




सीएमपीडीआई  
मिनी रत्ना  
**cmpdi**  
Mini Ratna




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WELFARE FOR ALL | HAPPINESS OF ALL



**NaCCER**  
NATIONAL CENTRE  
FOR COAL AND  
ENERGY RESEARCH



PHASE I  
CMPDI CAMPUS



**TechVista**  
*CMPDI's bi-monthly technical booklet*  
March 2026, NaCCER Edition

# NaCCER

## NATIONAL CENTRE FOR COAL AND ENERGY RESEARCH



PHASE I  
CMPDI CAMPUS

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## National Centre for Coal and Energy Research (NaCCER)

To address the need for development of an advanced R&D centre for research in coal and energy sector at par with global standards, National Centre for Coal and Energy Research (NaCCER) has been established in line with other R&D centres under several ministries.

### *NaCCER Phase-I Establishment:*

- ❖ Established at CMPDI, Ranchi, utilizing existing infrastructure and manpower.
- ❖ Inaugurated on October 7, 2024 by Hon'ble Minister of Coal.

### *Key Objectives:*



Boosting synergy, fostering innovation and ensuring timely application of research outcomes for industry performance improvement.

NaCCER was established with vision to build a national research hub of global standards where innovation thrives and industry challenges are met with innovative solutions. From clean coal technologies and AI-powered mining to renewable energy and environmental conservation, NaCCER aims to tackle almost all critical areas for the future of energy security and sustainability. It aims to build a multidisciplinary team of experts, creating partnerships with leading institutions like the IITs and NITs, and collaborating with start-ups and with National & International stakeholders to unlock the full potential of this initiative. NaCCER strives to be more than just a research centre—it stands as a symbol of coal industries collective commitment to building a brighter, cleaner and more sustainable future.

NaCCER is also the coordinating agency for implementing the S&T-FIRST initiative of Ministry of Coal (MoC) aimed at engaging startups in the research activities of coal sector.

### *Nodal Agency:*

- ❖ For S&T projects funded by Ministry of Coal (MoC).
- ❖ For R&D projects funded by Coal India Limited (CIL).



### *Thrust Areas of research under NaCCER*

Broad thrust areas have been identified keeping in view the sustainable goals of the coal industry:

- ❖ Production, Productivity, Safety and Exploration.
- ❖ Environment, Ecology, Conservation and Sustainability.
- ❖ Coal Mining "Waste to Wealth".
- ❖ Clean Coal Technologies and Coal Beneficiation.
- ❖ Alternative Use of Coal.
- ❖ Renewable Energy.
- ❖ AI/ML/IoT Based Smart Mining.
- ❖ Technology Innovation and Indigenization.

# Automation, Control & Wireless Communication in Underground Mines on 4G LTE/5G Ready Communication Network

## 1. Background

Underground mining presents unique operational challenges due to the harsh working environment, deep underground operations, and limited communication infrastructure. Key issues in underground coal mines include ensuring miner safety, maintaining operational efficiency, and improving communication systems. Currently, traditional communication networks, such as leaky feeders and wired systems, are limited in their ability to provide real-time data transfer, making it difficult to implement modern technologies for automation, monitoring, and safety.

### Communication Challenges:

**Voice and Video Communication:** Underground environments are well known for signal attenuation, causing frequent communication disruptions. Current systems struggle to provide reliable voice communication, and video communication is often non-existent due to bandwidth limitations.

**Latency and Reliability:** Low-latency and high-reliability networks are crucial for remote-controlled operations and emergency response. However, the existing infrastructure cannot support real-time communication and control, which limits the use of advanced automation and safety measures.

### Operational Inefficiencies:

**Manual Operation of Equipment:** Conveyor belts, pumps, and ventilation systems are mostly operated manually, leading to delays and inefficiencies. Automated systems require high-speed data networks to function seamlessly, but the lack of reliable communication infrastructure prevents their widespread deployment.

**Inefficient Asset and Miner Tracking:** Tracking the real-time location of miners and critical assets underground is vital for both safety and operational management. Current systems are unable to provide accurate, real-time tracking data, making it difficult to optimize operations or respond swiftly during emergencies.

### Safety Concerns:

**Environmental Monitoring:** Mines consist of dangerous working environments due to the presence of harmful gases like methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>). Continuous monitoring of gas levels, temperature, humidity, and air velocity is crucial to ensure Mines, Miner and Operational safety. Existing monitoring systems are either too slow or less reliable, leading to potential delays in responding to hazardous conditions.

**Emergency Response:** In the event of accidents, communication systems need to support rapid response, location tracking, and video feeds to guide rescue operations. However, the current communication networks do not have the capacity to handle such demands, increasing the risk to miners.

### Regulatory Compliance:

**DGMS Certification:** To ensure compliance with safety standards set by the Directorate General of Mines Safety (DGMS), all electrical/electronic equipment deployed in underground mines must be Intrinsically Safe (IS) certified. This includes all equipment/modules related with communication, automation, and monitoring devices.

## 2. Objectives

Keeping in view the above challenges in underground coal mines, the project is under implementation by NaCCER, Mining Electronics department of CMPDI, and ITI Limited through the R&D fund of CIL. The project aims to deploy a 5G Captive Non-Public Network (5G CNPN/4G LTE) at the Jhanjra mine of ECL focusing on enhancing communication, automation, safety, and compliance through advanced technological solutions. The specific following objectives are tailored to address the critical challenges faced in underground mining operations:

- a. To provide seamless voice and video communication between underground workers and control centers using 5G CNPN/4G LTE.

- b. To automate conveyor belts, pumps, and other critical systems to enhance operational efficiency and reduce manual intervention.
- c. To deploy IoT-based sensors for monitoring gases (CH<sub>4</sub>, CO<sub>2</sub>), temperature, humidity, and air velocity inside the mine.
- d. To implement an asset and miner tracking system for improved safety and resource management.
- e. Obtain DGMS certification for all equipment to be deployed in the underground mine as part of the project.

### 3. Expected Deliverables and Impact

The project aims to address the key challenges faced during the underground mining operations, with a strong focus on safety, efficiency, and regulatory compliance with following deliverables:

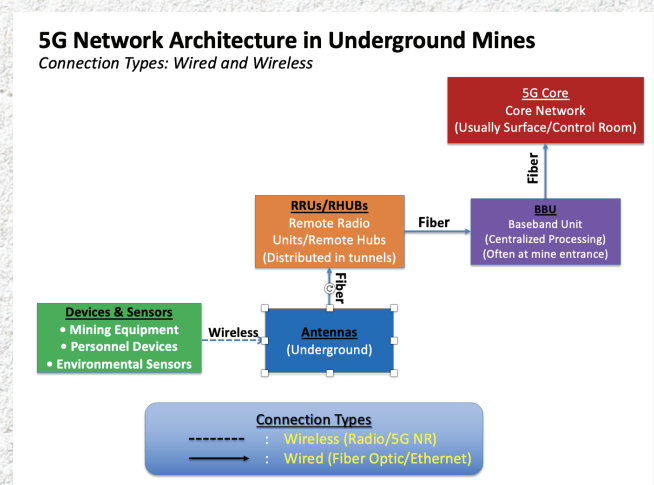
- i. **Enhanced safety through monitoring and Communication:** IoT-based sensors will be deployed in the mine, connected via the 5G CNPN/4G LTE, to monitor the environmental parameters including concentration of gases like methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>), temperature, humidity, and air velocity in real time. The system will provide continuous data on gas levels, temperature, and ventilation, triggering immediate alerts in case of abnormal conditions. This real-time monitoring will enable quicker preventive measures, thereby ensuring a safer working environment for the miners.
- ii. **Real-time voice and video communication:** A robust communication infrastructure will be established that ensures high-quality, low-latency voice and video communication between workers underground and the control centers above. This will improve coordination during routine operations and enhance responsiveness during emergencies, leading to faster decision-making and better situational awareness.
- iii. **Improved Operational Efficiency Through Automation:** Sensors and IoT devices connected through the 5G network will be installed in

the underground in order to allow machinery like conveyor belts and pumps to be operated automatically or remotely. The automation will lead to better resource utilization, reduce downtime, and lower the need for miners to manually intervene, improving overall mine efficiency and safety.

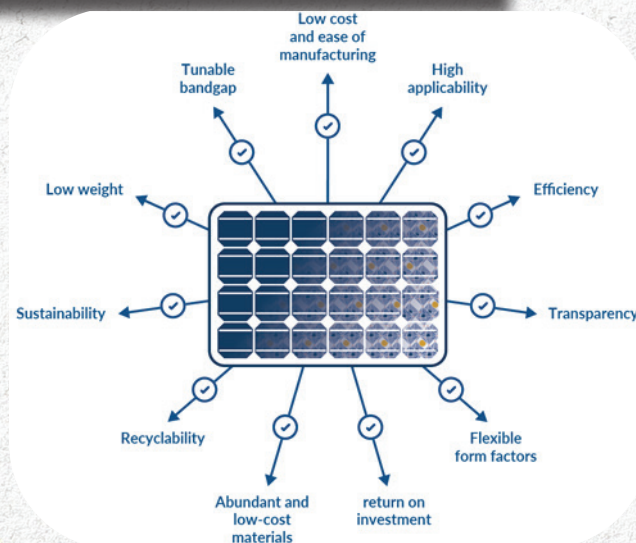
- iv. **Real-Time Tracking of Miners and Assets:** The 5G CNPN/4G LTE will be leveraged to enable real-time tracking of miners and assets, providing control room operators with precise location data at any given time. In the event of an emergency, rescue operations can be directed more efficiently by knowing the exact positions of miners. Furthermore, tracking machinery and equipment will allow for better maintenance scheduling, reducing downtime and improving resource management
- v. **DGMS Certification:** Directorate General of Mines Safety (DGMS) certification will be obtained for all equipment used in the mine for the project.

Deploying a 5G CNPN/4G LTE in the Jhanjra mine aligns with the broader industry trend toward digital transformation. The high-speed, low-latency network will act as a backbone for a variety of Industry 4.0 applications, including real-time data analytics, predictive maintenance, and AI-powered decision-making. By integrating 5G technology into mining operations, the Jhanjra mine can become a model for future digitalized mining, showcasing the value of adopting cutting-edge technology in improving safety, productivity, and sustainability.

### 4. Representative network diagram



# Carbon electrode based indigenous low-cost perovskite solar cells development



## Introduction

India's transition towards a low-carbon and sustainable energy future requires innovative technologies that can leverage existing resources while enabling clean power generation. In this context, perovskite solar cells have emerged as a next-generation photovoltaic technology due to their high efficiency, low material consumption, and compatibility with cost-effective manufacturing processes. However, conventional perovskite solar cells rely heavily on noble metal electrodes such as gold or silver and expensive organic charge transport layers, which increase device cost and limit long-term stability. To address these challenges, NaCCER along with Indian Institute of Technology (IIT) Roorkee, are developing carbon electrode-based perovskite solar cells that replace costly metal electrodes with low-cost, abundant, and stable carbon materials. This approach aligns strongly with India's energy security goals and supports the broader objective of de-carbonization through indigenous technological innovation.

## Carbon Electrodes: Value Addition Beyond Combustion:

Carbon materials offer several intrinsic advantages when used as electrodes in perovskite solar cells. They are chemically stable, hydrophobic, resistant to moisture-induced degradation, and can function simultaneously as both electrode and hole-transport layer. This enables simplified, hole-transport-layer-free device architectures, reducing material usage

and manufacturing complexity. Importantly, carbon electrodes can be deposited using scalable, low-temperature techniques such as screen printing and doctor-blade coating, making them well suited for large-area and industrial production. The ongoing research focuses on optimizing conductive carbon inks and engineering the perovskite-carbon interface to overcome performance limitations traditionally associated with carbon-based devices. By enabling the use of carbon as a functional material in advanced solar cells, this project demonstrates a high-value, non-combustion application of carbon resources and opens new avenues for coal-derived materials in clean energy technologies.

## Impact on Coal sector and Sustainable Energy Transition:

The development of carbon electrode-based perovskite solar cells presents a strategic opportunity for Coal companies to diversify into advanced energy technologies while supporting India's renewable energy mission. This research promotes value addition to carbon resources, reduces dependence on imported noble metals, and enables the fabrication of stable and cost-effective solar devices suitable for Indian climatic conditions. Beyond technological outcomes, the project contributes to skill development, advanced materials processing, and industry-academia collaboration in emerging clean-energy domains. By supporting such

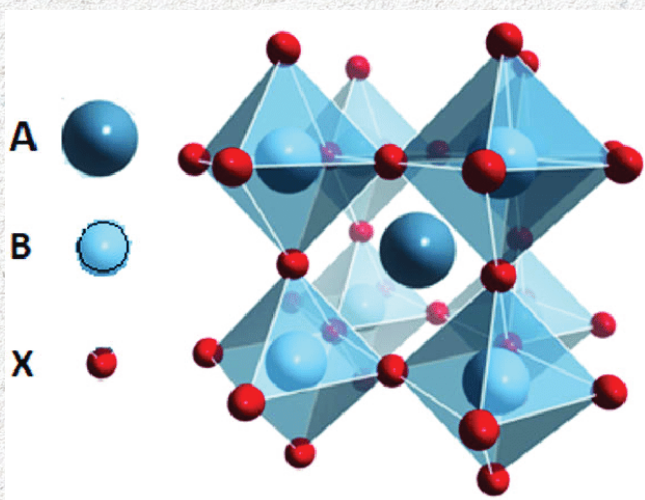
initiatives, NaCCER reinforces its role as a forward-looking research centre by actively participating in the national energy transition, demonstrating how traditional energy sectors can contribute meaningfully to sustainable and climate-resilient solutions.

**Objective:**

The objective of this project is to develop an indigenous, low-cost and scalable carbon-based perovskite solar cell (PSC) technology by leveraging India's coal-derived carbon resources, thereby aligning the coal sector with the nation's clean-energy and just-transition goals.

**Methodology:**

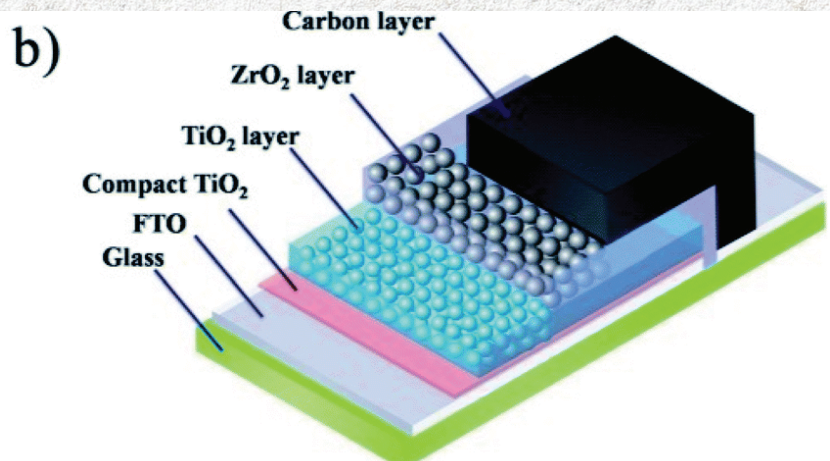
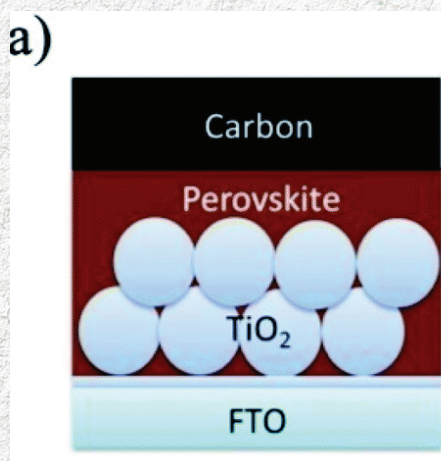
The methodology involves the fabrication and advanced characterization of conductive carbon electrodes using blade-coating techniques, followed by the development of high-efficiency HTL-free carbon-based perovskite solar cells to enhance device stability and reduce material and processing costs. The performance, durability and scalability of the fabricated cells will be systematically evaluated, and a detailed cost-benefit analysis of the resulting perovskite modules will be carried out to assess their techno-economic viability for large-scale deployment under the Make-in-India framework.



[Conductive carbon electrode](#)



[HTL-free PSC fabrication](#)



[Perovskite module Development and Cost Analysis](#)

# Development of an Indigenous Ground Vibration Monitoring and Analysis System using IoT Enabled devices and AI-ML Techniques

## Introduction

Blasting is essential for breaking or fragmenting rocks in a systematic and safe manner. In a surface mine, blasting is carried out to remove overburden and coal from in-situ benches. However, ground vibration does occur during surface mine blasting when explosives are used to break up rocks. The explosion generates shock waves that travel through the ground, causing vibrations that can potentially damage nearby structures or cause safety hazards. These may result into compromise the Environmental Protection Law and the Mining Law of the land and may have a significant impact on the environment.

Monitoring blast vibration is in vogue for ages and is crucial in surface mining to ensure that the vibrations caused by the blast remain within safe limits. This involves measuring the intensity (mostly in terms of peak particle velocity, (PPV)) and frequency of the vibrations, as well as their impact on the surrounding environment.

Measurement of Velocity of Detonation (VoD) is also an aspect of explosives for ascertaining their efficiency. The performance of explosive invariably depends on the VoD, density and water resistance properties. The power or strength of explosive to cause fragmentation of the rock determines the efficiency of the blast performed.

The real time Internet of Things (IoT) enabled continuous monitoring of blast vibration using AI/ML techniques allow us to distinguish ground vibration signatures between blasting and other sources. Further, it is also possible to identify the dominant frequency and amplitude which affect the nearby surface structures. Vibration data will be directly sent to a cloud server as soon they are recorded after a trigger threshold. Data will be analyzed and classified using statistical and AI techniques to identify the signatures in terms of PPV, PPA, frequency, time durations, and other factors. It will also be possible to distinguish the vibration signatures of an Overburden (OB) blast and dragline blast. Blast vibration signatures can also be different for blast at different elevations (benches). Similar monitoring system can be implemented elsewhere upon successful research outcome of this project.

Apart from that a blasting dashboard will be developed to visualize, make queries and get information regarding the blast design, explosives and vibration data.

There is hardly any work reported in India for the analysis of the signatures blast vibration using artificial intelligence methods. A few works were reported where artificial neural network technique was applied in place of regression analysis. The advance machine learning method such as Random Forest and Tree-Classification methods may be used for classification of various signatures of vibration either in time or in frequency domain.

## Objectives:

1. Development of indigenous IoT enabled continuous monitoring system for measuring ground vibrations, peak particle velocity (PPV), peak particle accelerations (PPA) and damage frequency in an opencast mine.
2. A blasting dashboard will be developed for easy access/query of geometry of the blast design, information of explosives and the measured vibration data.
3. The dashboard will be designed to display the timing delays of each blast hole, as well as identify any delays below 8 milliseconds between successive blast holes. In the event of such a delay, the dashboard will indicate an error in the delay sequence and provide an alert to adjust the delay sequence for improved fragmentation and reduced ground vibrations.
4. The dashboard will include a feature that allows access to blast fragmentation analysis software, which is used for the purpose of analyzing the fragmentation of blasted material.
5. The compliance of vibration and air-overpressure intensity levels with the impact assessment on the nearby surface structures.
6. Effect of dominant frequency and peak intensities on surface structures due to cyclical blast vibrations conducted at different elevations (benches).
7. Classification and comparison of blast and traffic-induced vibration signatures (such as PPV, frequency, PPA, and duration of vibration) using AI-ML techniques

## Implementing agencies:



## Research Methodology:

In this project work, a complete wireless system will be developed for transmitting data from monitoring sensors, termed as Node to a master controller (MAC) as shown in Figure 1. The provision for wired communication will be kept as a contingency measure.

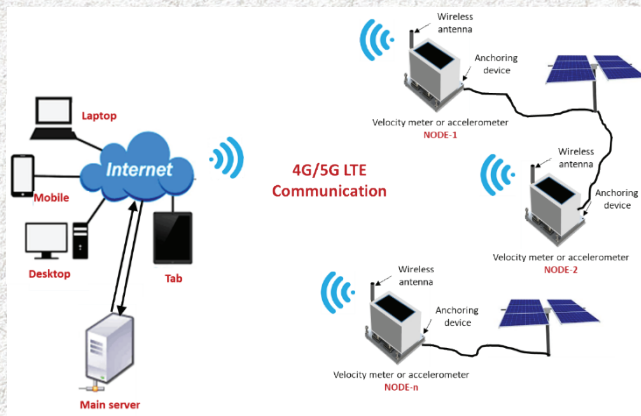


Figure 1. Schematic diagram of sensors and data generation and presentation

The data flow will happen as mentioned below:

**1. Node:** It is the hub of sensors mainly composed of velocity meter like triaxial-geophone or triaxial-accelerometer. They will be firmly placed on the ground and will be bolted, if required. A node will be placed near a critical surface structure where the mine management feel that vibration monitoring is absolutely essential for its safety. A node will also have 4G LTE communication device and will continuously send data in packets. The frequency of data gathering and

transferring can be controlled remotely using mobile communication devices using a customized APP.

**2. Master Controller (MAC):** It is the heart of the communication devices. It will collect data from all the nodes and will store in its memory. This device will operate with 4G LTE enabled communication system as well as can receive data through direct wire communication. A MAC will be located centrally to the all nodes. MAC will then send the data to a server located at the mine office through fibre optic cable. All nodes and MAC can also be controlled remotely using mobile App.

**3. Computer Server:** The computer server, upon receiving vibration data from several sources, will analyse them to identify the closet signature of vibrations either from blasting or truck movement or other sources

**4. IoT Devices:** On the other side of the internet, clients with various IoT devices such as laptop, mobile phone, tab, desktop and others can communicate with the cloud server and get the information through the App as mentioned above.

**5. Rock Mass Properties (RMR):** Rock mass properties such as geological strength index (GSI) or RMR will be estimated to understand the attenuation characteristics of vibration waves with distance from the blast. These data along vibration data will help in developing empirical vibration model in terms of PPV, acceleration and frequency.

## Development of the IoT-based Ground Vibration Monitoring System:

Indigenous IoT-based ground vibration monitoring system successfully developed, consisting of Triaxial geophones, IoT-enabled nodes, Master controller and Data storage at both node and master level (Figure 2). System calibration completed using the existing

InstanTel Minimate in presence of CMPDI officials, verifying sensor performance. The developed system is also calibrated with known frequency motor which is developed in lab (Figure 2). This test assured that the developed system is working as per the desired results.

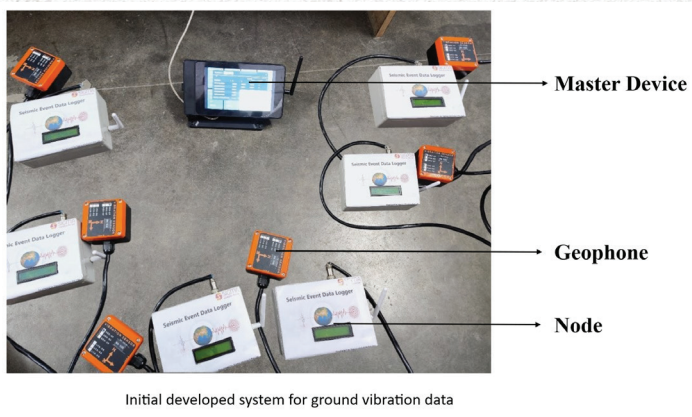


Fig. 2 Initial developed system for ground vibration data and Calibration Device (Known Frequency)

The dashboard is also designed to transform complex analytical outputs into intuitive visual representations, thereby facilitating real-time monitoring, historical assessment, compliance evaluation, and informed decision-making (Figure 3). It is an interactive blasting dashboard and visualization platform that enables effective interpretation of large volumes of vibration data by mine planners, blasting engineers, and regulatory personnel.

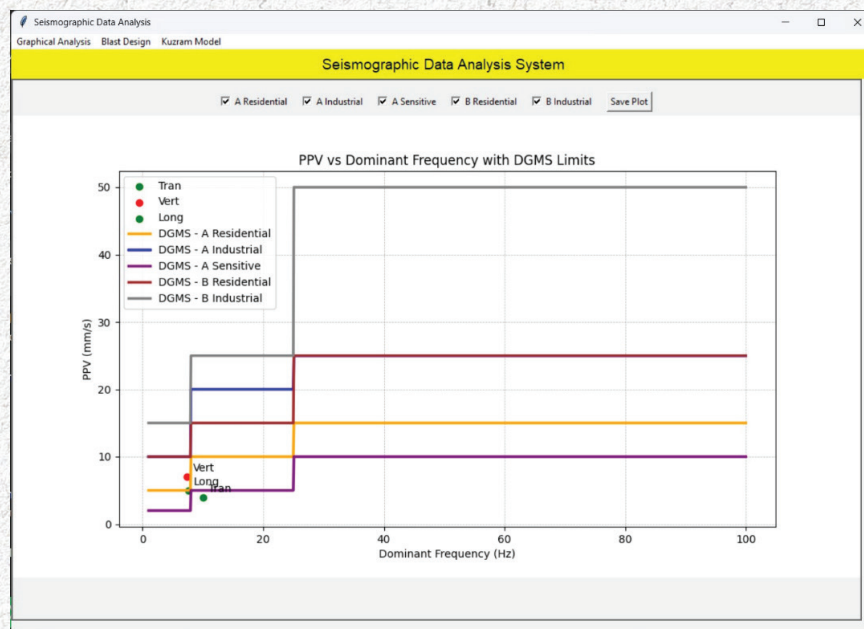


Figure 3: Development of dashboard

# Indigenous Development of IoT-Enabled Technology for Monitoring, Analysis and Interpretation of Longwall Shield Pressures for Improving Safety and Productivity (Phase-II, TRL 5 to 8)



## Introduction

A real-time data monitoring system was developed and installed in Jhanjra Longwall Project during the earlier completed Phase-I of the project. During the Phase-I, Forty longwall shield supports were monitored, and pressure data was transferred in real-time to the surface using optical fibre.

A data acquisition system (Master Data Acquisition System (MDAS) and Nodes) was indigenously developed for monitoring longwall shield pressures and shearer positions every 10 to 20 seconds. The system was intrinsically safe and data flowed seamlessly from Jhanjra longwall panel to a surface server. A software system was also developed for analysing the collected shield pressure data for understanding roof behaviour specifically the interaction with the longwall shields. The system was IoT enabled in such a way that anyone can visualize the data over the internet using a smart phone, laptop or tab. This feature has been operational during the project execution period and now it has been stopped.

In continuation to this, Phase-II of the project has been taken up by NaCCER in association with IIT, Kharagpur and ECL, Sanctoria to further augment the system for subsequent longwall panels at Jhanjra UG mines, ECL. Based on the experience gained during

the Phase-I execution of the project, it was decided to install pressure sensors in all the eighty-four (84) shields of Jhanjra longwall project and to further augment the data collections and interpretations so that periodic weighting and maintenance problems can be forecasted. This project is aimed to deliver seamless data acquisition from the entire longwall panel in a more efficient manner and improve the software for data analysis and interpretation.

## Objectives

The objective of this project are:

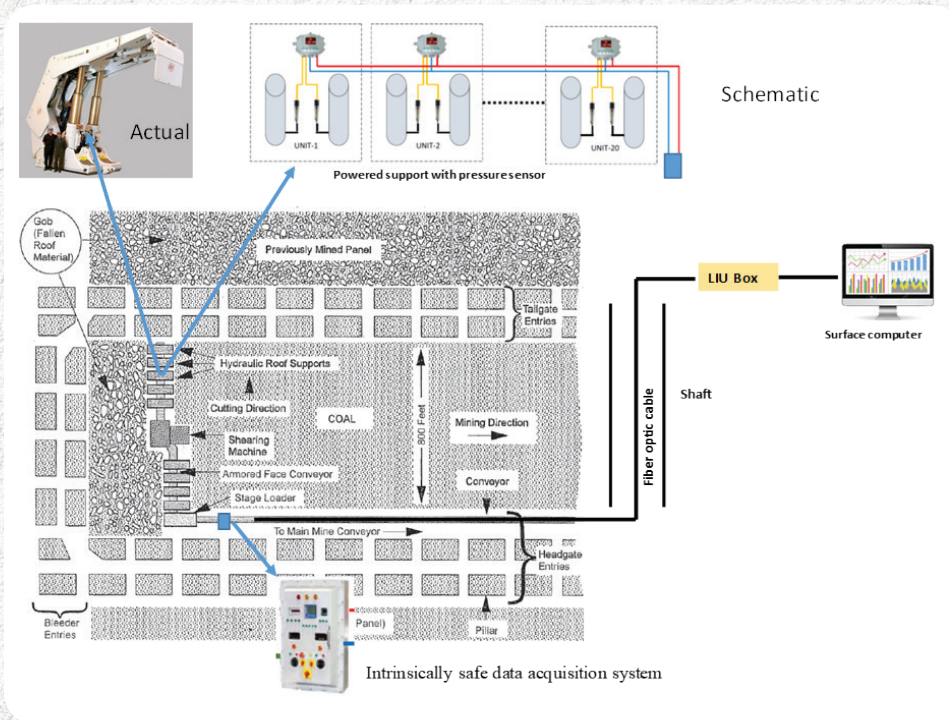
- Pressure sensors will be installed in 84 shields and 40 position sensors will be installed at the designated shields for collecting information on shear position at every 60 seconds. This will cover the monitoring of the entire panel
- The master data acquisition system (MDAS) will be placed at a suitable location on the energy trolley such that the length of RS485 cable can be made shorter and the problem of moving the MDAS trolley can be eliminated. In other words, layout of the entire system can be made in a much more compact form.

- c. The communication and power cables at the longwall face can be thought to lay in an efficient way such that they do not get cut or disturbed due to the movement of shields.
- d. Improve the software for data collection and early forecasting of periodic roof weighting, shield leakage and other maintenance information.
- ii. Implementation of location sensor for detecting shearer position with respect to power support
- iii. Implementation of a layout plan to minimize the cut of communication and power cables at longwall face.
- iv. Analytical and mathematical models for data presentation and interpretation
- v. Data analytics methods for early prediction of strata control and maintenance problems.

**Work Plan**

The work methodology comprises of the following:

- i. Augmentation of IoT enabled monitoring system of shield pressures from the entire longwall panel



**Fig. 1: Work Plan of the study**

An integrated IoT-enabled monitoring framework for longwall shield pressure measurement and strata behavior analysis has been illustrated in Figure-1. In the longwall panel, hydraulic roof supports (powered supports) are installed along the coal face to maintain immediate roof stability during shearer operation and face advance. Each shield is equipped with pressure transducers mounted on the hydraulic legs to continuously measure support load, which reflects roof convergence, abutment stress redistribution, and periodic weighting phenomena. The sensor outputs are transmitted through a communication network to a Local Interface Unit (LIU) that performs signal conditioning, analog-to-digital conversion, preliminary filtering, and edge-level data processing. The processed data are then relayed to a surface monitoring system for real-time visualization, trend analysis, anomaly detection, and predictive assessment of strata behavior. By enabling shield-wise pressure profiling, detection of abnormal load concentration, and early warning of potential roof instability, the system enhances operational safety, optimizes support setting pressures, reduces downtime, and supports data-driven decision-making for improved productivity and longwall performance.

# Development of an Indigenous Optical Fiber Based Instrument for Measuring In-The-Hole Velocity of Detonation (VoD) and Analyze the Performance of Explosives & Accessories in Field Condition (Phase-II, TRL 5 to 8/9).

## Background

Evaluation of the blast design is carried out assuming that the explosives have performed as per the specification, which may not be true in all cases. A reduction in the velocity of detonation (VoD) will cause a reduction in the detonation pressure and the availability of the shock energy of the explosive. Besides all these degrees of fragmentation, ground vibration produced and safety in the charging and handling of explosives are equally important parameters. Establishing the relationship between the product's VoD characteristics to the rock characteristics, blast design and other measurements is important. The selection and evaluation of the explosive performance depends on the properties of the explosive used which directly affect the blast performance.

This project is being taken up by NaCCER to upgrade the instrument (developed under R&D scheme of CIL) in order to make it user friendly, networked, multi-channel optical fiber-based measurement system (NOFPEMS) for assessing the **velocity of detonation (VoD)** and **delay time** of explosives and detonators to **Technology Readiness Level (TRL) 8/9**. The prototype integrates a real-time automated report generation system and is designed for operation in confined and harsh environments. The goal is to optimize the system for full-scale production, validate its performance in real-world operational settings, and achieve regulatory compliance for deployment in mining, and safety-critical applications.

## Objective:

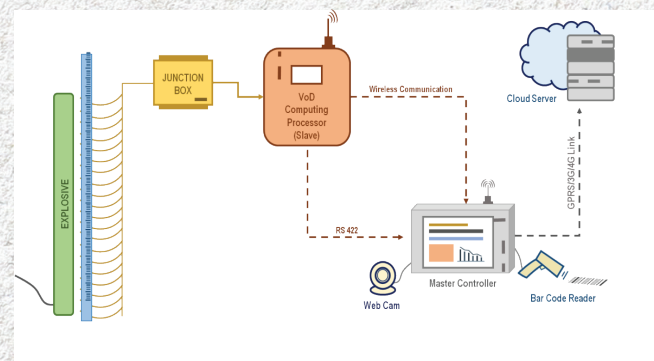
To achieve TRL 8/9 for developed in-the-hole networked, multi-channel optical fiber-based measurement system (NOFPEMS) for explosives and detonators (VoD and Delay Time) in confined environments for commercial use.

## Expected Deliverables and Impact

1. Validated System: A fully operational, certified instrument ready for deployment.
2. Field Trial Reports: Documentation of system performance and user feedback from diverse operational environments.
3. A comprehensive and standardized procedure for accurately measuring the Velocity of Detonation (VOD) of explosives within a borehole environment
4. Manufacturing Readiness: Scalable design and cost model for production.
5. User Support Resources: Manuals, training materials, and service guidelines.
6. Calibration system's performance for ensuring measurement consistency across channels and over time.

The project will provide an indigenously developed multi-channel optical fiber-based instrument for measurement of in-hole VoD of explosives and performance of accessories in field condition.

## Representative Block diagram



# "Hackathon"

NaCCER regularly organises Hackathons for inviting startups, academic institutes, private organization etc. to provide out of the box solution for the challenges faced by the coal sector. The winners of the Hackathons are encouraged to submit the scalable project proposal for field implementation.

Four Hackathons have been organized by NaCCER during last three years.

2023

*Hackathon on R&D*

2024

*Hackathon on Coal Gasification*

2025

*Hackathon on R&D*

*Hackathon on Carbon Capture Technology*

## Hackathon on R&D

2023

Optimization of dust suppression in opencast mines.

Payload monitoring of loading equipment (Shovel / Excavators) displayed in operator's cabin.

Technology for efficient management of coal grade monitoring system.

"Hackathon on R&D" was organized with the following five problem statements to promote "Make in India" initiatives in coal sector by giving wide publicity and made efforts to promote/encourage start-ups in coal and lignite sector:

Technology to detect the effect of blasting on Propagation of cracks in structures.

Design, Develop & Implementation of Pilot 5G Application and Use Cases for Coal Industry

Winners were felicitated at CMPDI, Ranchi on 03.10.2023 by Secretary (Coal), MoC.



### Hackathon on Coal Gasification 2024

Successfully organized “Hackathon on Coal Gasification” with following (6) problem statements to harness a vital natural resource to meet the energy and chemical needs of the nation, fostering economic independence and environmental sustainability:

Coal to Blue Hydrogen

Emission Reduction in coal gasification

End-product optimisation of coal gasification

Utilization of by-Product produced in gasification process

Technology Advancement for Efficiency Enhancement in coal gasification

Alternatives technologies

The hackathon invited solutions which are scalable, poised for demonstration or commercial replication within the intricate tapestry of coal companies. It also provided opportunities to Start-ups, research organization, academic institutes etc. to innovate in the field of coal gasification.

Winners were facilitated at CMPDI, Ranchi on 04.10.2024 by the Honourable Minister of State for Coal and Mines, Govt. of India.

### Hackathon on R&D 2025

Hackathon on R&D 2025 has been organized by NaCCER with following 6 problem statements:

Application or Development of methodology/ instruments for advance prediction of minor faults (especially 2m-5m) dykes, sills, and local water bodies etc. which are present 350 m ahead of the UG mine panel face development

Development of Exploration Methodology for unexplored lower coal seams in multi-seam working coal mines.

Indigenous Development of Low cost Multigas Detector for underground coal mining for continuous monitoring.

Dry Coal Beneficiation: Addressing Efficiency, Scalability, and Adaptability Challenges for Indian Coal.

Indigenous development of Intelligent Monitoring and Control System for Ventilation and Fire Management System in Underground Coal Mines

Indigenous Development of Suitable Pastefill Material for Use in Underground (UG) and Highwall Mining.

The result was declared on 27.05.2025 and the felicitation ceremony was held on 04.09.2025 which was attended by Hon'ble Union Minister of Coal and Mines, and, Hon'ble Minister of State for Coal and Mines, Govt. of India.

### Hackathon on Carbon Capture Technology 2025

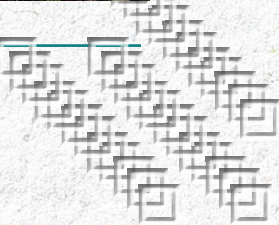
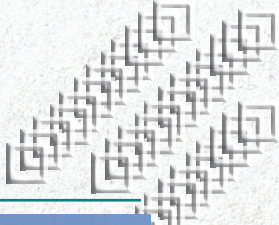
NaCCER organized Hackathon on Carbon Capture Technology, focusing on following 3 problem statements:

Direct Air Capture (DAC) of GHG

Geological storage of captured CO<sub>2</sub> in the coal bearing regions of India.

Development of carbon capture-based bio-fuel utilizing algae cultured in the mine pit lakes.

The felicitation ceremony was held on 04.09.2025 and attended by Hon'ble Union Minister of Coal and Mines, and, Hon'ble Minister of State for Coal and Mines, Govt. of India.



# Centre Of Excellence

## MoUs signed by CIL (NaCCER)

NaCCER played an instrumental role in formulation and signing of the following MoUs between CIL and renowned National / International research institutes:

### CIL & IIT (ISM), Dhanbad- TEXMiN:

- ❖ MoU focuses on creating Innovation in Mining (IMiN)–Centre of Excellence for Mining 4.0.
- ❖ Research and Development (Process Engineering, Designing, Simulation, etc.) in the field of Coal and Energy-related processes, technologies, products, etc.



### CIL & IIT-Hyderabad:

- ❖ The MoU focuses on the creation of a Centre of Excellence (CoE) in the name of Centre of Clean Coal Energy and Net Zero (CLEANZ)
- ❖ The MoU is with a mission to develop multiple technologies related to Clean Coal Technology and Net Zero utilization, with special emphasis on low-grade Indian coal.

### CIL & IIT-Madras:

- ❖ The MoU focuses to establish a "Centre for Sustainable Energy" at IIT Madras.
- ❖ R&D for sustainable technologies, including repurposed coal mines, low-carbon initiatives, and mining equipment electrification to support India's net-zero goals.



For more details contact,

General Manager (S&T),

CMPDI Ranchi

email: [gmsnt.cmpdi@coalindia.in](mailto:gmsnt.cmpdi@coalindia.in)

web: [www.cmpdi.co.in](http://www.cmpdi.co.in)

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