The maximum level of vibration recorded was 13.31 mm/s with dominant peak frequency of 25 Hz at 25 m behind blast free face near signature hole due to the blast conducted at North East face (2<sup>nd</sup> bench). The vibration recorded at House of Sri Ravi Bowry (470 m) from the same blast was only 1.571 mm/s with dominant peak frequency of 35.25 Hz. In this blast 300 kg of explosive were distributed in 10 holes and were detonated with explosives weight per delay of 31 kg.
- ❖ The maximum air over-pressures recorded from production blast was 124.3 dB(L) at 20 m from the blast conducted at 2<sup>nd</sup> Bench of North East face of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited. The blast design details and recorded vibration and air over pressure data are presented in annexure as Tables A1 and A2 respectively.
- ❖ All the recorded vibration and air overpressure data at concerned locations were well within the safe limits. There was no ejection of flyrocks during the study period.
- ❖ The rock fragmentation was very good in most of the blasts. Nonel initiation system has added advantages in comparison to D-cord initiation system because it detonates the explosives in the blast holes from the bottom of the hole at sub-grade level and reduces the ejection of fly rocks significantly.
- ❖ The recorded dominant peak frequencies of vibrations were in the range of 22.69 - 35.25 Hz. So, the safe level of vibration has been taken as 10 mm/s for the safety of houses/structures of the surrounding villages and 15 mm/s for the structures belonging to the mine as per DGMS standard. Keeping in view the greater safety of the structures/houses in the nearby villages, the safe level of vibration has been taken as **5 mm/s for the safety of houses/structures not belonging to Barjora (N) Coal Mine.**

- ❖ The propagation equation for the prediction of blast vibration has been established and is given as Equation 1. The permissible explosives weight per delay may be computed from the equation to contain vibration within safe limits for the distances of houses/structures concerned. For convenience, the permissible explosives weight to be detonated in a delay and total explosive weight to be detonated in a round has been computed and has been presented in annexure as Table A3. The predicted peak particle velocity levels at various distances due to detonation of explosives weight per delay of 35 kg, 45 kg, 50 kg, 60kg and 70 kg is given in annexure as Table A4.
- ❖ Recommended blast designs are given annexure as Figures A1-A3 which should be followed in day to day blasting operations with judicious modifications.

## **1. Introduction**

The mine management of Barjora North Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDC) and MDO Montecarlo Limited entrusted CSIR-Central Institute of Mining and Fuel Research (CIMFR), Dhanbad, vide work order reference No. 15024963 dated 14.11.2018 on Advice for optimization of blast design parameters at Barjora North coal mine of M/s West Bengal Power Development Corporation Limited for scientific study to conduct controlled deep hole blasting at Barjora North coal mine and subsequent advice

The Rock Excavation Engineering Research team of CSIR-CIMFR, Dhanbad carried out field investigations in the month of April and May, 2019. Altogether, twelve blasts were conducted and blast induced ground vibration and air over-pressure/noise was monitored at various locations in and around the mine. The blasts were photographed to document the ejection of fly rocks, if any, during blasting. The report contains the results of the study, analyses of data and recommendations for safe and efficient blasting operations.

## **2. Location and geology**

The Barjora North Block of Barjora Coalfield lies between Latitudes 23°25'55" N & 23°27'42" N and Longitudes 87°13'48" E & 87°15'36" E and falls within the administrative jurisdiction of Barjora Thana in the Bankura district of West Bengal. The nearest railway station from Barjora Coalfield is Durgapur at a distance of 30 km, located on the Howrah-Delhi main line of Eastern Railway. Barjora Block is connected to Durgapur by a metalled road via Durgapur Barrage. The total coal bearing area of Barjora Coalfield based on exploration data is 13.5 sq. km. The explored area has been divided into two blocks, viz. Barjora North and Barjora South covering an area of 8 sq. km. and 5.5 sq. km. respectively. The Barjora Coalfield is named after the village Barjora in Dist. Bankura, West Bengal, appears to be a detached and localized basin within the Archaean metamorphic in which Lower Gondwana sediments were deposited.

The area in and around the Barjora Coalfield is mostly covered by alluvium (6m to 21m), Laterite and soil. Towards west and north, the limits of this coalfield are covered by Laterite having a thickness of 3m to 35m. The exposures of basement rocks towards west as well as the intersection of metamorphic directly in boreholes beneath the alluvial cover towards east and absence of coal seams towards west and south-west are suggestive of the limit of the coal basin. The northern limit of this coalfield has been suggested to be defined by a fault sympathetic to the southern limiting boundary fault of the Raniganj coalfield. The overview of the Barjora North coal mine is presented in Photograph 1.



Photograph 1. Overview of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDC).

### **3. Instrumentations**

Blast induced vibrations and air overpressure were monitored by seismographs namely MiniMate Plus and MiniMate DS-077 (Made in Canada by M/s Instantel Inc.). The MiniMate plus is an eight/four channel seismograph provided with two/one tri-axial transducer for monitoring vibration (in mm/s) and two/one channel for monitoring air over-pressure/noise in dB(L) or Pa. MiniMate DS-077 is a four channel seismograph provided with one tri-axial transducer for monitoring vibration (in mm/s) and one channel for monitoring air over-pressure/noise in dB(L) or Pa. All the seismographs record vibration in three directions i.e. Longitudinal (L), Vertical (V) and Transverse (T). They also record peak frequency of vibration and compute the peak vector sum of the vibration.

### **4. Blasting details**

Twelve blasts were conducted at different benches of Barjora (N) coal mine. The drill diameter was of 159 mm for all the blasting patches. The hole depths were in between 4.8 and 5.5 m. Aquadyne and Energel, Slurry cartridge explosives of M/s IDL Explosives Ltd. were used for one blast and the SME explosives of M/s IDL Explosive Limited were used in rest of the blasting. The maximum explosives detonated in a delay ranged between 30 and 32 kg. The explosives detonated in a blast round varied from 261 to 1875 kg. Pyrotechnic initiation system (Nonel) was used in all of the blasts. The down-the-hole timing of 250 ms and trunk line delays of 25 ms and 42 ms were used. The connection of blast holes at North West face of Barjora (N) Coal Mine are presented in Photograph 2.



Photograph 2. View of the charging and connection with Nonel initiation device at North West face of Barjora (N) Coal Mine.

Vibrations were monitored in terms of peak particle velocity (PPV) that varied from 0.524 mm/s to 13.31 mm/s depending upon the distance of measuring transducers of seismographs from the blasting face and the amount of explosives detonated in a particular delay of the blast. The ground vibration measuring distances varied from 20 to 650 m for production blasts. The levels of air over-pressure/noise recorded were in the range of 98.84 to 124.3 dB(L). The details of blasts conducted and vibration & air-over pressure data recorded are given in Annexure as Tables A1 & A2. Photographs 3 depict the vibration monitoring locations at nearby village and in the periphery of Barjora (N) Coal Mine. The ejections of flyrocks were monitored for each blast. The flying fragments were restricted to the blasting patch itself.



Photograph 3. View of the vibration monitoring at different locations in the periphery of Barjora (N) Coal Mine.

## 5. Analyses of recorded vibration data

Ground vibrations data recorded were grouped together for statistical analysis. An empirical relationship has been established correlating the maximum explosives weight per delay ( $Q_{\max}$  in kg), distance of vibration measuring transducers from the blasting face ( $R$  in m) and recorded peak particle velocity ( $V$  in mm/s). The established equation for Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL) is presented as equations:

$$V = 37.297 \times [R/\sqrt{Q_{\max}}]^{-0.743} \quad (1)$$

Correlation co-efficient = 90.4 %

Coefficient of determination ( $R^2$ ) = 0.818

Where,

$V$  = Peak particle velocity (mm/s)

$R$  = Distance between vibration monitoring point and blasting face (m)

$Q_{\max}$  = Maximum explosive weight per delay (kg)

The above equation is site specific and applicable only for Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL). It may be used to compute maximum explosives weight to be detonated in a delay for distances of concerned

locations from the blasting site. The regression plot of vibration data recorded at their respective scaled distances for both the quarries are presented in Figure 1.

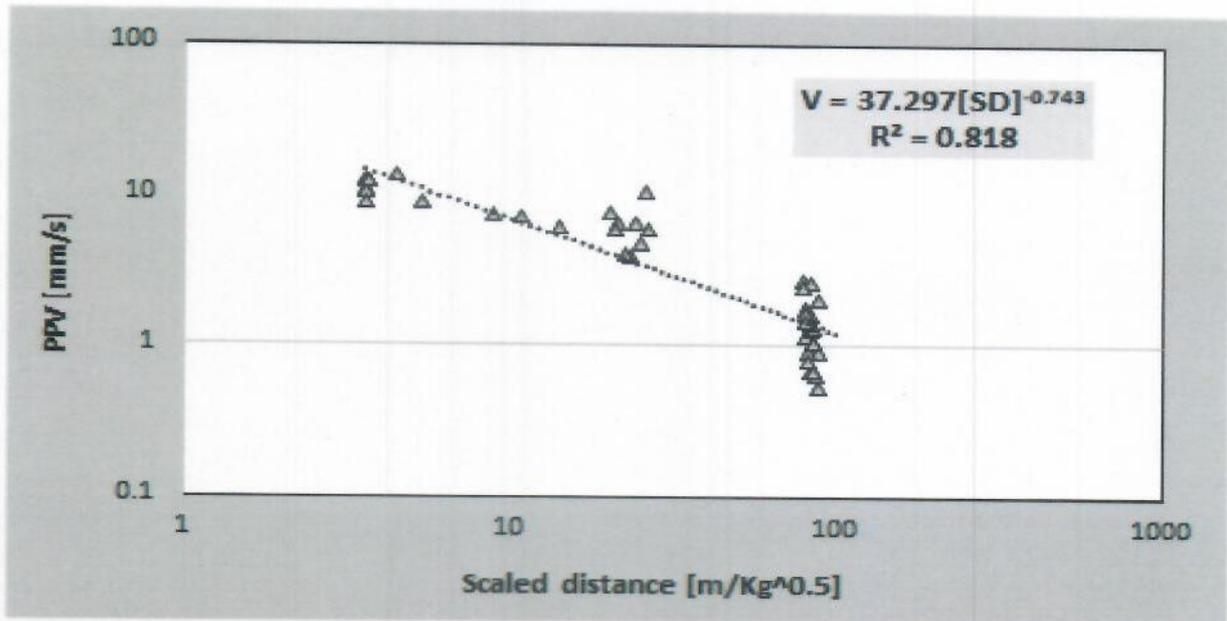


Figure 1. Regression plot of vibration data recorded at Barjora (N) Coal Mine, M/s West Bengal Power Development Corporation Limited (WBPDCCL).

### 5.1 Frequency of blast vibration

The maximum level of vibration recorded was 13.31 mm/s with dominant peak frequency of 25 Hz at 25 m behind blast free face near signature hole due to the blast conducted at 2<sup>nd</sup> bench of North East face. The vibration recorded at 470 m at House of Sri Ravi Boury from the same blast was 1.571 mm/s with dominant peak frequency of 35.25 Hz. In this blast 300 kg of explosive were distributed in 10 holes and were detonated with explosives weight per delay of 31 kg.

The blast wave signature recorded at Mine Boundary at a distance of 150 m due to the blast conducted at Mine centre bench of Barjora (N) Coal Mine on 03.05.2019 is depicted in Figure 2 and the Fast Fourier Transform (FFT) analyses of their frequencies of vibration are presented in Figure 3. The blast wave signature recorded near signature hole face due to the blast conducted at North East face (2<sup>nd</sup> bench) of Barjora (N) Coal Mine on 03.05.2019 is presented in Figure 4 and its Fast Fourier Transform Analyses of their frequencies of vibration are presented in Figure 5. It is evident from the Fast Fourier Transformation analyses that the concentration of vibration energy is in the range of 25.0 - 35.25 Hz. The plot of dominant frequency with their respective distances is shown in Figure 6.

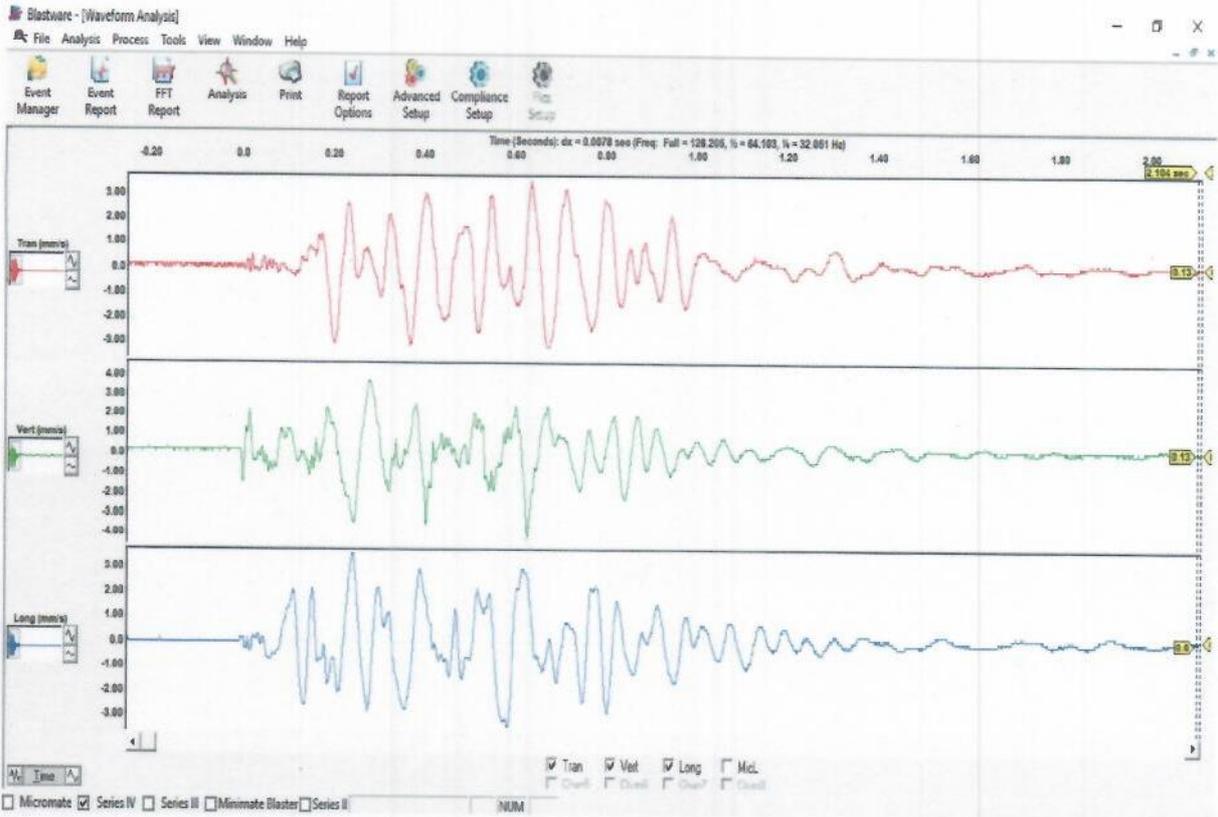


Figure 2. Blast time history recorded at Mine Boundary due to the blast conducted at Mine Centre bench of Barjora (N) Coal Mine.

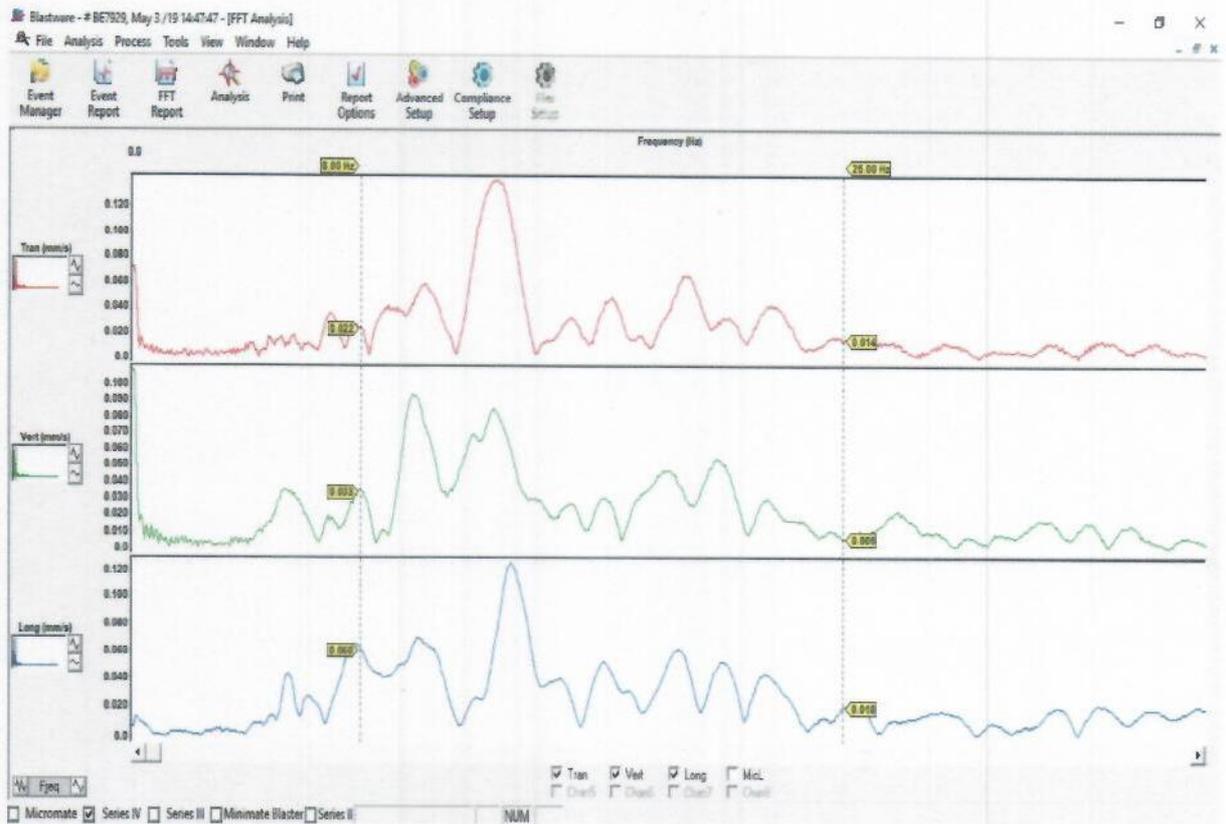


Figure 3. FFT analyses of frequency of vibration data shown in Figure 2.

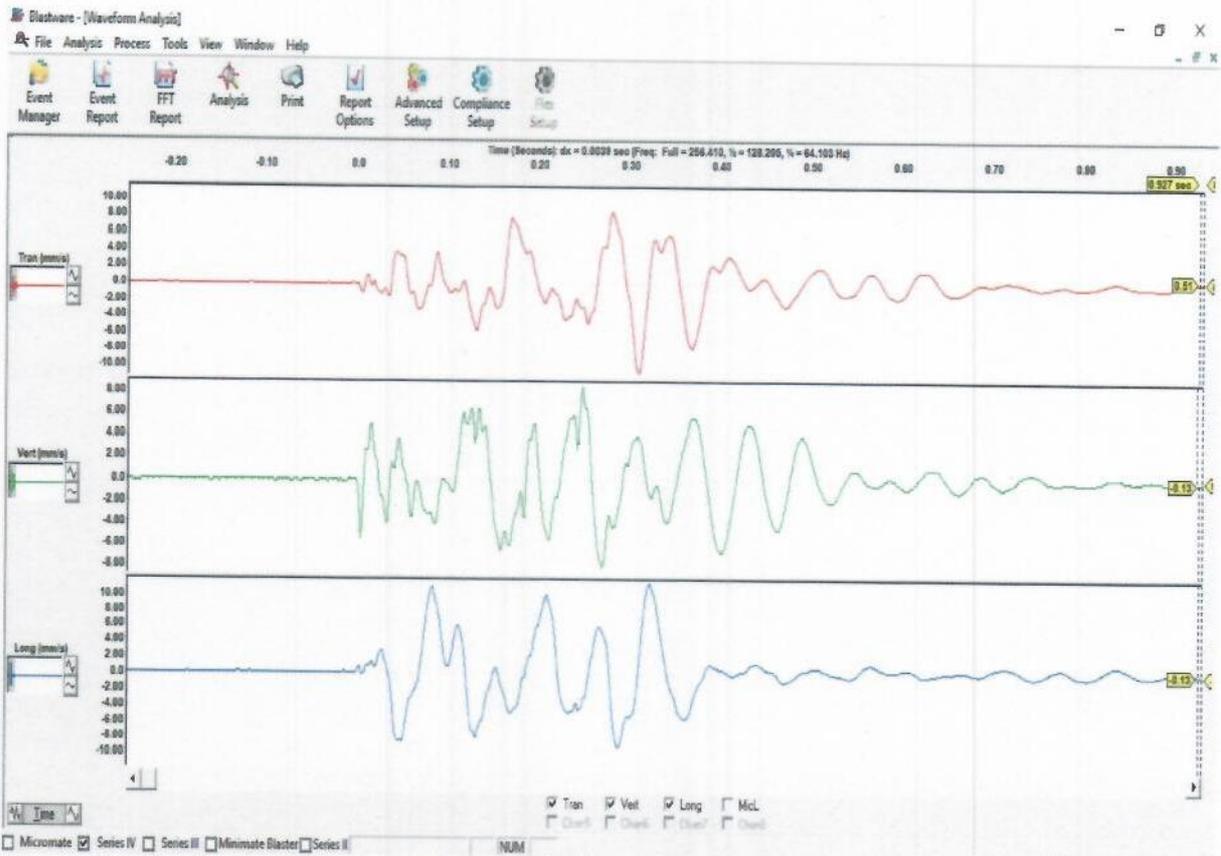


Figure 4. The blast wave signature recorded at due to the blast conducted at 2<sup>nd</sup> bench East face of Barjora (N) Coal Mine.

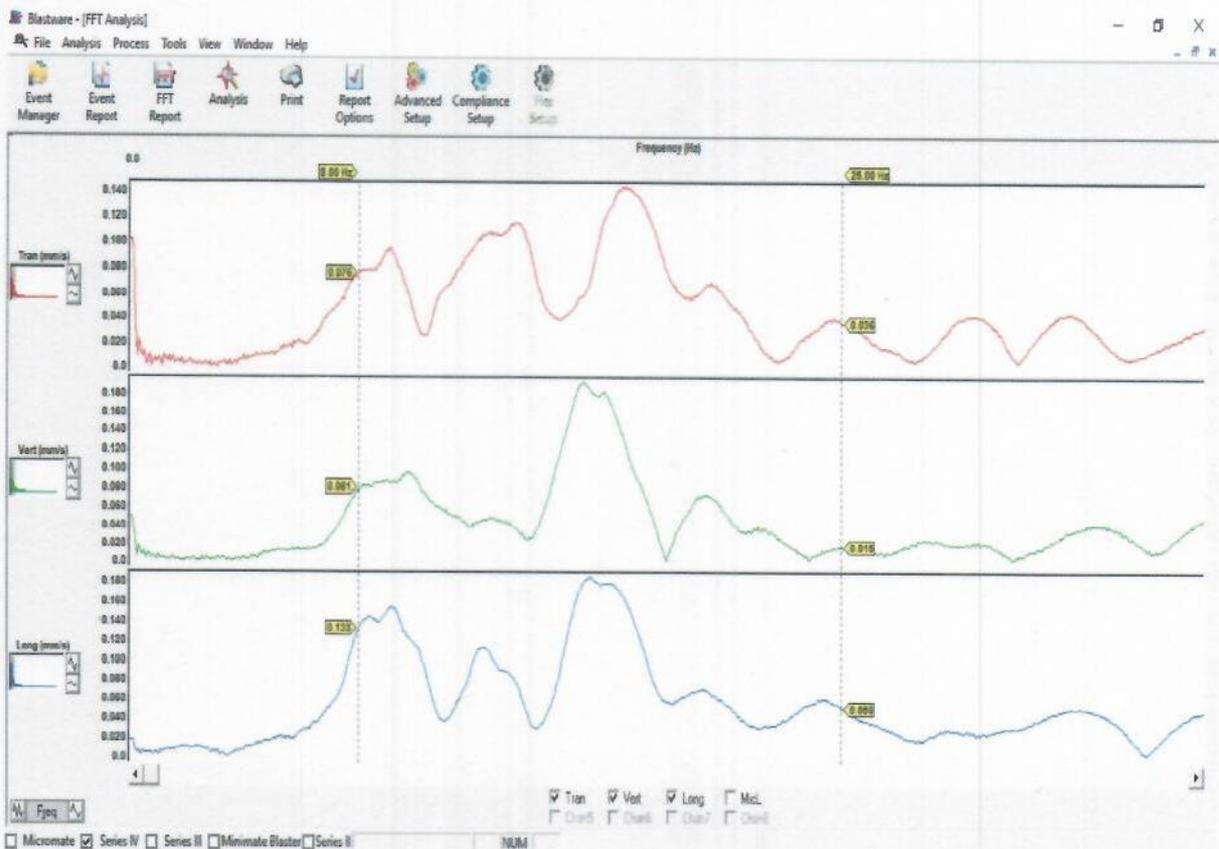


Figure 5. FFT analyses of frequency of vibration data shown in Figure 4.

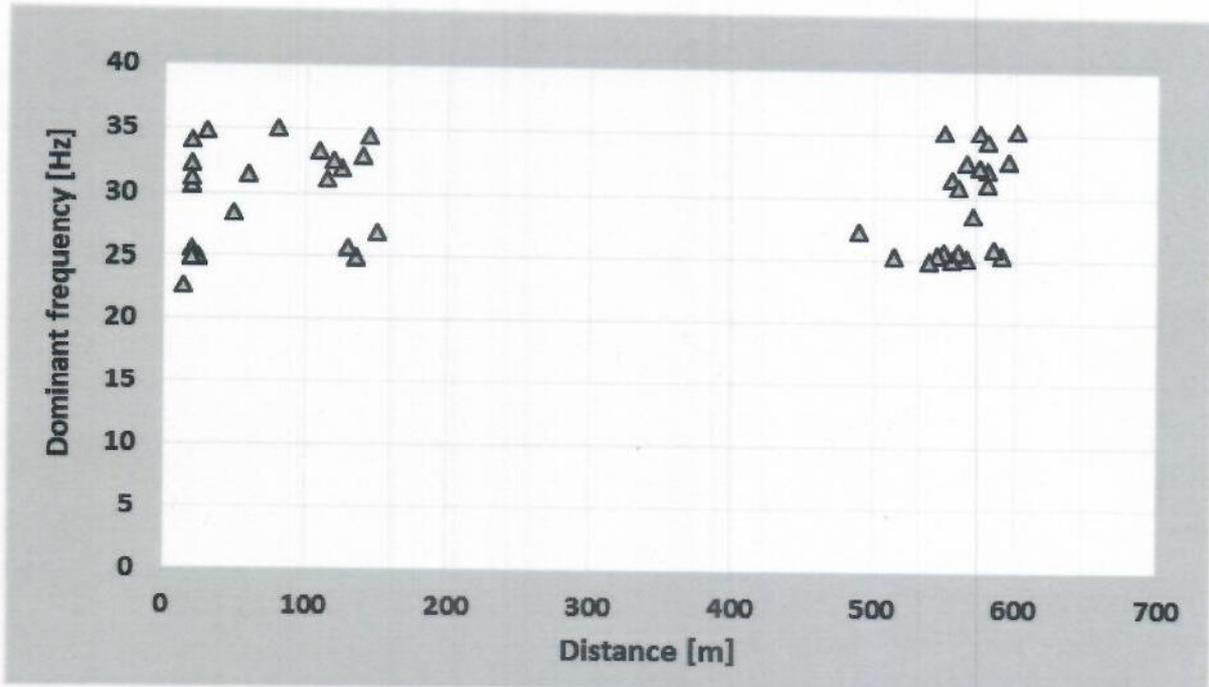


Figure 6. Plot of dominant frequency with their respective distances.

## 6. Existing vibration standard and criteria to prevent damage

Peak particle velocity has been globally used in practice for assessment of blast induced damage to the structures. Different countries adopt different standards depending on their type of industrial/residential buildings. In India, presently DGMS technical circular 7 of 1997 is considered as vibration standard for the safety of surface structures in mining areas. The DGMS standard is given in Table 1.

Table 1. DGMS technical circular 7 of 1997 concerning to blast vibration standard in mm/s.

Type of structure	Dominant excitation frequency, Hz		
	< 8 Hz	8-25 Hz	> 25 Hz
<b>(A) Buildings/structures not belong to the owner</b>			
1. Domestic houses/structures (Kuchcha, brick & cement)	5	10	15
2. Industrial buildings	10	20	25
3. Objects of historical importance and sensitive structures	2	5	10
<b>(B) Buildings belonging to owner with limited span of life</b>			
1. Domestic houses/structures	10	15	25
2. Industrial buildings	15	25	50

## 7. Air over-pressure/noise

Air overpressure in the mining or quarrying context is the superposition of a number of impulsive air pressures as a result of the detonation of explosives. Air over-pressure can be measured in pressure unit as well as sound pressure level (SPL).

$$SPL(dB) = 20 \log \left( \frac{p}{p_0} \right)$$

Where,  $p$  = measured over-pressure in Pascal (pa)

$p_0$  = reference pressure level of the lowest sound that can be heard, i.e.,  
zero dB =  $2 \times 10^{-5}$  pa.

United State Bureau of Mines (USBM) has correlated the damage due to air over-pressure. The recommended values are given below:

Over-pressure [dB(L)]	Over-pressure [Kpa]	Air Blast Effects
177	14	All windows break
170	6.0	Most windows break
150	0.63	Some windows break
140	0.20	Some large plate glass windows may break, desk and windows rattle
136	0.13	USBM interim limit for allowable air blast
126	0.05	Complaints likely

The maximum air over-pressures recorded was 124.3 dB(L) at 20 m from the blast conducted at 2<sup>nd</sup> Bench of North East face mine centre bench of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL). The surface and down-the-hole connection were made with Nonel. In this blast, the total explosives detonated in this blast round was 261 kg whereas explosives weight per delay was 30 kg. The recommended threshold level of air over pressure/noise is 136 dB(L) as per USBM standard.

## 8. Causes for cracks other than blasting

Most structures have cracks of some kind unusually due to normal environmental stress. When blasting comes in to the area it usually gets credited for these environmentally induced cracks.

Cracking is a normal occurrence in the walls and ceilings of structures, and have several causes, ranging from poor construction to normal environmental stress, such as thermal stress, wind etc. The Small Home, published by the Architects Small Home Services Bureau of the United States, gave a list of reasons for the development of cracks in the buildings other than blasting. These are as follows.

- ❖ Failure to make the footings wide enough.
- ❖ Width of footings not made proportional to loads to carry.
- ❖ The posts in the basement not provided with separate footings.
- ❖ Not enough cement used in the concrete.
- ❖ Dirty sand or gravel used in the concrete.

- ❖ Failure to protect beams and sills from rotting through dampness.
- ❖ Setting floor joists one end on masonry and the other end on wood.
- ❖ Wooden beams used to support masonry over openings.
- ❖ Braces omitted in wooden walls.
- ❖ Drainage water from roof not carried away from foundations.
- ❖ Sub-flooring omitted.
- ❖ Poor materials used in plasters.
- ❖ Plaster applied too thin.
- ❖ Metal reinforcement omitted in plaster at corner.
- ❖ Sub-soil drainage not carried away from walls.
- ❖ First coat of plaster not properly keyed to backing.
- ❖ Floor joints placed too far apart.
- ❖ Wood beams spanned too long between posts.
- ❖ Failure to use double joists under unsupported partitions.
- ❖ Failure to erect trusses over wide wooden openings.

## **9. Conclusions and recommendations**

- ❖ The maximum level of vibration recorded was 13.31 mm/s with dominant peak frequency of 25 Hz at 25 m behind blast free face near signature hole due to the blast conducted at North East face (2<sup>nd</sup> bench). The vibration recorded at 470 m at House of Sri Ravi Bowry from the same blast was only 1.571 mm/s with dominant peak frequency of 35.25 Hz. In this blast 300 kg of explosive were distributed in 10 holes and were detonated with explosives weight per delay of 31 kg.
- ❖ The maximum air over-pressures recorded was 124.3 dB(L), behind blast face at 20 m from the blast conducted at 2<sup>nd</sup> Bench of North East face of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCL). The blast design details and recorded vibration and air over pressure data are presented in Tables A1 and A2 respectively.
- ❖ All the recorded vibration and air overpressure data at concerned locations were well within the safe limits. There was no ejection of flyrocks during the study period. The rock fragmentation was very good in most of the blasts. Nonel initiation system has added advantages in comparison to D-cord initiation system because it detonates the explosives in the blast holes from the bottom of the hole at sub-grade level and reduces the ejection of fly rocks significantly.
- ❖ The recorded dominant peak frequencies of vibrations were in the range of 22.69 - 35.25 Hz. Most of the frequencies were above 25 Hz, Thus, the safe level of vibration has to be 10 mm/s for the safety of houses/structures not belonging to Barjora (N) Coal Mine and 15 mm/s for the safety of houses/structures of the Barjora (N) Coal Mine as per DGMS

blast vibration standard. Keeping in view the greater safety of the structures in the nearby villages the safe level of vibration has been taken as **5 mm/s**.

- ❖ The propagation equation for the prediction of blast vibration has been established and is given as Equation 1. The permissible explosives weight per delay may be computed from the equation to contain vibration within safe limits for the distances of houses/structures concerned. For convenience, the permissible explosives weight to be detonated in a delay and total explosive weight to be detonated in a round has been computed and has been presented in Table A3. The predicted peak particle velocity levels at various distances due to detonation of explosives weight per delay of 35 kg, 45 kg, 50 kg, 60kg and 70 kg is given in Table A4.
- ❖ The attempt should be made to deploy 100 mm and 115 mm drill diameter machines at all the benches of 5.5 – 6.0 m. This will help in proper loading of explosives with better utilization of explosive energy and will help in smooth run-off of velocity of detonation of explosives in the formation and will yield desired fragmentation with reduced level of ground vibration.
- ❖ Recommended blast designs are given in annexure as Figures A1-A3 should be followed in day to day blasting operations with judicious modifications for safe and efficient blasting operations. The blast designs, will ensure the safety of the houses/structures, life of human beings and other property in the periphery of the mines.

## **Acknowledgements**

The research team is thankful to management of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL) and MDO M/s Montecarlo Limited for sponsoring the study. The sincere co-operation and help extended to the team by the following official and staffs of the Barjora North Coal Mine in completing the study successfully are thankfully acknowledged.

Shri Shantipada Khwas	Agent
Shri Suresh Kumar	Mine Manager
Shri Trilokdeep Sinha	Blasting officer
Shri Krishna Murari	Blasting overman
Shri G. Ravichandran,	Chief Project Manager (MDO)
Shri Dinesh Singh	Mine Manager (MDO)
Shri Dastagir Alam	Safety Manager

The research team expresses their gratitude to the inhabitants of nearby village for their co-operation in blast vibration and air overpressure monitoring.

# **ANNEXURE**

Table A1. Blast design parameters of blasts conducted at Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL).

Blast No.	Date of blast	Location of blast	Hole dia. [mm]	No. of holes	Hole depth [m]	No. of decks	Burden [m]	Spacing [m]	Top stemming [m]	Explosives per hole [kg]	Total explosives weight [kg]	Initiation system
1.	06.04.19	North West face	159	60	5-5.5	Nil	3.5	4	3.2-3.5	31.25	1875 (Aquadyne and Energel, Slurry cartridge explosives of M/S IDL Explosives Ltd.)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
2.	03.05.19	Mine centre	159	30	5.5	Nil	4	4	3	31	930 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
3	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	14	5.5	Nil	4	4	3	31	434 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
4.	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	10	5	Nil	4	4	3	31	300 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
5.	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	9	5	Nil	4	4	3	30	270 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
6.	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	9	5	Nil	4	4	3	30	270 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms

Table A1. Continued....

7.	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	9	5	Nil	4	4	3	30	270 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
8.	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	9	5	Nil	4	4	3	30	270 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
9.	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	9	5	Nil	4	4	3	30	270 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
10.	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	9	4.8	Nil	4	4	3	29	261 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
11	03.05.19	North East face (2 <sup>nd</sup> Bench)	159	9	4.8	Nil	4	4	3	29	261 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms
12	03.05.19	Signature hole East Side (2 <sup>nd</sup> Bench)	159	1	5.5	Nil	4	4	3	31	31 (SME of M/S IDL Explosive Ltd)	Nonel Twindet delay detonator: TLD-25 ms DTH-250 ms

Table A2. Blast induced ground vibrations and air over-pressures monitored at different locations of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL).

Blast No.	Date of blast	Location of blast	Total explosives fired in the round [kg]	Max <sup>m</sup> explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant frequency [Hz]	Air over-pressure dB (L)
1.	06.04.19	North West face (70 mRL)	1875	31.25	❖ Towards forest ❖ Towards village	600 650	<0.5 <0.5	- -	- -
2.	03.05.19	Mine centre	930	32	❖ Behind blast face ❖ Mine Boundary ❖ House of Sri Boran Bowry ❖ House of Sri Ravi Bowry	80 150 450 475	6.029 5.718 2.706 2.59	35.0 26.88 35.19 35.19	116.1 119.3 107.4 105.5
3.	03.05.19	North East face (2 <sup>nd</sup> Bench)	434	32	❖ Behind blast face ❖ Mine Boundary ❖ House of Sri Boran Bowry ❖ House of Sri Ravi Bowry	30 50 455 480	8.696 7.257 1.143 1.047	34.75 28.5 31.5 32.13	120.8 115.7 103.5 103.5
4.	03.05.19	North East face (2 <sup>nd</sup> Bench)	300	31	❖ Behind blast face ❖ Mine Boundary ❖ House of Sri Boran Bowry ❖ House of Sri Ravi Bowry	25 145 450 470	13.31 10.27 1.732 1.571	25.0 34.44 34.44 35.25	118.5 119 112.6 110.2
5.	03.05.19	North East face (2 <sup>nd</sup> Bench)	270	31	❖ Behind blast face ❖ Mine Boundary ❖ House of Sri Boran Bowry ❖ House of Sri Ravi Bowry	20 140 470 495	10.71 4.576 0.684 0.524	32.31 32.94 28.56 32.88	119.7 116.7 102.1 98.84
6.	03.05.19	North East face (2 <sup>nd</sup> Bench)	270	31	❖ Behind blast face ❖ Mine Boundary ❖ House of Sri Boran Bowry ❖ House of Sri Ravi Bowry	20 135 465 490	12.42 6.281 1.27 0.925	25.63 25.0 25.19 25.44	118.1 111.8 110.1 98.84
7.	03.05.19	North East face (2 <sup>nd</sup> Bench)	270	31	❖ Behind blast face ❖ Mine Boundary ❖ House of Sri Boran Bowry ❖ House of Sri Ravi Bowry	20 130 460 485	10.33 3.812 0.925 0.648	30.56 25.69 25.75 25.94	117.9 116.1 102.6 104.2

Table A2. Continued....

Blast No.	Date of blast	Location of blast	Total explosives fired in the round [kg]	Max <sup>m</sup> explosives weight per delay [kg]	Location of vibration measuring transducer	Distance of monitoring point from the blasting face [m]	Peak particle velocity (PPV) [mm/s]	Dominant frequency [Hz]	Air over-pressure dB (L)
8.	03.05.19	North East face (2 <sup>nd</sup> Bench)	270	31	❖ Behind blast face	20	8.77	25	119.7
					❖ Mine boundary	125	3.896	31.88	115.0
					❖ House of Sri Boran Bowry	455	0.813	25.06	102.0
					❖ House of Sri Ravi Bowry	480	0.684	31.13	101.0
9.	03.05.19	North East face (2 <sup>nd</sup> Bench)	270	31	❖ Behind blast face	20	12.14	34.13	118.7
					❖ Mine Boundary	120	6.423	32.5	115.9
					❖ House of Sri Boran Bowry	450	1.442	25.69	106.3
					❖ House of Sri Ravi Bowry	475	1.332	32.38	104.2
10.	03.05.19	North East face (2 <sup>nd</sup> Bench)	261	30	❖ Behind blast face	20	12.11	31.19	121.4
					❖ Mine Boundary	115	5.796	31.06	117.1
					❖ House of Sri Boran Bowry	445	1.661	25.44	107.2
					❖ House of Sri Ravi Bowry	460	1.42	30.88	102.8
11	03.05.19	North East face (2 <sup>nd</sup> Bench)	261	30	❖ Behind blast face	20	12.09	25	124.3
					❖ Mine Boundary	110	7.497	33.25	119.2
					❖ House of Sri Boran Bowry	440	1.448	25	113.8
					❖ House of Sri Ravi Bowry	465	1.055	32.75	103.5
12	03.05.19	Signature hole East Side (2 <sup>nd</sup> Bench)	31	31	❖ Behind blast face	15	25.76	22.69	129.4
					❖ Mine Boundary	60	6.96	31.44	121.1
					❖ House of Sri Boran Bowry	445	2.426	25.31	102.9
					❖ House of Sri Ravi Bowry	490	1.972	27.31	101

Table A3. Recommended explosives weight per delay and total explosive to be detonated in a blasting round considering the safety of houses/structures in the village and taking 5 mm/s (Domestic houses/structures not belong to the owner) as safe limit of peak particle velocity for different benches of Barjora (N) Coal Mine of West Bengal Power Development Corporation Limited (WBPDCCL).

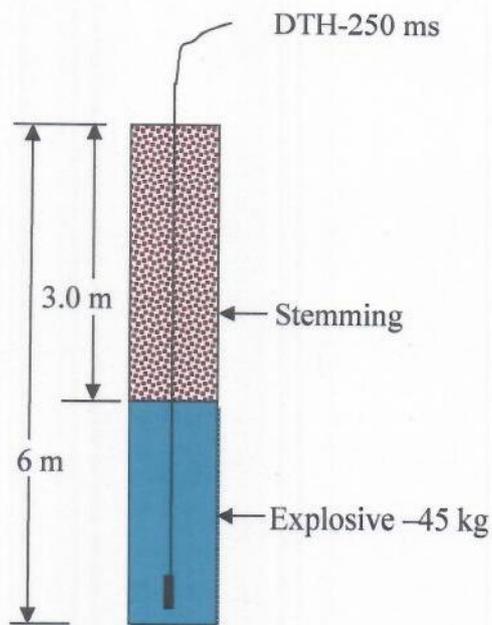
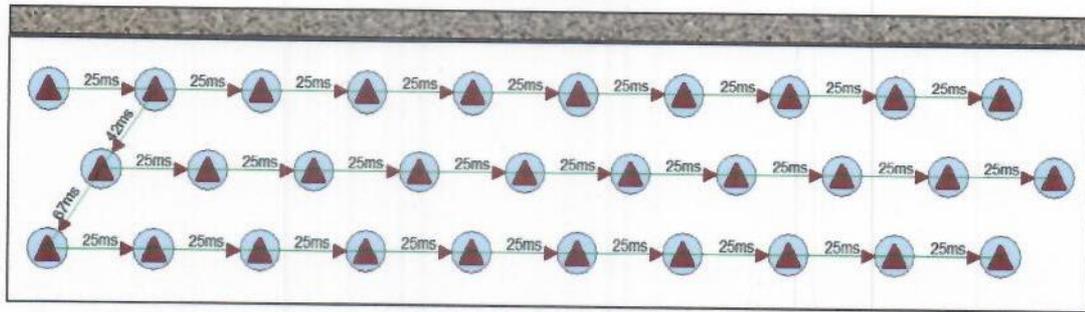
Distance of structures from the blast face [m]	Maximum explosive weight to be detonated in a delay	Total explosive weight to be detonated in a round
	Considering 5 mm/s as safe limit of vibration [kg]	Considering 5 mm/s as safe limit of vibration [kg]
100	45	476
125	70	744
150	101	1071
175	137	1458
200	179	1905
225	227	2411
250	280	2976
275	338	3601
300	403	4286
350	548	5833
400	716	7619
450	906	9643
500	1119	11905

Table A4. Predicted peak particle velocity levels at various distance from the blasting face considering explosive weight per delay of 35, 45, 50, 60 & 70 kg for different benches of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL).

Distance of structures from the blast face [m]	Predicted peak particle velocity levels [mm/s]				
	35 kg	45 kg	50 kg	60 kg	70kg
100	4.56	5.01	5.21	5.58	5.90
125	3.87	4.24	4.41	4.72	5.00
150	3.38	3.71	3.85	4.12	4.37
175	3.01	3.31	3.44	3.68	3.90
200	2.73	2.99	3.11	3.33	3.53
225	2.50	2.74	2.85	3.05	3.23
250	2.31	2.54	2.64	2.82	2.99
275	2.15	2.36	2.46	2.63	2.78
300	2.02	2.21	2.30	2.46	2.61
350	1.80	1.98	2.05	2.20	2.33
400	1.63	1.79	1.86	1.99	2.11
450	1.49	1.64	1.70	1.82	1.93
500	1.38	1.52	1.58	1.69	1.79



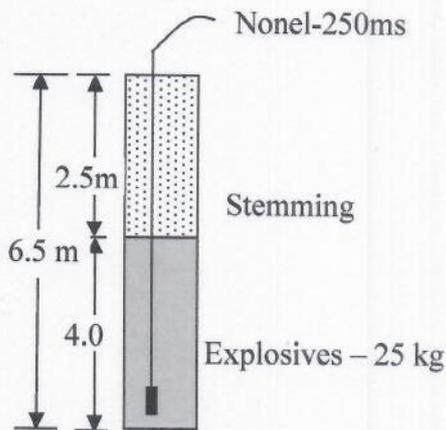
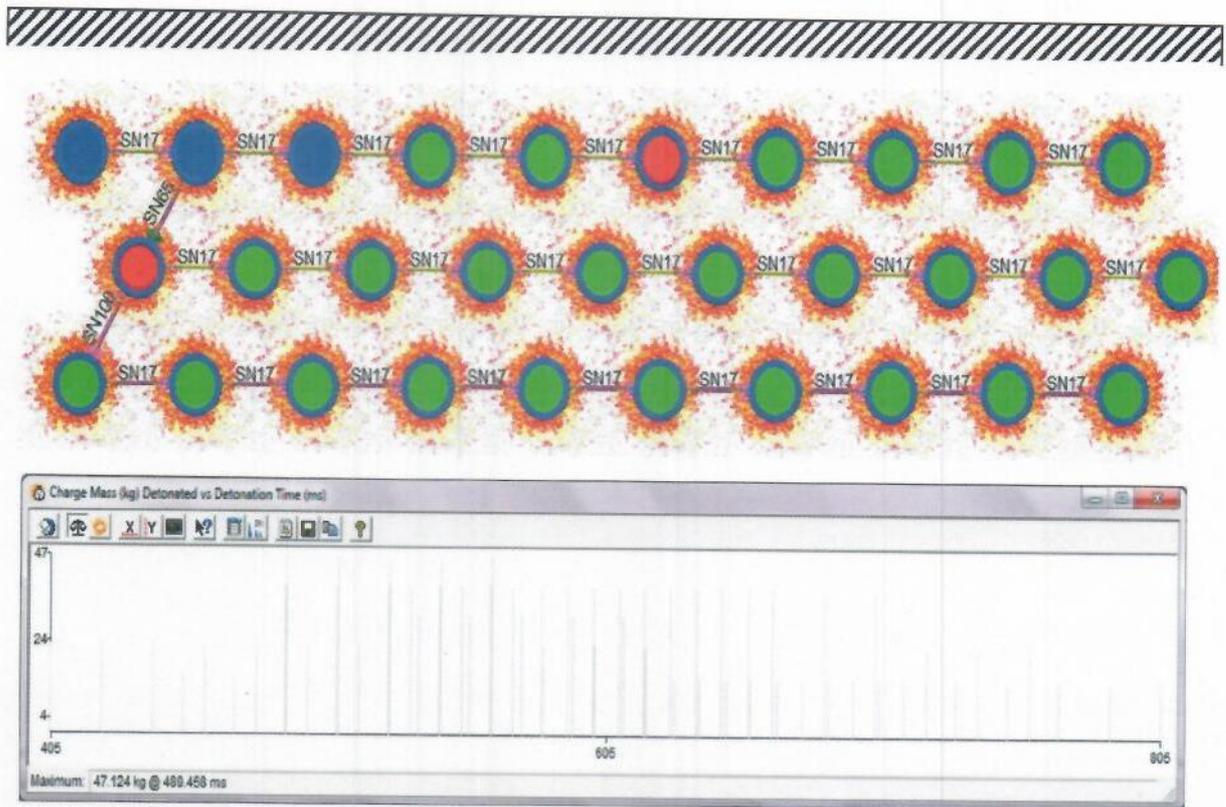
## FREE FACE



### BLAST GEOMETRY

Hole diameter	: 159 mm
No. of holes	: 30
Hole depth	: 6 m
Bench height	: 5.5 m
Burden	: 3.2 m
Spacing	: 3.7 m
Explosive per hole	: 45 kg
Total explosives in around	: 1350 kg
Design charged factor	: 0.69 kg/m <sup>3</sup>

Figure A2. Recommended blast design, time contours and charging pattern of holes for Medium hard starta of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDC).



<b>BLAST GEOMETRY</b>	
Hole diameter	: 100 mm
No. of holes	: 30
Bench height	: 6.0 m
Hole depth	: 6.5 m
Burden	: 2.5 m
Spacing	: 3.0 m
Explosive per hole	: 25 kg
Maximum charge per delay	: 50 kg
Designed charge factor	: 0.55 kg/m <sup>3</sup>

Figure A3. Recommended blast design, time contours and charging pattern of holes for Medium hard starta of Barjora (N) Coal Mine of M/s West Bengal Power Development Corporation Limited (WBPDCCL).



## Event Report

Date/Time Vert at 14:47:47 May 3, 2019  
 Trigger Source Geo: 0.510 mm/s  
 Range Geo: 254.0 mm/s  
 Record Time 10.0 sec at 1024 sps

Serial Number BE7929 V 10.72-8.17 MiniMate Plus  
 Battery Level 5.9 Volts  
 Unit Calibration April 24, 2019 by CIMFR Dhanbad  
 File Name I929HX3D.3N0

### Notes

Location: On ground surface  
 Client: MonteCarlo Ltd.  
 User Name: REED, CSIR-CIMFR, Dhanbad  
 General:

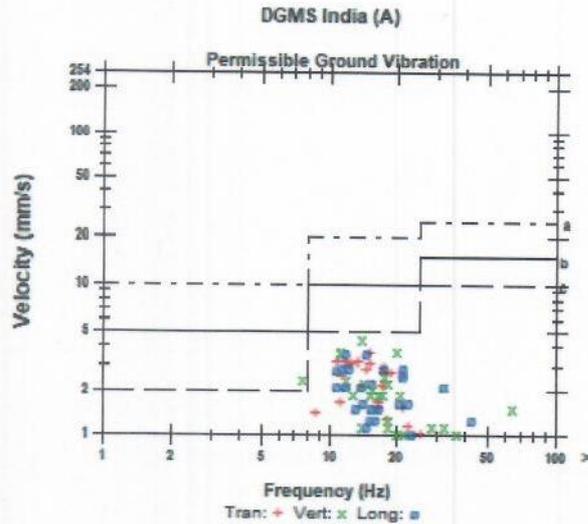
### Extended Notes

Blast vibration study at Barjora North Coal Mine.

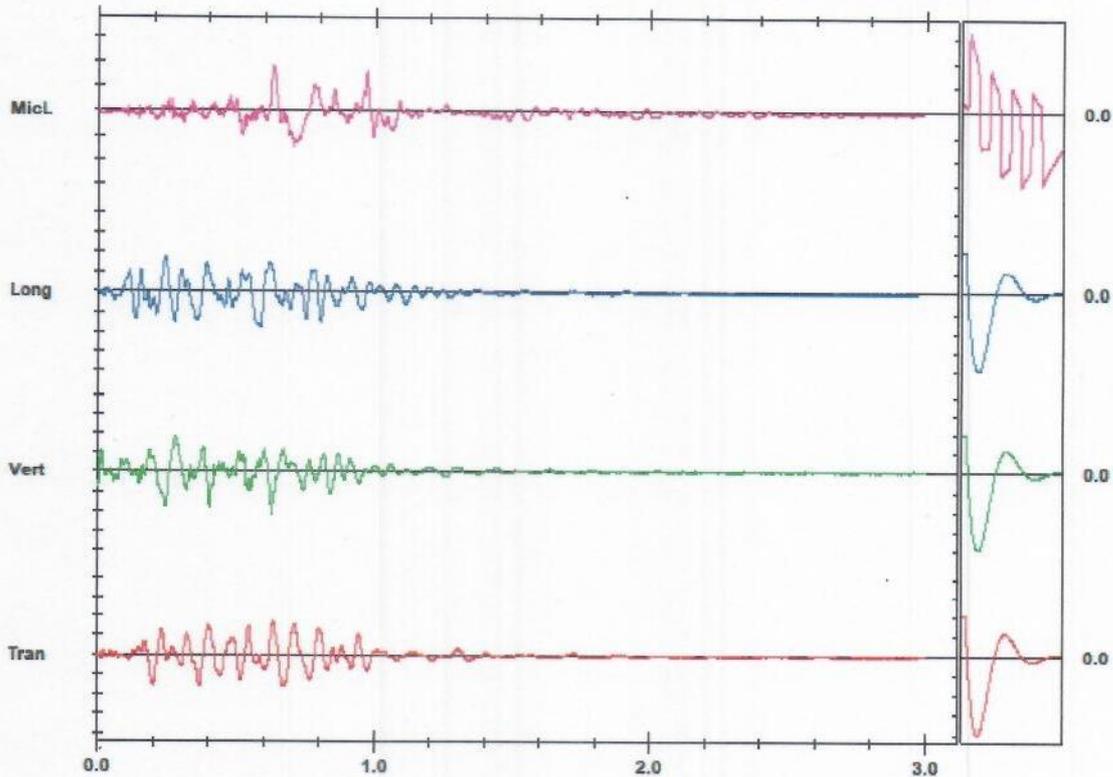
Microphone Linear Weighting  
 PSPL 119.3 dB(L) 18.50 pa.(L) at 0.631 sec  
 ZC Freq 14 Hz  
 Channel Test Passed (Freq = 19.7 Hz Amp = 626 mv)

	Tran	Vert	Long	
PPV	3.558	4.445	3.558	mm/s
ZC Freq	15	14	15	Hz
Time (Rel. to Trig)	0.636	0.628	0.242	sec
Peak Acceleration	0.053	0.080	0.053	g
Peak Displacement	0.042	0.049	0.053	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.8	7.4	7.3	Hz
Overswing Ratio	3.6	3.6	3.8	

Peak Vector Sum 5.718 mm/s at 0.628 sec



- a) Industrial Buildings
- b) Domestic houses/structures
- c) Historic objects, sensitive structures



Time scale has been modified and may not represent the actual length of the event record  
 Time Scale: 0.20 sec/div Amplitude Scale: Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div

Sensor Check



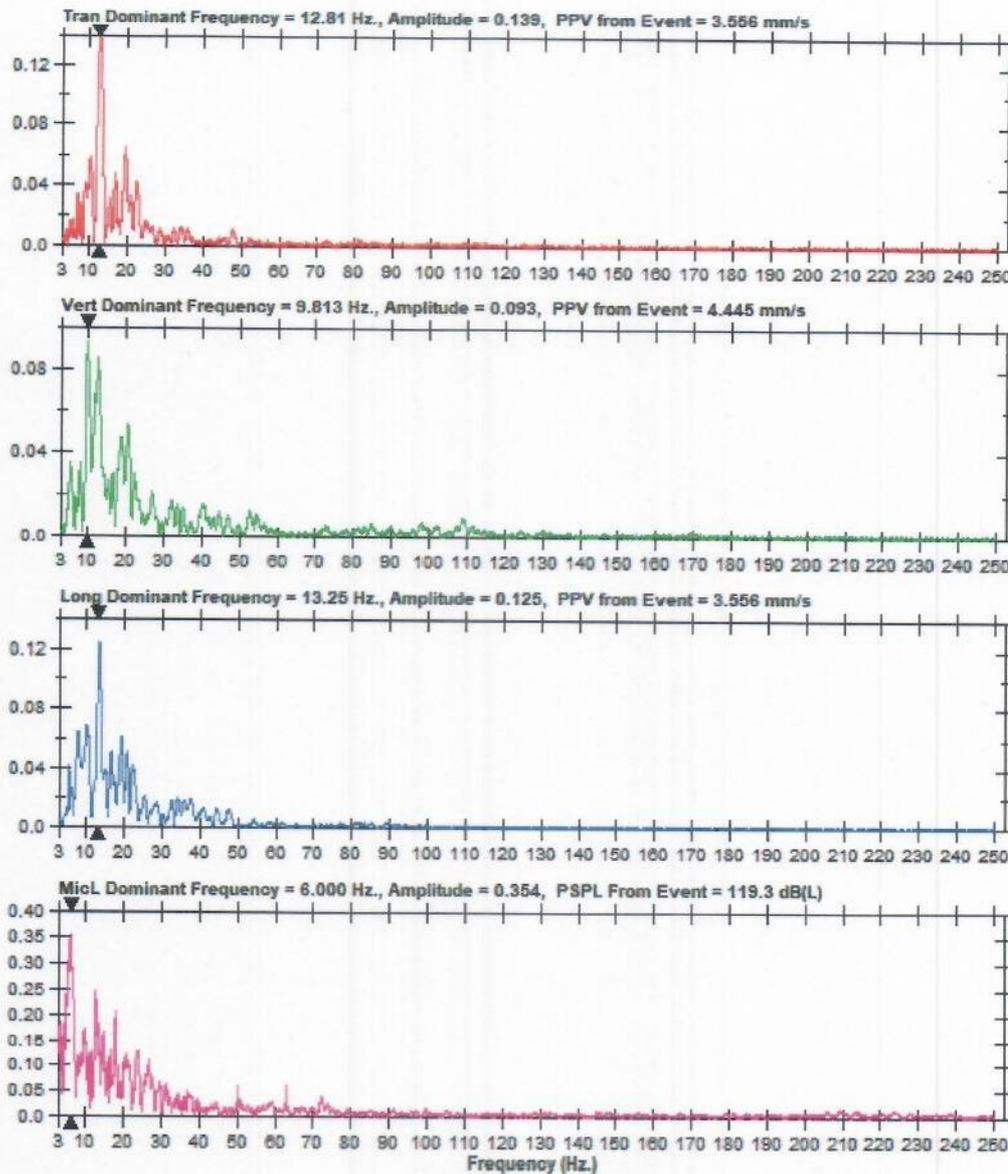
# FFT Report

Date/Time Vert at 14:47:47 May 3, 2019  
Trigger Source Geo: 0.510 mm/s  
Range Geo: 254.0 mm/s  
Record Time 10.0 sec at 1024 sps

Serial Number BE7929 V 10.72-8.17 MiniMate Plus  
Battery Level 5.9 Volts  
Unit Calibration April 24, 2019 by CIMFR Dhanbad  
File Name I929HX3D.3N0

Notes  
Location: On ground surface  
Client: MonteCarlo Ltd.  
User Name: REED, CSIR-CIMFR, Dhanbad  
General:

Extended Notes  
Blast vibration study at Barjora North Coal Mine.





## Event Report

Date/Time Vert at 16:07:27 May 3, 2019  
 Trigger Source Geo: 0.510 mm/s  
 Range Geo: 254.0 mm/s  
 Record Time 10.0 sec at 1024 sps

Serial Number BE20377 V 10.60-8.17 MiniMate Plus  
 Battery Level 6.2 Volts  
 Unit Calibration April 23, 2019 by CIMFR Dhanbad  
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### Notes

Location: On ground surface  
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 User Name: Rock Excavation Eng, CSIR-CIMFR, Dhanbad  
 General:

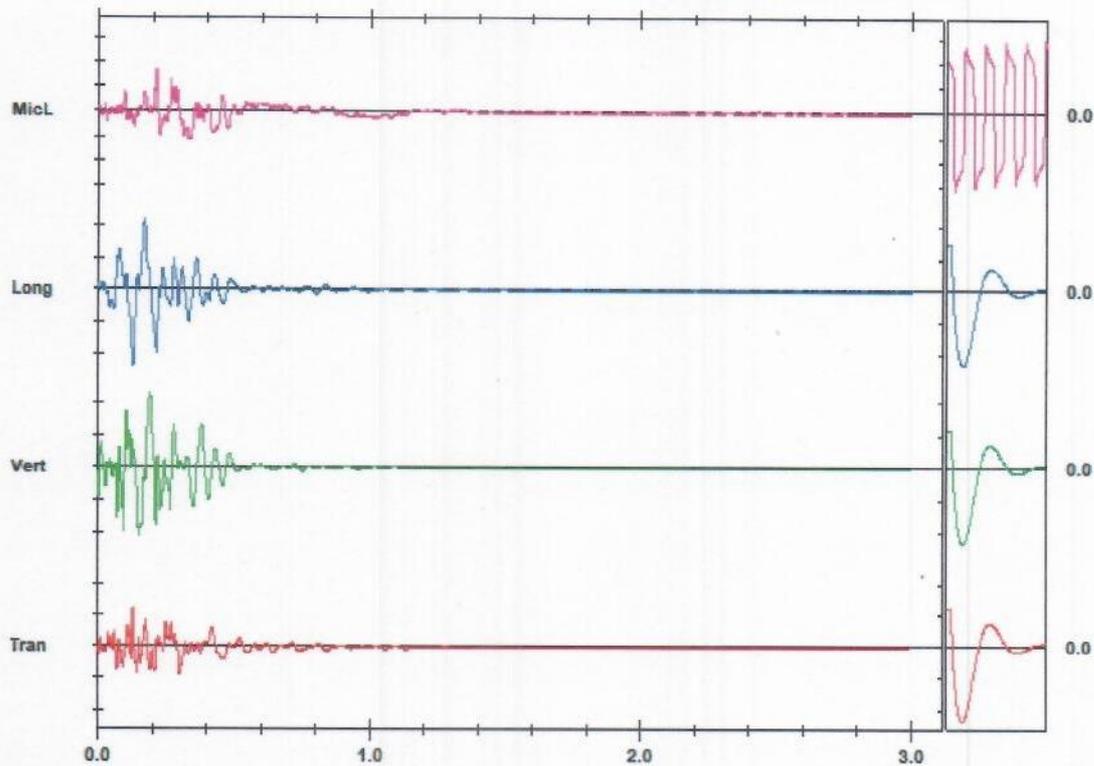
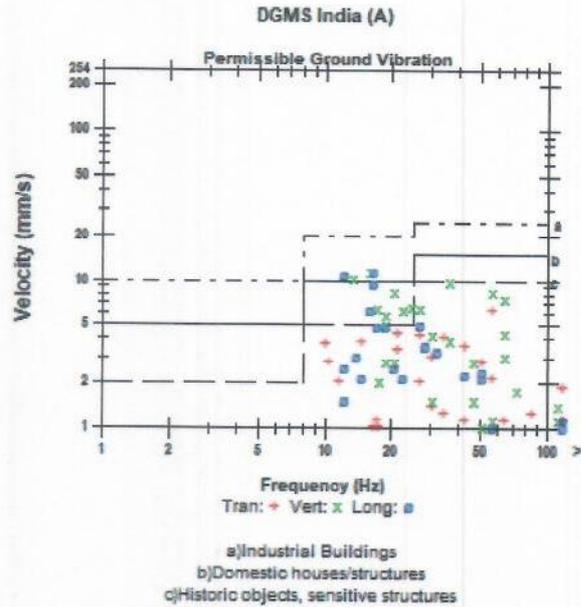
### Extended Notes

Blast vibration study at Barjora North Coal Mine.

Microphone Linear Weighting  
 PSPL 118.5 dB(L) 16.75 pa.(L) at 0.212 sec  
 ZC Freq 20 Hz  
 Channel Test Passed (Freq = 20.5 Hz Amp = 541 mv)

	Tran	Vert	Long	
PPV	6.223	11.43	11.68	mm/s
ZC Freq	57	16	17	Hz
Time (Rel. to Trig)	0.131	0.191	0.130	sec
Peak Acceleration	0.199	0.331	0.186	g
Peak Displacement	0.042	0.106	0.112	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.5	7.3	Hz
Overswing Ratio	3.5	3.5	3.6	

Peak Vector Sum 13.31 mm/s at 0.130 sec



Time scale has been modified and may not represent the actual length of the event record  
 Time Scale: 0.20 sec/div Amplitude Scale: Geo: 5.000 mm/s/div Mic: 10.000 pa.(L)/div

Sensor Check



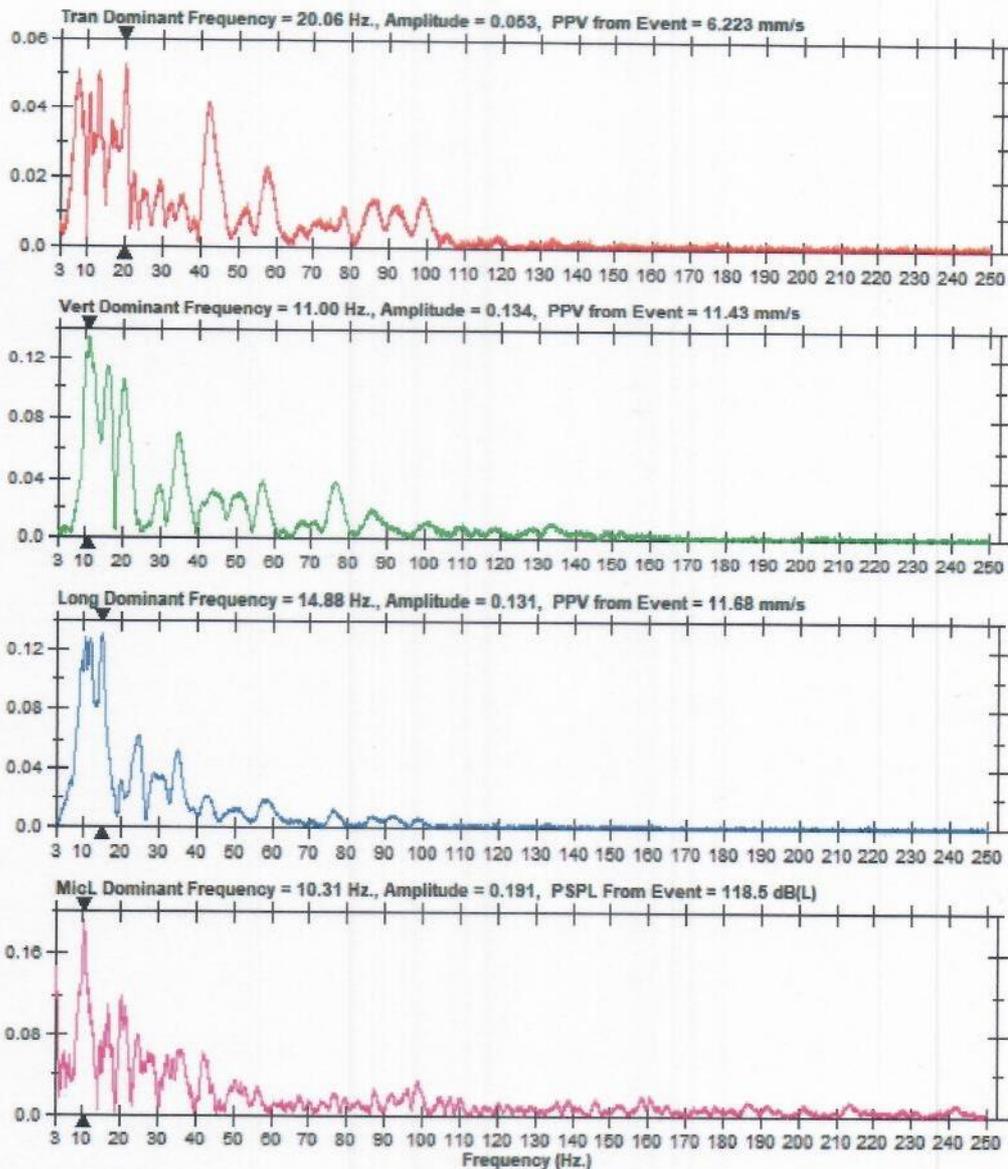
# FFT Report

Date/Time Vert at 15:07:27 May 3, 2019  
Trigger Source Geo: 0.510 mm/s  
Range Geo: 254.0 mm/s  
Record Time 10.0 sec at 1024 sps

Serial Number BE20377 V 10.60-8.17 MiniMate Plus  
Battery Level 6.2 Volts  
Unit Calibration April 23, 2019 by CIMFR Dhanbad  
File Name V377HX3E.0F0

Notes  
Location: On ground surface  
Client: MonteCarlo Ltd.  
User Name: Rock Excavation Eng, CSIR-CIMFR, Dhanbad  
General:

Extended Notes  
Blast vibration study at Barjora North Coal Mine.





## Event Report

Date/Time Vert at 15:14:25 May 3, 2019  
 Trigger Source Geo: 0.510 mm/s  
 Range Geo: 254.0 mm/s  
 Record Time 10.0 sec at 1024 sps

Serial Number BE7929 V 10.72-8.17 MiniMate Plus  
 Battery Level 5.9 Volts  
 Unit Calibration April 24, 2019 by CIMFR Dhanbad  
 File Name I929HX3E.C10

**Notes**

Location: On ground surface  
 Client: MonteCarlo Ltd.  
 User Name: REED, CSIR-CIMFR, Dhanbad  
 General:

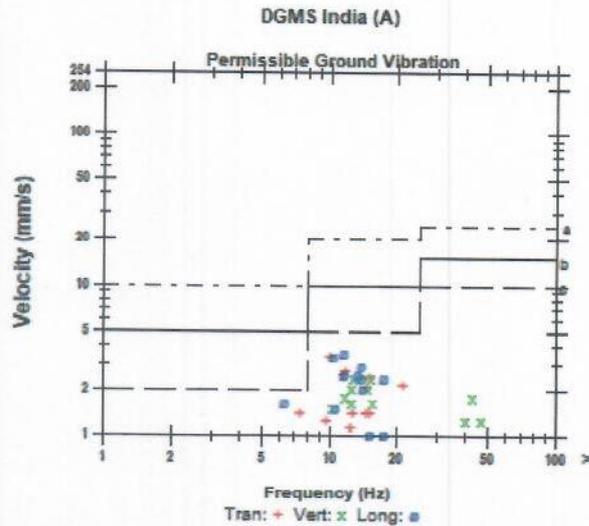
**Extended Notes**

Blast vibration study at Bajora North Coal Mine.

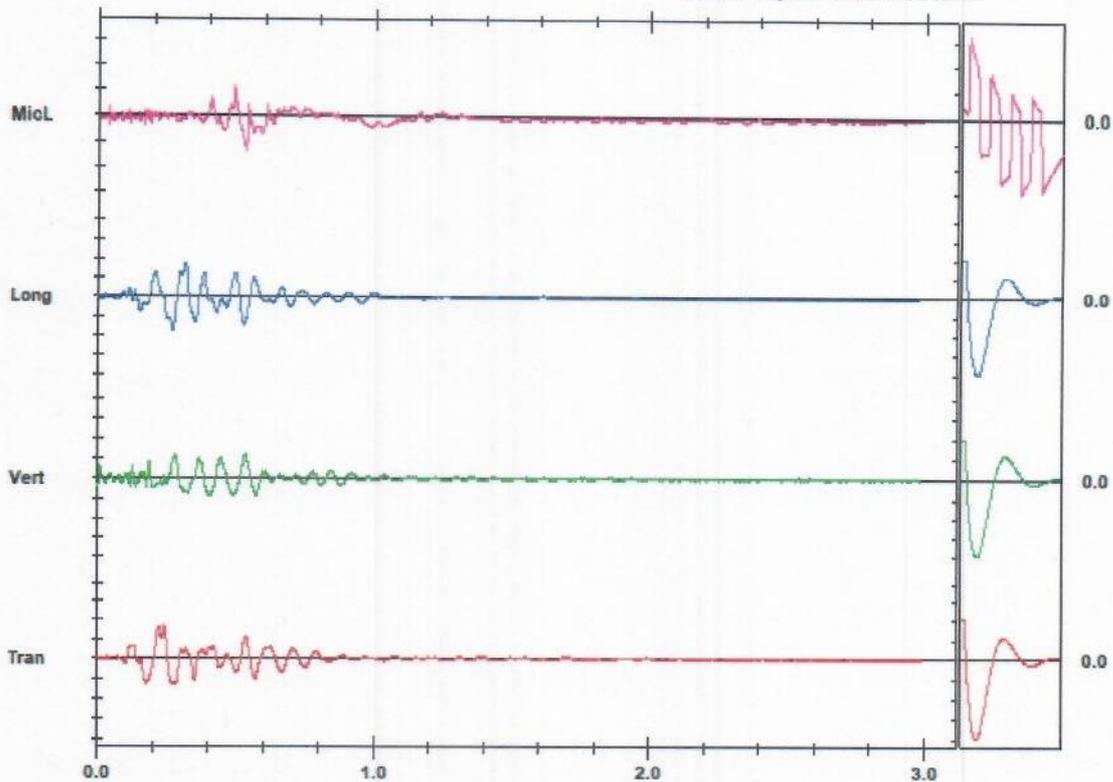
Microphone Linear Weighting  
 PSPL 116.7 dB(L) 13.75 pa.(L) at 0.532 sec  
 ZC Freq 10 Hz  
 Channel Test Passed (Freq = 19.7 Hz Amp = 626 mv )

	Tran	Vert	Long	
PPV	3.429	2.413	3.660	mm/s
ZC Freq	10	15	12	Hz
Time (Rel. to Trig)	0.244	0.280	0.313	sec
Peak Acceleration	0.040	0.053	0.063	g
Peak Displacement	0.058	0.029	0.049	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.4	7.3	Hz
Overswing Ratio	3.6	3.6	3.8	

Peak Vector Sum 4.576 mm/s at 0.271 sec



- a) Industrial Buildings
- b) Domestic houses/structures
- c) Historic objects, sensitive structures



Time scale has been modified and may not represent the actual length of the event record  
 Time Scale: 0.20 sec/div Amplitude Scale: Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div

Sensor Check



# FFT Report

Date/Time Vert at 15:14:25 May 3, 2019  
Trigger Source Geo: 0.510 mm/s  
Range Geo: 254.0 mm/s  
Record Time 10.0 sec at 1024 sps

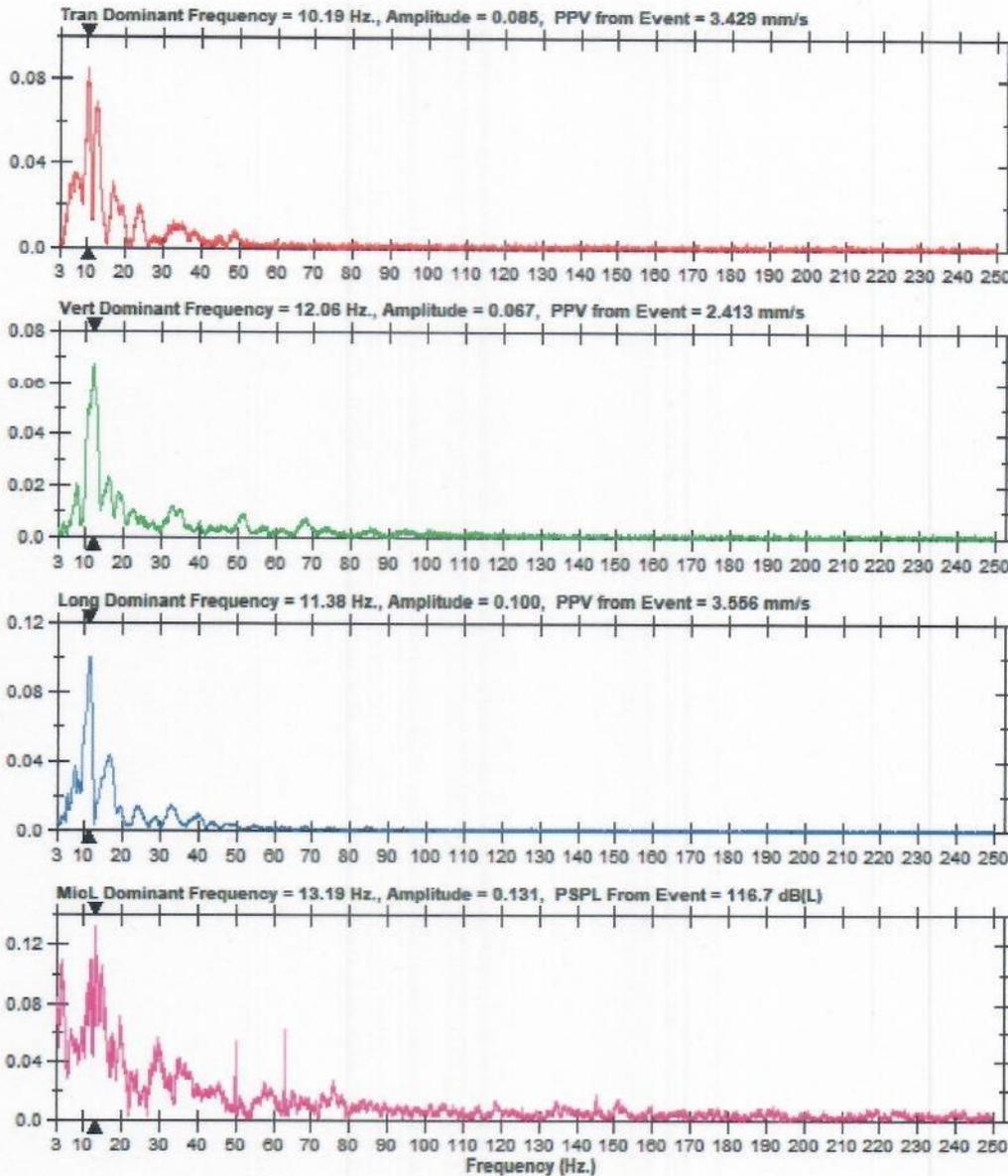
Serial Number BE7929 V 10.72-8.17 MiniMate Plus  
Battery Level 5.9 Volts  
Unit Calibration April 24, 2019 by CIMFR Dhanbad  
File Name I929HX3E.C10

### Notes

Location: On ground surface  
Client: MonteCarlo Ltd.  
User Name: REED, CSIR-CIMFR, Dhanbad  
General:

### Extended Notes

Blast vibration study at Barjora North Coal Mine.





## Event Report

Date/Time Vert at 15:22:30 May 3, 2019  
 Trigger Source Geo: 0.510 mm/s  
 Range Geo: 264.0 mm/s  
 Record Time 10.0 sec at 1024 sps

Serial Number BE7929 V 10.72-8.17 MiniMate Plus  
 Battery Level 5.9 Volts (Battery Low)  
 Unit Calibration April 24, 2019 by CIMFR Dhanbad  
 File Name I929HX3E.PI0

### Notes

Location: On ground surface  
 Client: MonteCarlo Ltd.  
 User Name: REED, CSIR-CIMFR, Dhanbad  
 General:

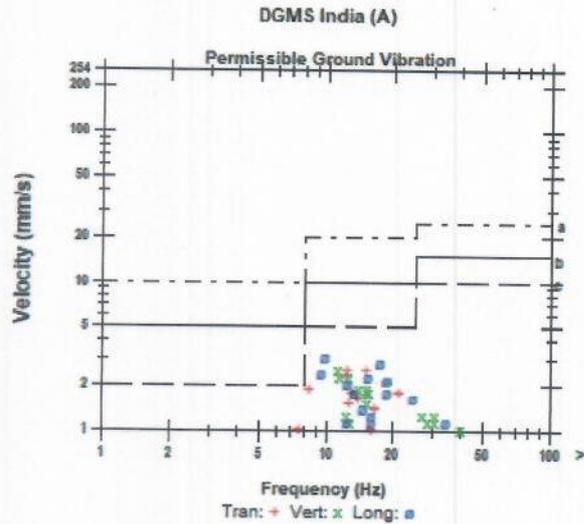
### Extended Notes

Blast vibration study at Barjora North Coal Mine.

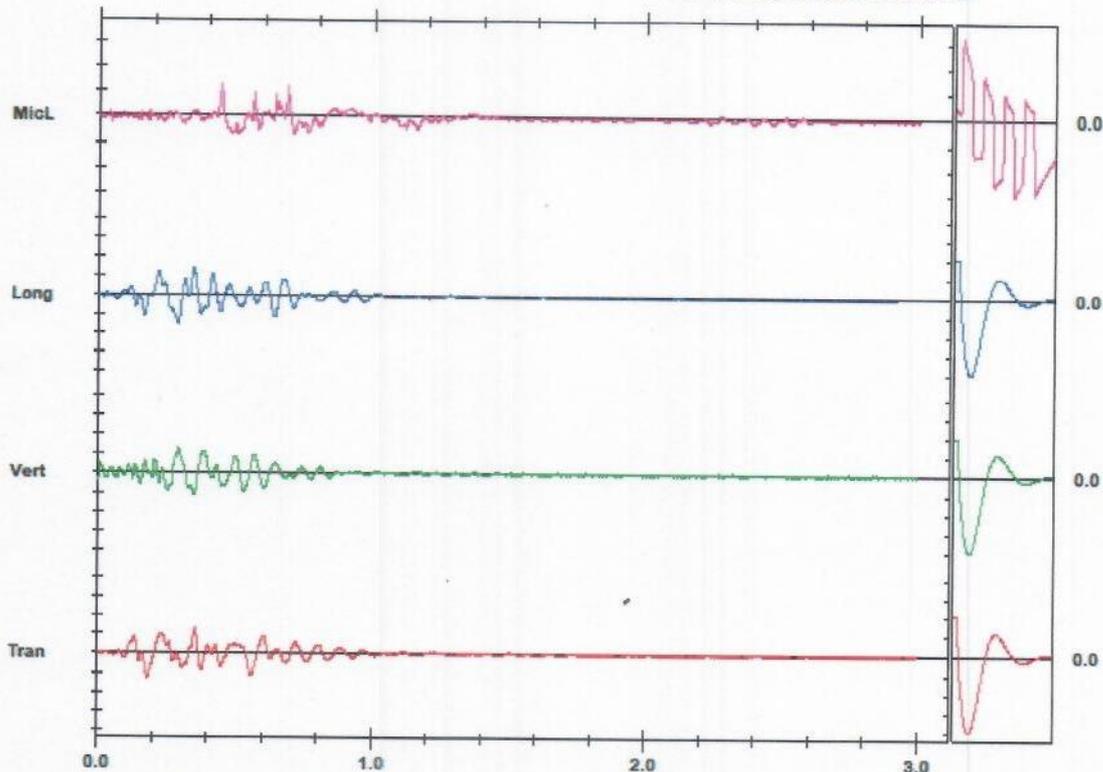
Microphone Linear Weighting  
 PSPL 116.1 dB(L) 12.75 pa.(L) at 0.444 sec  
 ZC Freq 20 Hz  
 Channel Test Passed (Freq = 19.7 Hz Amp = 626 mv)

	Tran	Vert	Long	
PPV	2.540	2.540	3.048	mm/s
ZC Freq	12	11	9.8	Hz
Time (Rel. to Trig)	0.186	0.294	0.289	sec
Peak Acceleration	0.040	0.053	0.040	g
Peak Displacement	0.030	0.034	0.046	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.6	7.4	7.3	Hz
Overswing Ratio	3.6	3.6	3.8	

Peak Vector Sum 3.812 mm/s at 0.290 sec



- a) Industrial Buildings
- b) Domestic houses/structures
- c) Historic objects, sensitive structures



Time scale has been modified and may not represent the actual length of the event record  
 Time Scale: 0.20 sec/div Amplitude Scale: Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div

Sensor Check



## FFT Report

Date/Time Vert at 15:22:30 May 3, 2019  
Trigger Source Geo: 0.510 mm/s  
Range Geo: 254.0 mm/s  
Record Time 10.0 sec at 1024 sps

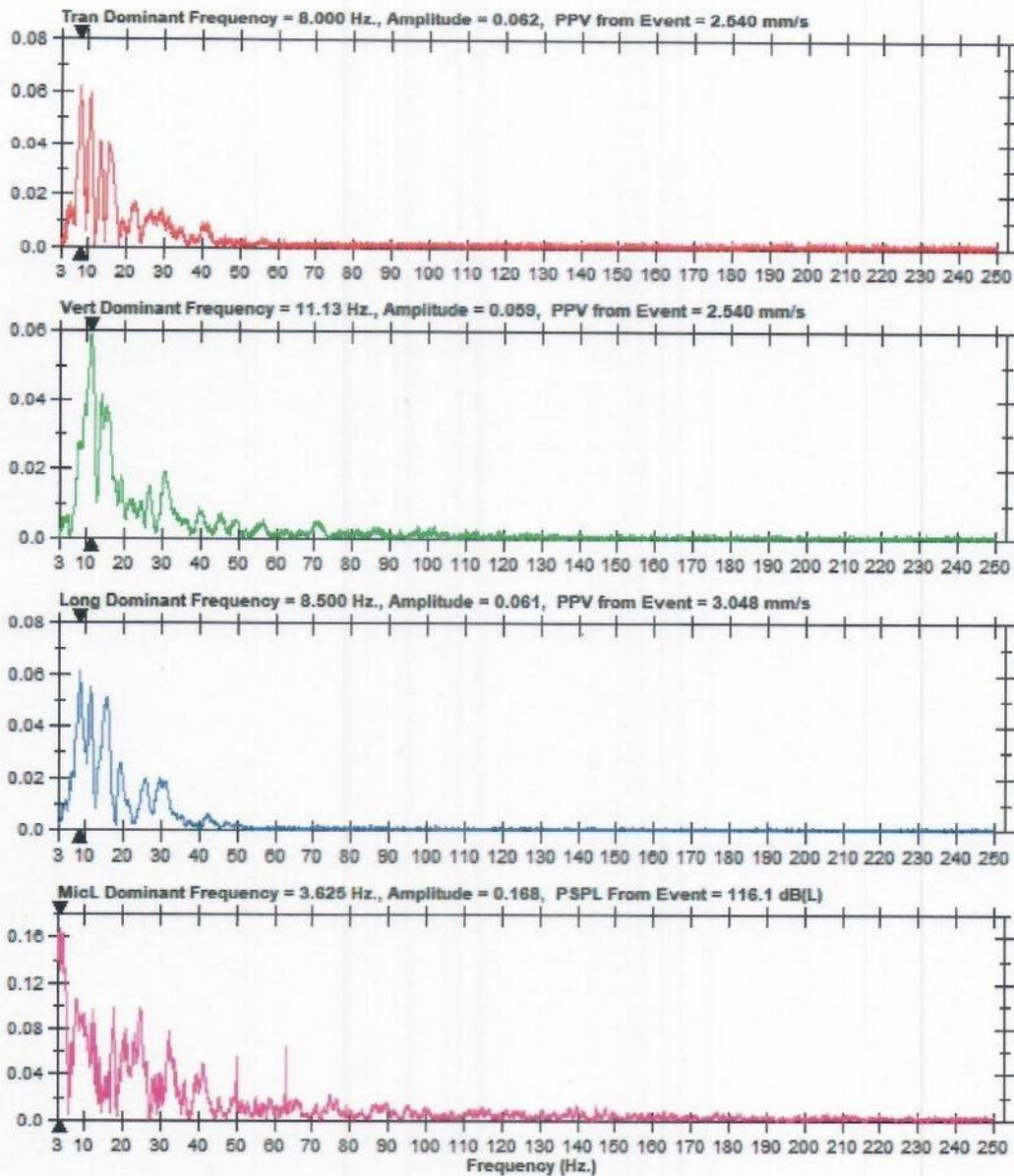
Serial Number BE7929 V 10.72-8.17 MiniMate Plus  
Battery Level 5.9 Volts (Battery Low)  
Unit Calibration April 24, 2019 by CIMFR Dhanbad  
File Name I829HX3E.P10

### Notes

Location: On ground surface  
Client: MonteCarlo Ltd.  
User Name: REED, CSIR-CIMFR, Dhanbad  
General:

### Extended Notes

Blast vibration study at Barjora North Coal Mine.





## Event Report

Date/Time Vert at 15:49:14 May 3, 2019  
 Trigger Source Geo: 0.510 mm/s  
 Range Geo: 254.0 mm/s  
 Record Time 10.0 sec at 1024 sps

Serial Number BE7929 V 10.72-8.17 MiniMate Plus  
 Battery Level 5.9 Volts (Battery Low)  
 Unit Calibration April 24, 2019 by CIMFR Dhanbad  
 File Name I929HX3F.Y20

### Notes

Location: On ground surface  
 Client: MonteCarlo Ltd.  
 User Name: REED, CSIR-CIMFR, Dhanbad  
 General:

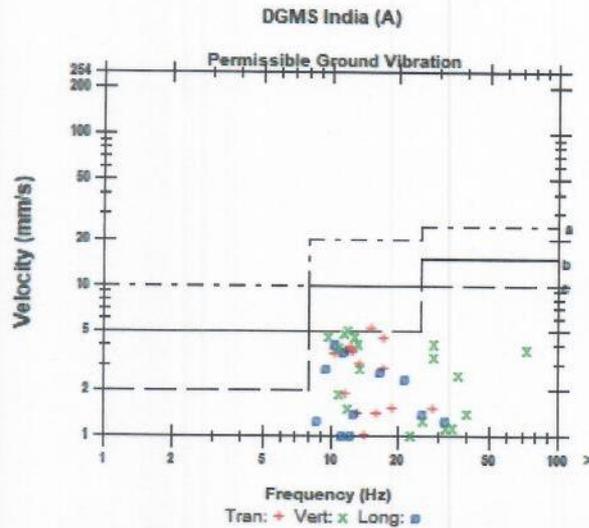
### Extended Notes

Blast vibration study at Barjora North Coal Mine.

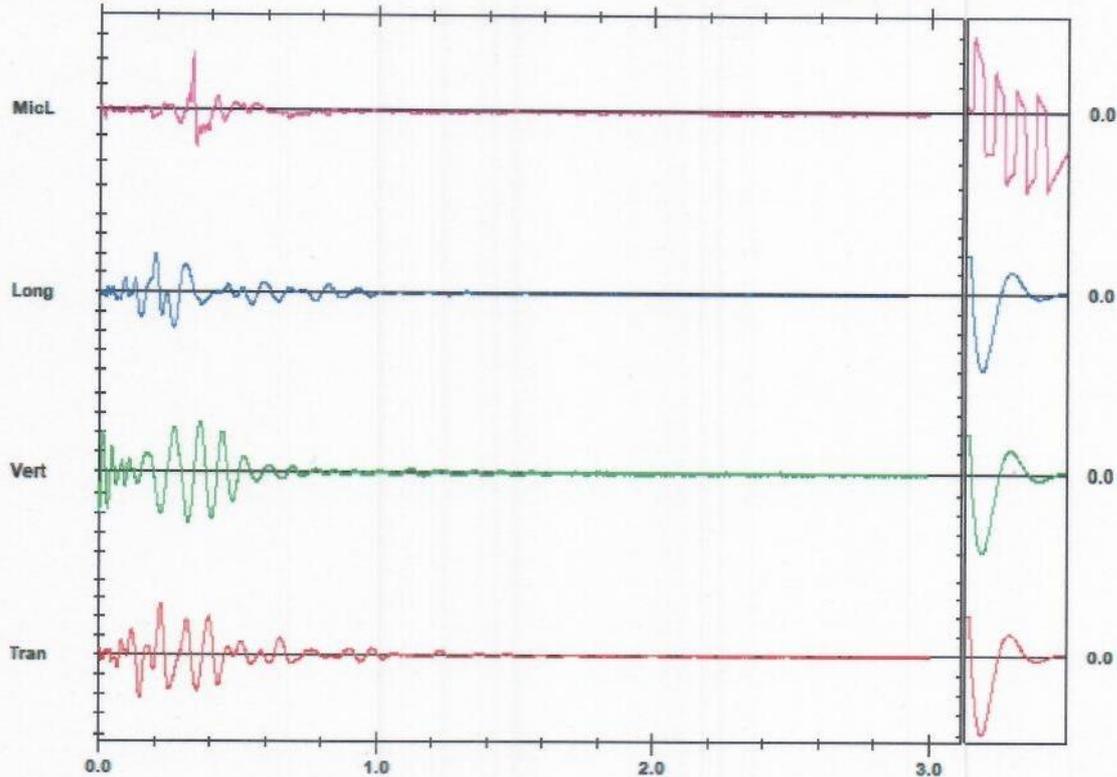
Microphone Linear Weighting  
 PSPL 121.1 dB(L) 22.75 pa.(L) at 0.336 sec  
 ZC Freq 16 Hz  
 Channel Test Passed (Freq = 20.1 Hz Amp = 673 mv )

	Tran	Vert	Long	
PPV	5.207	5.080	4.064	mm/s
ZC Freq	15	12	10	Hz
Time (Rel. to Trig)	0.222	0.362	0.201	sec
Peak Acceleration	0.063	0.172	0.063	g
Peak Displacement	0.063	0.069	0.048	mm
Sensor Check	Passed	Passed	Passed	
Frequency	7.5	7.4	7.3	Hz
Overswing Ratio	3.7	3.6	3.9	

Peak Vector Sum 6.960 mm/s at 0.223 sec



a) Industrial Buildings  
 b) Domestic houses/structures  
 c) Historic objects, sensitive structures



Time scale has been modified and may not represent the actual length of the event record  
 Time Scale: 0.20 sec/div Amplitude Scale: Geo: 2.000 mm/s/div Mic: 10.000 pa.(L)/div

Sensor Check



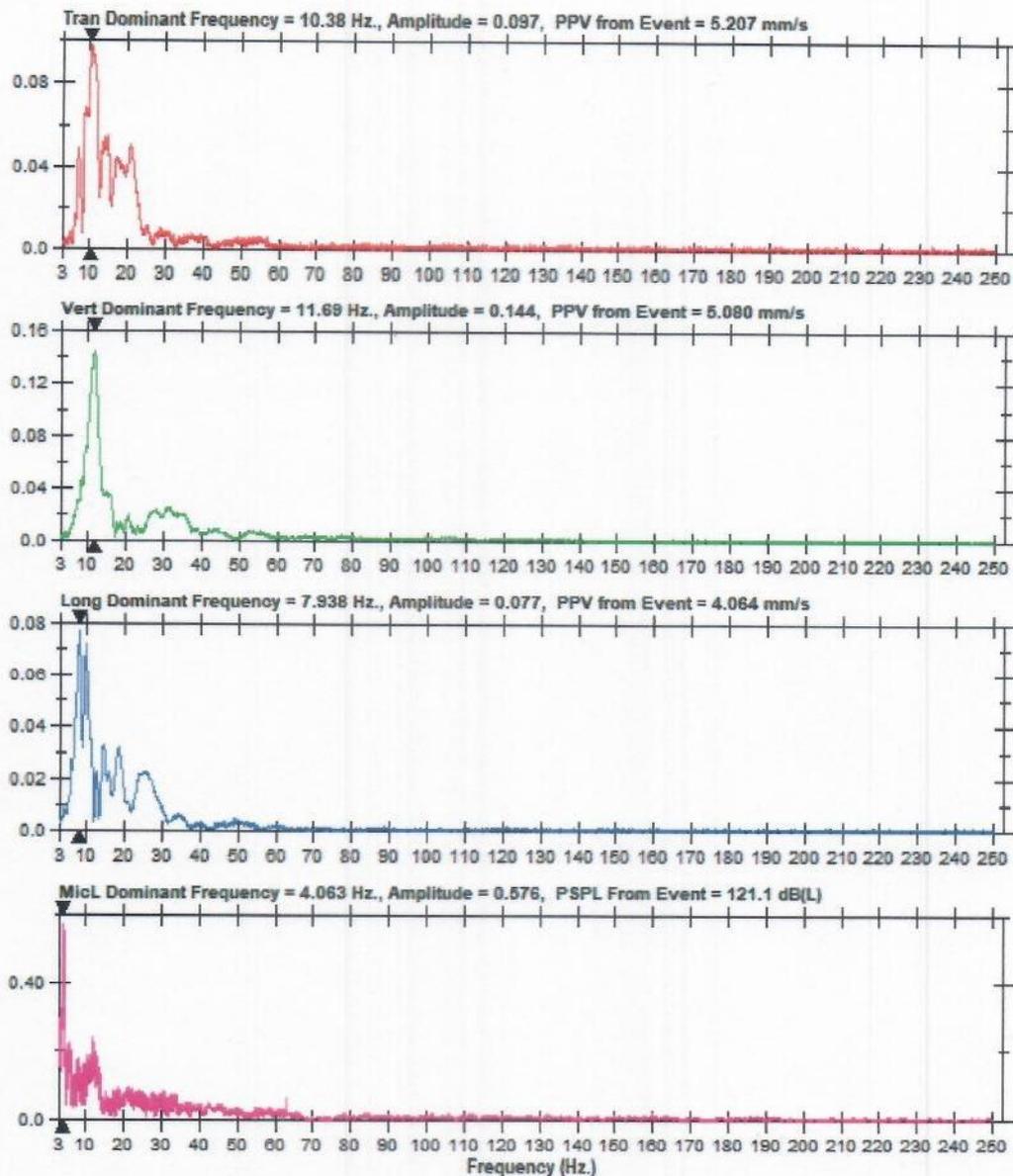
# FFT Report

Date/Time Vert at 15:49:14 May 3, 2019  
Trigger Source Geo: 0.510 mm/s  
Range Geo: 254.0 mm/s  
Record Time 10.0 sec at 1024 sps

Serial Number BE7929 V 10.72-8.17 MiniMate Plus  
Battery Level 5.9 Volts (Battery Low)  
Unit Calibration April 24, 2019 by CIMFR Dhanbad  
File Name I929HX3F.Y20

Notes  
Location: On ground surface  
Client: MonteCarlo Ltd.  
User Name: REED, CSIR-CIMFR, Dhanbad  
General:

Extended Notes  
Blast vibration study at Barjora North Coal Mine.





भारत सरकार  
Govt. of India  
श्रम एवं रोजगार मंत्रालय  
Ministry of Labour & Employment  
खान सुरक्षा महानिदेशालय  
Directorate-General of Mines Safety



NO: 010985|EZ|Sitarampur Region No.I|Perm|2024|264869

Date: 22.08.2024

From

Director of Mines Safety, SITARAMPUR REGION NO.I Region, EASTERN ZONE SITARAMPUR WEST BENGAL

To

The Agent

Barjora North Coal Mine, M/s West Bengal Power Development Corporation Ltd. (WBPDC), Village: Ghutgoria, Po: Ghutgoria, Barjora, Dist- Bankura M/s West Bengal Power Development Corporation Ltd. (wbpdcl), Village: Ghutgoria, Po: Ghutgoria, Barjora, Dist- Bankura

**Sub:Permission under Regulation 196(3) of the Coal Mines Regulations, 2017 to conduct controlled deep hole blasting within 500 m but beyond 100 m of 220KV HT line of M/s DVC and factory area not belonging to the owner at Barjora (North) Coal Mine of M/s. The West Bengal Power Development Corporation Limited (WBPDC) issued vide letter No.010985/EZ/Sitarampur Region No.1/Perm/2024/264869 dated 15.07.2024 – Modification thereof.**

Sir,

Please refer to this Directorate's Permission Letter No. No.010985/EZ/Sitarampur Region No.1/Perm/2024/264869 dated 15.07.2024 on the above mentioned subject and subsequent inspection mad by the undersigned on 8th August, 2024.

In exercise of powers conferred on Chief Inspector of Mines (also designated as Director-General of Mines Safety) under Regulation 196 (3) of the Coal Mines Regulations 2017, and by virtue of the authorization granted to me by the Chief Inspector of Mines (also designated as Director-General of Mines Safety) under Section 6(1) of the Mines Act, 1952, I hereby modify the condition Nos. 6, 8, 19k of the permission issued by this Directorate vide letter No.010985/EZ/Sitarampur Region No.1/Perm/2024/264869 dated 15.07.2024. On modification, the modified condition Nos.6, 8, 19k shall be strictly complied with, which are as follows:

(1). **Condition No.6** - The explosive weight per delay and total explosive to be detonated in a blasting round shall not be more than the quantities specified below:

Distance of structures from the blast face (m)	Maximum explosive weight to be detonated in a delay	Total explosive weight to be detonated in a round	Maximum no. of hole charge	Height of charge column (m)	Stemming height (m)	Hole depth (m)	Drill hole dia (mm)	Initiation System
100-200	25	1125	45	1.2	4.8	6	153	Electronic detonator
200-400	25	1250	50	1.2	4.8	6	153	Electronic detonator
400-500	25	1250	50	1.2	4.8	6	153	Electronic detonator/NONEL

(2). **Condition No.8** – Sufficient number of blast induced ground vibration monitoring instruments to be maintained and monitoring of Peak Particle Velocity (PPV) of blast induced ground vibrations and the dominant frequency shall be done by the management of M/s The West Bengal Power Development Corporation Limited (WBPDC) for each round of shots fired.

(3). **Condition No.19.k.** - The blasting within 400 meters distance from structure shall be conducted using Electronic Detonator. Electronic detonator/NONEL system of initiation shall be used beyond 400 meters distance.

All other conditions stipulated in the permission letter issued vide this Directorate's letter No.010985/EZ/Sitarampur Region No.1/Perm/2024/264869 dated 15.07.2024 shall remain unchanged and shall be strictly complied with.

Your Sincerely,



IRFAN AHMED ANSARI (DIRECTOR - SITARAMPUR REGION NO.I)

THIS IS A SYSTEM GENERATED DOCUMENT, DOES NOT REQUIRE ANY SIGNATURE.



Director (Mining)  
Corporate Office,  
WBPDCL



# ABOUT US

## WBPDC..... Powering Bengal

### **Power Plants:**

The goal of WBPDC is to carry on the business of electric power generation and supply in the state of West Bengal. The thermal power plants under WBPDC are in Kolaghat, Bakreswar, Sagardighi, Santaldih and Bandel. The Registered & Corporate Office is at Bidyut Unnayan Bhaban, Salt Lake, Kolkata. WBPDC formed in July, 1985 with only one generating unit at Kolaghat having turnover of Rs. 64 Crore paced up further to Rs. 10974.42 Crore in the financial year 2023-24 with 17 Units. WBPDC is working in tandem with West Bengal State Electricity Distribution Company Limited (WBSEDCL) and Calcutta Electric Supply Corporation (CESC).

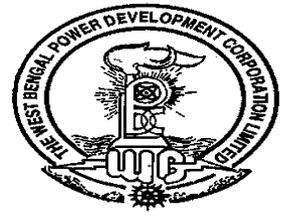
### **Solar Projects:**

The WBPDC stepped into solar power generation with a 40 KW Rooftop Solar PV Plant at Bidyut Unnayan Bhaban in the year 2014. With the success of this small venture, WBPDC has entered in solar power generation in a big way by installing rooftop, ground mounted as well as floating Solar PV Plants. In the year 2018, 2 X 3 KW Solar Tree was installed at Bidyut Unnayan Bhaban.

Rooftop Solar PV Plants have been installed on the roofs of 71 buildings of its power plants. Total cumulative capacity of Roof Top Solar PV plant is 10.54 MWp considering all its Thermal Power Plants.

**Captive Coal Mines:** MoC GoI has allocated 6 coal blocks to WBPDC. Out of 6 WBPDC started coal production from 4 coal mines namely Pachwara(N), Barjora(N), Gangaramchak, Borjore and Tara(E & W) since 2018 onward. Reserve of Borjore exhausted Mine closure activity is under progress.

Deocha –Pachami-Dewanganj-Harinsingha Coal Block: GR and conceptual report prepared by CMPDIL.



# THE WEST BENGAL POWER DEVELOPMENT CORPORATION LIMITED

WBPDC

(A GOVERNMENT OF WEST BENGAL ENTERPRISE)

BIDYUT UNNAYAN BHABAN

3/C, LA BLOCK, SECTOR-III, BIDHANNAGAR, KOLKATA-700106



## Present Status of active Thermal Power Plants of WBPDC

PLANTS	CONFIGURATION (MW)	CAPACITY (MW)
STPS	2 X 250	500
KTPS	4 X 210	840
BKTPP	5 X 210	1050
BTPS	1 X 60	275
	1 X 215	
SGTPP (PHASE-I)	2 X 300	600
SGTPP (PHASE-II)	2 X 500	1000
WBPDC	4265	4265

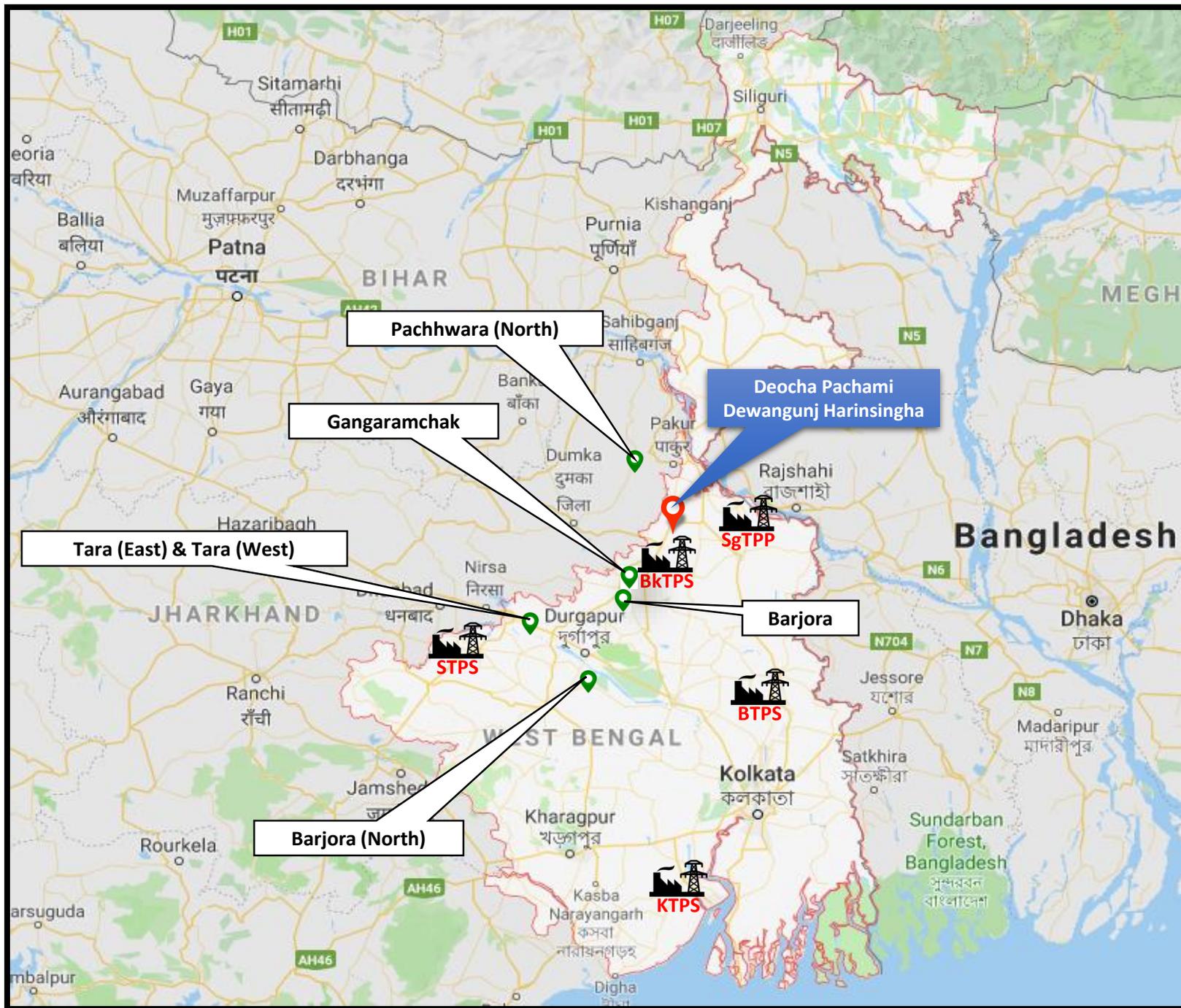
ANOTHER 660 MW SUPER CRITICAL UNIT WILL COME INTO OPERATION IN FY: 2024-25 AT SAGARDIGHI

**The Details of Coal Blocks allotted by Ministry of Coal, Government of India to WBPDCCL for supplying coal to its end use Thermal Power Plants located in the State of West Bengal.**

Coal Block Name	Location	Allotment Order No. & Date of Allotment	Existing Mining Lease (ML) area(Ha)	Applied Lease(Ha)	Remaining Mineable Reserve(Million Tonne)	PRC(MTPA)	Production FY 23-24(MTPA)	Avg. Annual Production(MT)	Expected Production FY,24-25(MT)	Requirement of Coal,FY 24-25	Shortfall(Million Tonne)	Reclamation Status of Forest Land			
												Total Forest Area(Ha)	Excavated Forest Area(Ha)	Back Filled/Reclaimed Area(Ha)	Bio-reclaimed Area(Ha)
PACHHWARA(NORTH)	Pakur,Jharkhand	103/12/2015/NA & 31.03.2015	1218	Nil	408.07	15	13.7	8.577	15	21.5	2	371.01	80.91	15.37	3.1
BARJORA (NORTH)	Bankura,West Bengal	103/7/2015/NA & 31.03.2015	260.14	422.9	65	3	1.12	1.117	1			Nil	Nil	Nil	Nil
TARA(EAST)&TARA(WEST)	Paschim Bardhaman,West Bengal	103/10/2015/NA & 31.03.2015	800	Nil	17.68	4	0.1	0.108	2.5			Nil	Nil	Nil	Nil
GANGARAMCHAK & GANGARAMCHAK -BHADULIA	Birbhum,West Bengal	103/8/2015/NA & 31.03.2015	47.65	101.77	5.63	3	3	1.439	1			101.77	78.73	65.03	29.18
BARJORA	Birbhum,West Bengal	103/6/2015/NA & 31.03.2015	58.49	Reserved Exhausted			0.5	0.421	0			Nil	Nil	Nil	Nil
DEUCHA-PACHAMI	Birbhum,West Bengal	CBA1-38011/2/2017-CBA1 & 17.12.2019	Nil	Nil	1240.353	Nil	Nil	Nil	Nil			Nil	Nil	Nil	Nil
									19.5						

  
 Director (Mining)  
 Corporate Office,  
 WBPDCCL

**Locations of  
Coal Mines &  
Thermal Power  
Plants  
Of WBPDCCL in  
the State of  
West Bengal**



*[Signature]*  
Director (Mining)  
Corporate Office,  
WBPDCCL